African Agricultural Research and Technological Development


Donatd C. Pickering, editor
African Agricultural Research and Technological Development

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German Foundation for International Development (DSE)

The World Bank

Ministry for Economic Cooperation (BMZ), Federal Republic of Germany
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FOREWORD

The future well-being of the peoples of Sub-Saharan Africa depends on the development of science-based agriculture appropriate to the diverse physical, social, and economic conditions encountered in the countries of this region. Recognizing this fact, the World Bank in 1985-86 commissioned comprehensive reviews 1/ of the status of international, regional, and national agricultural research activities in western, and in eastern and southern Africa. The reviews reflected extensive consultations with national, regional, and international researchers and research managers at regional workshops in Cotonou, Benin, and Nairobi, Kenya, held in December 1986.

These reviews provided the basis for formulating a draft strategy for agricultural research in Sub-Saharan Africa. The objective of this endeavor was to provide a framework in which the World Bank, its borrowers, and other interested parties could pool their resources for strengthening agricultural research systems in the continent.

In view of the importance of collaboration, the World Bank presented an early draft of its strategy paper to the donor community at a meeting of the Special Program for African Agricultural Research (SPAAR) in May 1987. Following appropriate revisions, the paper was discussed by participants at the meeting on which these proceedings are based.

The High-Level Meeting on African Agricultural Research and Technology Development, co-hosted by the Ministry for Economic Cooperation of the Federal Republic of Germany (BMZ), the German Foundation for International Development (DSE), and the World Bank was held at the Food and Agricultural Development Center of the DSE at Feldafing, West Germany, September 24-27, 1987. Invited participants included ministers and other senior officials from agencies responsible for finance, planning, education, agriculture, science and technology, and the university community from African countries. Some senior officials from regional, bilateral, and multilateral development organizations concerned with African agricultural research and development were also invited.

As the proceedings indicate and participants can testify, the Feldafing meeting achieved its two primary objectives:

(a) to solicit the views of decision-makers on African economic development and the closely related subject of agricultural research and technology on the World Bank's proposed strategy on African agricultural research; and

(b) to provide a forum for an exchange of ideas on this important topic, and thereby to help concerned governments and regional and international agencies formulate programs to strengthen agricultural research in Sub-Saharan Africa.

The success of the meeting was due mainly to the quality of participants' inputs, for which we express our gratitude. We also thank the Government of Canada and the Canadian International Development Agency (CIDA) for its generous contribution to the travel expenses of African participants.

We believe that this volume will serve as a record of the Feldafing meeting, thereby adding in its own way to the corpus of material directed toward strengthening Sub-Saharan African agricultural research and hence the development of the countries of the continent and the well-being of their people.

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Director General
German Foundation for International Development

Edward V.K. Jaycox
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World Bank

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Parliamentary State Secretary
Ministry for Economic Cooperation
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SUMMARY

Ten African ministers and 20 other high-ranking officials from a total of 16 countries representing ministries of Agriculture, Rural Development, Research, Science and Technology, Education, Finance, Planning, and the university community attended the High-Level Meeting on African Agricultural Research and Technological Development. Also participating were senior officials from the Organization of African Unity (OAU), the Economic Commission for Africa (ECA), the Food and Agriculture Organization (FAO), the United Nations Development Programme (UNDP), the Consultative Group for International Agricultural Research (CGIAR), and the Special Program for African Agricultural Research (SPAAR). Representatives of major bilateral donor agencies and African regional development institutions also took part in the discussions, which were held from September 24 to 27, 1987, in the Food and Agriculture Development Centre (ZEL) of the DSE in Feldafing, Federal Republic of Germany.

The meeting was co-sponsored by the German Federal Ministry for Economic Cooperation (BMZ), the German Foundation for International Development (DSE), the Canadian International Development Agency (CIDA), and the World Bank.

Participants were asked to consider the World Bank's paper "Strengthening Agricultural Research in Sub-Saharan Africa, a Proposed Strategy," which had been distributed before the meeting with supporting documentation in English and French. They were informed that the paper was based on extensive reviews, workshops, and discussions initiated by the World Bank and involving senior African scientists and research managers, as well as officials of bilateral and multilateral donor agencies. The last such discussion took place at the May 1987 meeting of the Special Program for African Agricultural Research (SPAAR). The proposed strategy was then submitted to high-level decisionmakers in African governments and the donor community for their comments and suggestions for improvement. The Feldafing meeting was convened to seek a consensus on key elements of a strategy that decisionmakers at the highest level could endorse and then cause to be implemented.

The basic premise of the strategy is that agricultural research is vital to the economic recovery, long-term progress, and future prosperity of Sub-Saharan Africa. There is now an extensive network of regional and international institutes capable of generating new agricultural technology for the region, but few national systems are currently strong enough to complete the vital step of adapting this technology to the needs of their local farmers. As a result, much past government expenditure on research has had little impact. The proposed strategy seeks to increase the tangible benefits from past and future research expenditures to the levels that African governments, and the donors who support them, are entitled to expect.
The main objectives of the strategy are as follows:

- to improve the correlation between the objectives of agricultural research and national macroeconomic and social goals;
- to reform and strengthen the institutions responsible for agricultural research and improve their interaction with extension and agricultural education agencies;
- to stabilize research budgets at levels consistent with the current and planned contributions of agriculture to the national economy, with an appropriate balance between essential research operating costs and other expenditures;
- to improve education and career opportunities in agricultural research and give increased emphasis to preparing existing and future researchers for the practical problems of adapting new technology to farm-level conditions in their country.

To adopt the strategy, countries would need to prepare an overall plan, specifying the future national role of agricultural research, key technical objectives and, consistent with this, the practical steps to be taken in the short, medium, and long term to strengthen the national system. The plan would then provide a framework for defining subsequent government funding and for incorporating coordinated donor assistance and support.

After the principal international and regional institutions represented gave their statements and the World Bank staff presented the strategy paper in plenary session, working groups were formed and asked to consider the major issues identified in the paper. These groups were chaired by African ministers. Expert discussants introduced the suggested issues in plenary session and then they were taken up by the working groups. Group chairmen subsequently reported back to the plenary session with observations and recommendations that their groups wished participants and especially the World Bank to consider:

Specifically, the working groups were asked to focus on the following six topics:

- The Role of Agricultural Research in National Development Strategy
- Technical and Research Programming Issues
- Financial Issues
- Education and Training Issues
Discussion was lively and productive, and most delegates accepted the main points of the paper. In particular, they welcomed the collaborative approach to formulating the proposed strategy and the opportunity to debate the issues before the strategy was finalized. A brief review of the meeting's findings is presented in the following paragraphs.

Many participants noted that the great agro-ecological and social diversity of Africa makes it especially difficult to devise new technologies for rural development. Thus an essential ingredient of any such effort is an understanding of farmers—many of whom are women. This in turn means that the social sciences should be incorporated into technical research programs. However, at present many national research systems are fragmented, lack a farmer orientation, and are giving poor value for the funds expended.

The African delegates expressed their strong commitment to setting their own research priorities for the future. They recognized that to set priorities is in itself a difficult exercise. There was considerable debate on the merit of attempting to achieve food self-sufficiency as opposed to expanding rural incomes from cash or export crops, but the consensus was that the best balance would vary between countries. At the same time, most agreed that, once appropriate national priorities have been set, governments should elaborate national plans for the development of their research systems. These plans should form the framework not only for formulating national actions to strengthen research, but also for establishing the complementary roles of external finance and donor agencies. They should also provide clear guidance on how to link national to regional and international research efforts, so that research tasks can be shared by countries whenever feasible. At the same time, many stressed the need for flexibility and emphasized the value of monitoring the relevance of planned actions against evolving conditions within the country and elsewhere. Effective coordination of outside contributions and contacts is vital in such circumstances and participants recommended that donors and technical agencies provide assistance only within the context of well-formulated national plans.

In discussing the financing of research, the delegates urged African governments to explore all possible sources to supplement budgetary funds. These could include levies, cesses and taxes, other payments by the beneficiaries of research, or increased reliance on the private sector. Most important, however, would be a long-term government commitment to a stable core of central funding, allied with measures to allow adequate flexibility in the deployment of these resources.
However, the consensus was that even then, agricultural research would prosper in Africa only if research manpower could be significantly upgraded. Delegates called for measures that would improve local agricultural training and education and increase the capacity of African universities in this respect. As part of their training, young African researchers, both male and female, should be exposed to the practical problems of the continent's farmers. Delegates agreed that it is essential to improve the conditions of service of African agricultural scientists so that their profession can compete more actively than it does now for the most gifted individuals available.

Delegates also discussed at length the institutional structures appropriate for national research systems and stressed the importance of giving scientists a degree of autonomy in planning and carrying out their programs. But they should also be assured that the necessary political commitment and financial support will be available and that their work will be directly linked to agricultural extension and broad national development objectives.

Participants agreed that the conclusions and recommendations arrived at during the meeting should be incorporated into an upgraded version of the Strategy Paper prepared by the World Bank. The paper is to be submitted to the Bank's Board of Directors, which includes representatives of all the African nations and governments of the bilateral donor agencies present at the meeting.

Finally, delegates expressed the hope that the paper will be utilized by the members of the SPAAR in coordinating the efforts of their governments and agencies to assist African governments in strengthening African agricultural research, thereby facilitating agricultural development and the economic and social well-being of the rapidly increasing population of the continent.
Acknowledgments

I am deeply indebted to many individuals for their assistance in the conception and preparation of this volume of Proceedings.

Particular thanks must be given to Leif Christoffersen, then Senior Agricultural Adviser, Eastern and Southern Africa Region, World Bank, and Erhard Krüsken, Director, Food and Agriculture Development Center, Feldafing for their work in initiating and facilitating the meeting from which these Proceedings are derived. Thanks are also due to the staff of the Center, and especially to Klaus Klennert with whom most of the preparation arrangements were agreed harmoniously by telephone and telex, and subsequently implemented under his guidance by Sylvia Matthies and Monika Weiss who, with Gritte Jantzen, ATSAF, Jeri Larson and Ann Karasanyi, World Bank, worked hard and long to ensure smooth implementation of the meeting's administrative aspects.

I am most grateful to those who consented to present papers, to act as chairmen, discussants, and secretaries of the working groups. I have sought to reflect accurately the essence of the contributions made by those who gave so freely of their knowledge and experience in the plenary and group discussions. The wisdom is theirs; I can only hope that I have done them justice in my interpretation of their contributions.

Hans Wyss and Belai Abbai of the World Bank, and Simon Hocombe of the World Bank/FAO Cooperative Program made valuable contributions in many ways, especially in the preparations for the meeting, and in the meeting itself. Special thanks are also due to the staff of the German Council for Tropical and Subtropical Agricultural Research (ATSAF) for their technical advice and valuable assistance in the preparation and conduct of the meeting.

Finally, I must thank Vicky McIntyre, Muriel Prah, Jéhanne Romain, Marie-Claude Verlaeten and particularly Gemma Abarcar for their tireless efforts in preparing, typing and retyping the manuscript. Without them these Proceedings would not have seen the light of day.
OPENING STATEMENTS
WELCOME ADDRESS

Prof. Dr. Paul Kevenhörster
Director General, DSE

On behalf of the president of the Board of Trustees of the German Foundation for International Development, I have the pleasure of welcoming you to this high-level meeting on African Agricultural Research and Technological Development.

Looking around this audience, I see many eminent persons. So the impression is probably not wrong that all of you have considered it worthwhile to take a few days off to attend this conference, hoping that it will bring you a step closer to promoting the conditions that will bring about independence in food production on the African continent, at least in the long run.

Beside land, labor and capital, technology is a decisive factor in economic growth, particularly in countries with a predominant agricultural sector. The question is how to accelerate technological development in African agriculture. Certainly research is needed: research that can tell what technological development should be aimed at and how this technological development could be implemented.

The international agricultural research institutes as well as those in various countries have obtained good results from measures that could be adopted in Africa to improve agricultural growth. Some of those measures might be implemented directly, but most of them would need to be adjusted to the specific conditions in the different ecological and sociocultural areas of Africa. This task could best be done by the national agricultural research institutes in Africa. Unless they work directly with the farmers in their fields, assisted by effective agricultural extension services, technological development will not take place on a large scale.

With a view to strengthening agricultural research in Sub-Saharan Africa, the World Bank recently undertook intensive studies on the status of such research. Several conclusions were reached concerning what could and should be done. To explore these possibilities, the World Bank arranged for two preliminary discussion rounds in Benin and Kenya last year and then approached the Ministry for Economic Cooperation of the Federal Republic of Germany to see if it would be willing to support a high-level meeting for the purpose of discussing the proposed strategy to strengthen African agricultural research.

The organization in the Federal Republic of Germany that is responsible for such events in the field of development cooperation is the German Foundation for International Development (Deutsche Stiftung für internationale Entwicklung, or DSE). The DSE is a private organization with a staff of about 380 people, but it is financially supported by the city of
Berlin and some state governments of West Germany. The state of Bavaria is the landlord of this center on these Bavarian premises. We are very grateful to the state government for holding a reception for the participants of this conference.

The principal task of DSE and its various centers is to facilitate the international exchange of information on development problems and the methods used to solve them. To this end, the foundation organizes international conferences, seminars, and expert consultations. In doing so, one of its aims is to mediate between science policy on the one hand and science and practice on the other hand. Therefore, the DSE also arranges for on-the-job training of post graduate professionals from Africa, Asia, and Latin America. In fact, this work accounts for more than 60% of DSE’s activities.

The DSE is also responsible for the country oriented preparation and training of German professionals who are to serve in projects connected with the country’s bilateral program for technical and economic development. Finally, the DSE provides information and documentation on development issues.

In carrying out its tasks and implementing its programs, the DSE cooperates with a large number of partner institutions, not only in Germany and other countries, many of which are African countries, but also with a considerable number of diverse international organizations and institutions. For example, the Food and Agriculture Development Center has been cooperating with FAO in various aspects of development for many years. One of the major conferences resulting from this cooperation took place in January 1987 here in Feldafing. The central theme was “Challenge of Rural Poverty—How to Meet It” which reflected the participants’ recognition of the fact that not only is growth important for general development, but also the just distribution of its benefits.

Within Germany, in the field of agricultural research, the Food and Agriculture Development Center has been collaborating closely with the Ministry for Economic Cooperation, the German Council for Tropical and Subtropical Research (ATSAF), and the German Agency for Technical Cooperation (GTZ). One outcome of this collaboration is a paper entitled "Priorities in International Agricultural Research, as Seen by German Research Institutions and Development Organizations." Another paper to emerge from this collaboration, which is now in press, discusses how to improve the acceptance of new technologies in African agriculture through the help of bilateral German development projects. DSE’s links with ATSAF and GTZ bring it closer to the activities of the international agricultural research centers.

The DSE has also cooperated with the World Bank on several occasions. Because the DSE joined the organization of this conference at a later stage, the preparatory work that led to the proposed strategy on agricultural research in Sub-Saharan Africa was done by the World Bank and its consultants.
Needless to say, we are grateful to the Federal Ministry for Economic Cooperation for bestowing on us the honor of hosting this conference. We hope that DSE can meet the international standards of such a conference despite its limited resources. As this center in Feldafing is the foremost center of the Federal Republic of Germany for the exchange of experience on agricultural development in the developing world and as all of the professional training for Africa within the German bilateral cooperation is being executed by this center, we felt it would be appropriate to acquaint the participants of this high-level meeting with the center’s tasks.

We are grateful to all of you for accepting the invitation to participate in this conference and for coming to Feldafing. I wish you successful results in your deliberations and hope that you will come away with favorable impressions of this country.
WELCOME ADDRESS

Dr. Volkmar Köhler
Parliamentary State Secretary,
Federal Ministry for Economic Cooperation

It is a pleasure for me to welcome you to Feldafing on behalf of the Federal Government. Together with the World Bank, we chose this peaceful and idyllic setting to discuss, in a relaxed and open atmosphere, ways of establishing and extending national agricultural research in Africa.

The joint preparation of this meeting by the World Bank, the Federal Ministry for Economic Cooperation and the German Foundation for International Development is an example of successful international cooperation. If there is one field which, more than any other, demonstrates the need to coordinate all efforts for the sake of the people in Africa, it is the field of agricultural research.

The goal of agricultural research and, moreover, the primary concern of German development policy, is to help the developing countries, and especially those in Africa, to achieve food self-sufficiency.

The results of our efforts over recent years give cause for hope but also for concern. On the one hand we find that in the world today, more people are being fed than ever before; in technical terms, the increase in food supply at global level has outstripped population growth. Africa, too, produces enough to feed her people. In a number of countries, favorable climatic conditions and, more importantly, economic reforms have even led to food surpluses. On the other hand, the time is by no means ripe to sound the all-clear. Between 500 and 800 million people around the world continue to suffer malnutrition. In the past few days alarming reports of hunger and starvation have once again been reaching us from countries such as Ethiopia and Mozambique. In the year 2000, in other words in just over twelve years, Africa will have a population of around 700 million. The FAO estimates that by this time as many as 29 African countries will no longer be able to feed their own peoples.

However, this gloomy prophecy was made on the condition that nothing changes in African agriculture. In other words, the countries of Africa are in a position to feed themselves if they develop their rural regions. Food security for Africa begins in Africa. This means abandoning the notion that, in the long run, Africa can achieve food security with the help of the food surpluses produced by the industrial countries. Justified as it may be when people are threatened by starvation, food aid taken from the surpluses of industrial countries cannot solve Africa's food problem. Indeed, in some cases it makes matters worse. I need only mention the following examples: changes in eating habits leading to structural
barriers to food security; problems of transport and distribution; the
danger of a charity syndrome developing.

People with a personal income are less likely to assume the role
of supplicant than those without. For this reason, the first step towards
food security is the creation of income in rural areas. Today we know
that, in most cases, hunger is not the result of a lack of food but a lack
of money to buy it. But how can income be created for smallholders forced
to farm a small piece of barely fertile land under adverse climatic
conditions?

The first step is to allow producer prices that make it
worthwhile to increase production above the subsistence level. This is a
matter of official agricultural policy and represents a challenge which an
increasing number of African countries have set about tackling. Not only
the policy framework must be right, but seed types, fertilizers, and
pesticides must also meet the needs of African countries. This is the task
of agricultural research.

Through its "green revolution", international agricultural
research has achieved outstanding results and has helped Asian and Latin
American countries to raise agricultural production significantly. For
instance, the rice yield per hectare has been more than quadrupled, from
1.5 tonnes to 8 tonnes, and the number of harvests per year has increased
from two to three. Today, the task faced by many of these countries is no
longer that of increasing farmers' output but that of distributing the
income they generate.

In contrast, there is a backlog of research in Africa. The most
urgent task is to develop and improve local food crops which offer greater
security of yield under adverse conditions such as drought. This must be
supplemented by efforts in the field of natural insecticides, pest control
and post-harvest protection. Research must also examine how best to use
sensitive eco-systems such as the Sahel. In regions of this kind mistakes
can have devastating results. As you know, in many parts of the tropics
and subtropics, wood is now just as scarce a resource as food was a short
time ago.

Lastly, research efforts must be directed at improving cash
crops. Earnings from the export of agricultural products are essential for
the development of countries which otherwise possess no other natural
resources. In this context, I am well aware that the export capacity of
developing countries depends not only on their productivity but also on the
pursuit of supportive agricultural and trade policies by industrial
countries. Africa, but also Europe, needs a reform of western agricultural
policy with the aim of reducing structural surpluses. I hope that the GATT
round in Uruguay will bring this a step closer.

Progress in agricultural research for Africa can only be the
result of close cooperation between African and international research
establishments. Without national research networks, international
agricultural research remains isolated and its findings cannot be put into practice. The frequent lack of support for national research has been one of the main reasons why Africa has not yet experienced a "green revolution". Technical and human resources have been scarce and training has left a lot to be desired. Above all, however, the importance of agriculture in general and of agricultural research in particular has been underestimated. If Africa's food problem is to be solved, national research on the continent must be able to cooperate on an equal footing with international agricultural research. I therefore call upon all donors not simply to establish and support one institute here and one research center there. Together with our African partners we must develop a strategy for carefully directed and well-balanced support for national research in Africa. This is the task facing today's meeting.

In working together to promote African agricultural research, we all bear a special responsibility. International agricultural research centers should endeavor to intensify their links with national research institutes in Africa and to work together with them more closely in a spirit of partnership. I call upon institutes in industrial countries to establish more exchanges with African universities and research institutes. This involves supporting and training African colleagues. What is more, networks must be established among African universities and between them and universities in industrial countries, in order to ensure that specialization in the field of research and training can help Africa catch up, and then keep up, with the international state-of-the-art. Finally, in planning their budgets African finance ministers must accord national research--from initial and advanced training to working conditions at research institutes--its proper place.

The Special Program for African Agricultural Research (SPAAR), created at the initiative of the World Bank, could well be an effective platform for commencing this by-no-means exhaustive list of activities. The Federal Government has given this project its full backing, and will support, as best it can, any of the Program's initiatives it considers appropriate. In promoting the work of the SPAAR, we must bear in mind that support for national research in Africa must be regionally planned because not every country needs to have, or can have, the same kind of comprehensive research infrastructure. Specialization within regions is the key to establishing and expanding national research networks in Africa. As you know, the idea of regional cooperation in the field of research is not new to Africa. Here I would mention the Southern African Center for Cooperation in Agricultural Research, SACCAR, which could serve as a model for similar institutions in other regions, for instance West Africa.

Ladies and gentlemen, allow me to conclude by expressing the following wish: Here in Feldafing we should not limit ourselves to discussing policy issues, difficult though they may be. We should go a step further and agree on specific actions in selected countries or regions. In this way we could put not only our strategy to the test, but also, and more especially, our will and ability to cooperate. A task lies
before us which we can only master together. Let us commence our work with realistic optimism. In this spirit I wish the meeting every success.
WELCOME ADDRESS

Dr. Thomas Goppel
State Secretary, Bavarian State Government

The announcement of your international meeting on African Agricultural Research and Technological Development prompted Dr. Hans Eisenmann, our experienced minister of agriculture, to keep this evening free for personal discussions with you. It was also he who pointed out to the Bavarian state government and the minister president that your meeting deserves our special interest.

Dr. Hans Eisenmann, to whom Bavarian farmers and Bavarian economic policy owe the efficient coexistence of industry and agriculture, tourism and supply on a broad medium industrial scale, died at the beginning of this month following a heart attack. What you experience in traveling through our state and in your encounters with the land and the people bears his signature. It is not easy to host this reception of the Bavarian state government in his place, conveying to you the greetings of the Bavarian state government and of our Minister President Franz Josef Strauss, on whose behalf I extend to you a most cordial welcome.

On September 30 the Bavarian Diet will ratify the new minister of agriculture who has just been nominated. Simon Nüssel, the state secretary, who worked with Dr. Hans Eisenmann closely over many years, is going to fill the post which was so suddenly vacated.

We are here in the Vier-Schimmel-Saal of the residence of the Bavarian kings. In their day Bavaria was an agrarian country, which it remained until after World War II. Its transformation did not begin until the postwar period. Industry and --during the last 10 years-- high technology have become the foremost economic resources in Bavaria. Although agriculture has lost its prime position it is still an important economic factor.

The change that we are witnessing can be traced to a variety of factors, including the preservation and development of family-sized farms, which still characterize Bavarian agriculture today. Although farms were modernized and upgraded to the latest state of the art, the traditional culture was preserved. Governmental and private consultants have encouraged this pattern of development. They are active all over the country and establish links between the farms, industry, and science.

Agricultural science takes place in Bavaria and in the Federal Republic of Germany at three different institutional levels. The agricultural faculties of the universities provide a thorough educational background for future graduates in the field of Agriculture. In this academic system, research and science are free and independent and thus meet the demands imposed by the constitutional law of the Federal Republic
of Germany. While the establishment of universities is financed by the federal government and the states, the cost of operating them is borne by each state. Government-owned research institutions and laboratories of private firms supplement the agricultural studies offered by the universities.

But agricultural research does not take place in laboratories, offices, or experimental stations alone. It frequently takes place in direct cooperation with the farms. The close relationship between agricultural practice and scientific research has made it possible for our agriculture to develop into a highly productive sector of the economy, which also provides significant incentives for the development of the economy as a whole. The results and successes of this economic sector are such that we now record surpluses from the scientific research results and technological progress converted into practice with the unremitting efforts of our farmers. As you all know, this situation has created political problems of a completely new nature in Bavaria, Germany, and in the European Community.

You, too, are concerned with the question of to what extent agricultural research can contribute to the development of agriculture in your countries. We all agree that no lasting agricultural development adapted to ecological requirements is possible without efficient agricultural research that looks into the problems of farmers and suggests regionally and locally differentiated solutions.

Our experience in Bavaria proves that continuous state support for research and extension is necessary. Research itself must not be restricted to the natural sciences if a basis is to be established for boosting production, which is so necessary for your countries. Unless the economic, social, and cultural conditions are also investigated, conflicts in converting research results into practice will arise from the outset. If the knowledge gained from the experience with our agricultural policy has any significance for the plans of others, then it is well to remember that a strategy aimed exclusively at increased yields can also and unexpectedly entail social problems. We convey this experience to you directly as we listen to your comments on the need for agricultural research and endeavor to help you meet that need by means of governmental or private assistance.

The high level of agricultural production reached in Bavaria with the aid of agricultural research prompted our state government to locate the Food and Agriculture Development Center of the German Foundation for International Development in Feldafing. One of the tasks of the center is to make the farm structure of Bavarian agriculture and the widely branched network of agricultural research and educational institutions, as well as rural self-help facilities, comparable to one another and analyzable for third parties. The Bavarian state government thus helps to solve agrarian problems in Africa, Asia, and Latin America. Advanced training of technical and executive staff from these developing continents can also be undertaken by the center.
The free state of Bavaria wishes to present itself to its guests as a land of dynamic industrial development while emphasizing that this development is based on a culture that is centuries old. The insight you are receiving into architecture, sculpture, the art of painting, poetry, and music demonstrates that much progress would not have been achieved without the unity of scientific, cultural and social conditions in our state. We are therefore making every effort to preserve these values even at a time when technical development is progressing so fast that it threatens to outpace man. If we succeed in Feldafing in helping you understand this diversity, which we are proud of and which we foster, then you will realize what this particular Bavarian flair stands for.

I wish agricultural research in your countries every success. The Ministry of Science, which is also responsible for university research into agriculture, encourages, wherever possible, initiatives that contribute to solving the difficult task of ensuring adequate food supply for the world population. You are taking on a particular role in achieving this objective. In your countries, self-sufficiency must be a primary goal without compromising the culture of your family farms, if you also hope to orient the pace of technical development toward those who are required to manage it. Meetings like this one can and should assist such efforts.

I therefore wish your deliberations every success in benefiting mankind and improving living conditions throughout this world.
THE ORIGINS AND AIMS OF THE FELDAFING MEETING

Hans Wyss
Director, Technical Department, Africa Region, World Bank

Allow me first to thank the government of the Federal Republic of Germany, the Bavarian state government authorities, and the German Foundation for International Development for their generosity in funding, organizing, and co-hosting this event. Let me also thank the government of Canada and its aid agency, CIDA, for a most helpful grant covering part of the travel costs of the representatives of African governments attending this meeting.

As you may be aware, the World Bank's strategy for strengthening agricultural research in Sub-Saharan Africa has been several years in the making. In many respects, this meeting represents the culmination of activities by African national agricultural research managers, by those responsible for regional and international agricultural research programs in Africa, by bilateral and other development agencies concerned with agricultural research in the region, and, of course, by those of us in the World Bank responsible for formulating such a strategy. In the Bank, the situation has been somewhat simplified since the creation in July, 1987 of a single Africa Regional Office and staff functioning under one Vice-President, in place of the formerly separate Western and Eastern and Southern Africa regions.

Let me hasten to add that, unfortunately Mr. E. V. K. Jaycox, Vice-President of the Bank's Africa region cannot be here today because this meeting overlaps with the initial discussions with African delegations to the Annual Meeting of the International Monetary Fund and the World Bank in Washington.

Mr. Jaycox wishes me to convey the following message to you: "Over the past two years, I have followed closely the dialogue between African governments and donor agencies with World Bank staff on the strengthening of national agricultural research systems in Africa. I see the development of science-based agriculture as a prerequisite for promoting economic and social development on the continent. It is particularly important, before the World Bank finalizes its strategy for assistance in this area, that we obtain your views as decisionmakers for investment and the direction of actions in this field. We would like to hear from you about the most effective approaches that we should take in this endeavor in partnership with the African governments, other donors, and the scientific community. I regret that I am unable to attend this meeting, but I look forward to hearing from you and from my staff what steps you feel should now be followed to ensure that the World Bank's strategy for supporting agricultural research in Africa can be pursued with the vigor it requires for successful accomplishment. This is a partnership
effort in which we must all be actively engaged. I am most grateful for
your participation, for the assistance provided by the government of the
Federal Republic of Germany and by the government of Canada for making this
meeting possible, and I convey to you every good wish in bringing this
meeting to a successful and definite conclusion."

I should now like to provide some background information on the
evolution of the strategy statement you have before you.

The World Bank has consistently emphasized that research is one
of the several essential elements required if agriculture is to contribute
in full measure to the economic development of its member countries. The
Bank published a general policy statement on agricultural research in 1981,
and over the past 25 years or so it has financed major projects designed to
strengthen national agricultural research systems in many countries. In
addition, it has funded research components in many of the production
projects that have received World Bank support, frequently in conjunction
with financing from other donors; it is one of the co-sponsors of the
Special Program for African Agricultural Research (SPAAR); and it is, of
course, a co-sponsor and significant financier of agricultural research
through the Consultative Group on International Agricultural Research
(CGIAR) in Research Centers in Africa and elsewhere. The Bank has also
made special contributions to the International Center for Insect
Physiology and Ecology (ICIPE) located in Nairobi.

The Bank's preoccupation with the development problems of
Sub-Saharan Africa is now at the center of its activities. We recognize
that addressing immediate social and economic problems is an enormous task
for many African governments, which often prevents them from putting the
needed efforts into vital longer-term endeavors such as technology
improvements. However, sustainable betterment of the well-being of
farmers, based on science-led agriculture, cannot be delayed without great
cost. As a result of this and many other considerations, including the
lack of success with research components in development projects, the Bank
in 1985 commissioned teams of internationally respected consultants to
review the status of agricultural research in the countries of the region.
The assessments sought, among other things, to provide the Bank's
management, staff, and interested member countries with the following
information on national and regional research activities:

- an appraisal of the present status of research and technology and of
current organizational capabilities for generating improved
agricultural technology at the regional and national levels;

- an appraisal of physical research facilities and of the numbers and
quality of the human resources devoted to agricultural research;

- promising possibilities for future investments in the generation of
new agricultural technology; and
strategic recommendations for strengthening agricultural research to meet the perceived needs of the region over the coming 20-30 years.

Draft reports prepared separately for western, and eastern and southern Africa were submitted to workshops in Benin and Kenya, respectively, in December 1986, where they were debated by the managers of national agricultural research systems from African countries, together with representatives of the donor community and relevant regional and international research agencies. Major contributors to the reviews and selected World Bank staff also attended the workshops. This group took into account the views expressed at the workshops in the final versions of the two agricultural research reviews that have already been distributed to you.

From the beginning, the Bank has been firmly committed to extensive and open consultation in this project. The two reviews indicated clearly that agricultural research in Sub-Saharan Africa has been hampered to a greater or lesser degree in the past, and continues to be hampered in many countries, by the failure to take into account the views of many key actors. These include the farming population for whose benefit most research is intended, as well as those responsible for formulating and helping to finance national and sectoral development strategies. That is why we asked African research managers their opinions on the two regional review reports at the Cotonou and Nairobi workshops. That is why we asked donor agencies at a meeting of the SPAAR group in May 1987 for their views on a synthesis paper based on the regional review reports, which addressed common issues for strengthening agricultural research in the region. And that is why we do not intend to finalize the draft paper that you have before you until we have obtained the views of predominantly African national decisionmakers at this high-level meeting.

This gives you an idea of the background and aims of our meeting here in Feldafing. You will undoubtedly agree that the subject this meeting addresses is not only tremendously important, but also challenging and exciting. My colleague, Mr. D. C. Pickering, will present the Bank’s paper to you later this morning. Thereafter --to use a good agricultural analogy-- you will wish to put your hands to the plow and take the opportunities presented in the program to discuss its proposals and state your views as to their feasibility. We trust that this will provide a strong basis for helping us to finalize a well-founded and realistic strategy for strengthening agricultural research in Sub-Saharan Africa.

I wish this meeting great success and all the participants a pleasant and productive stay.
STATEMENT ON BEHALF OF THE ORGANIZATION OF AFRICAN UNITY

Dr. Idris M. N. Nur
Head, Natural Resources Division, OAU

It is a great honor and pleasure for me to address this meeting on behalf of the Secretary-General of the Organization of African Unity, His Excellency Mr. Ide Oumarou at a time when you are about to discuss a topic of high priority for Africa and the OAU, namely, African agricultural research and technological development. Mr. Oumarou asked me to convey to you his special thanks for the attention that will be given to Africa's problems as well as his hope that the conclusions drawn at the end of your deliberations will further enhance international cooperation in accelerating development in Africa. He has also asked me to convey to you his sincere apologies for not being able to be with you and to wish you successful deliberations.

First of all, I wish to thank the World Bank for inviting the OAU to address this distinguished gathering and to participate in your deliberations. Second, I should like to express my sincere thanks to the government of the Federal Republic of Germany and its people for the warm welcome they have accorded my delegation since our arrival in this country.

The OAU commends those countries, peoples, associations, bodies, and organizations that have continued to support Africa in combating famine, drought, and other natural disasters. We do hope that further avenues can be found to assist in the economic recovery programs of Africa.

The OAU also commends those organizations and donors who have already provided assistance and initiated agricultural research projects in Africa. These include co-sponsoring governments, USAID, the World Bank, EEC, and other bilateral and international agencies. Some of these donors prefer to finance buildings and equipment and to avoid the long-term investments that are required to develop indigenous, scientific, managerial and technical capacity.

OAU hails the activities of the international agricultural research centers and counts on their programs in research and training in Africa. It takes about ten years of graduate study and on-the-job training for an agricultural research scientist to be productive.

The question of aid to African agriculture has brought to light some problems that require analysis, adjustment, and change. Donors' attention should shift from pricing policy reforms to other issues in agricultural development that would bring about the required change. However, pricing and technology policy could be viewed as a package, by donors as they are complementary.
The presence of eminent personalities in this hall is evidence of the participants' interest in and dedication to a meeting that promises to contribute much toward the direction our future activities will take in promoting agriculture in our continent. The motto of this meeting might well have been "today's research is for tomorrow's needs".

Africa has long had a network of research stations producing results equal to those achieved in many parts of the world. Research in Africa has helped control tsetse flies, locusts and other insect pests. It has produced high-yielding varieties of some crops and has shown that intercropping is vastly more important than the monocrop system. Much of this research, however, was directed toward commercial agriculture. Little was done to improve the yield of food crops. Most of the research work depended on foreign technicians and resources, and it developed little in the way of a self-sustaining body of local expertise.

Furthermore, the response of new production technologies to the continent's evolving needs has been inadequate. This failure stems from a poor understanding of small farmers' goals and limited resources. For example, intensive use of surface mulch in combination with herbicide and minimum or zero tillage have yet to prove effective in on-farm testing in the humid tropics. Countries in these areas have also had little success in introducing exotic high-yielding crop varieties, with the exception of irrigated rice where the environment can be modified to suit the crop. Moreover, few research findings have significantly influenced local practices or helped to improve the economies concerned.

One reason for these failings is that most of the research being done is not oriented toward problem solving. Another is that some research establishments do not have staff from the various disciplines required. Moreover, in many cases the agronomists, plant breeders, pathologists, entomologists or soil scientists who are on staff work in isolation, whereas farming is a multidisciplinary industry.

Research projects at most of the agronomic research institutions concludes with the phrase "the results are statistically significant". This means very little to the farmer, although he may not be able to read and write, he is still an economic investor and as such is interested in results that have been proved to be economically feasible and profitable. Some of our research establishments have no economists, social scientists and subject matter specialist who can translate the agronomic research results in terms of dollars, pounds, and feasibility --the language in which the farmer conducts business.

Africa's agricultural productivity cannot be increased unless new biological, chemical, and mechanical technologies are introduced at the level of small-scale farming. In addition, new techniques must be developed to help conserve soil, water, and forest resources. At the same time, livestock production requires research, especially in the area of livestock diseases and feed supply.
Although the economies of African states are changing, for the immediate future, most tropical African economies will continue to rely heavily on agriculture. Already, the size of agriculture's contribution is growing rapidly. Thus, better agricultural research will continue to be essential for some time to come.

The five main problems that African agriculture faces and that need immediate attention are

1. how to increase food output and improve nutrition;
2. how to help alleviate the uneven economic development that occurs between farm and nonfarm sectors;
3. how to formulate a policy that will ensure that agricultural research works in the best interest of Africa, and how to communicate research findings to the African farmer;
4. how to reduce the strong competition between agricultural produce, synthetics, and the fast-growing industry of biotechnology; and
5. how to convince the international community to help Africa implement its programs.

Food and agriculture in Africa have been subject to highly fluctuating supplies, demand, and prices. The decline in food production per person was 7% in the 1960s and 15% in the 1970s. Estimates point to further deterioration in the 1980s.

The period 1970 to 1985 saw total food imports increase by 8.14% per year. Grain imports for human consumption in 1985 stood at 20.4 million tons, or US$5 billion. At the same time, food aid accounted for upward of 15 million tons. Some countries do not have the means to pay for the additional food required, or to carry the foreign exchange burden involved.

The causes of the food and agriculture crisis have been identified as internal, external, natural and man-made, economic, political, and institutional. Although many studies have been carried out on the crisis, action to resolve it has been rather minimal.

In many forums, the opinion has been expressed that the developing countries should increase their food output by 3.4% per year. That is about 1% above the average population growth rate.

The Lagos Plan of Action (LPA), Africa's Priority Program for Economic Recovery 1986-90 (PPER), and the United Nations Program of Action for African Economic Recovery and Development (UNPAAERD) have stressed the importance of the food and agriculture sector, making it a top priority, and have proposed a set of measures to be undertaken at different levels.
In an effort to remedy the situation, African countries have committed themselves to the implementation of the LPA, APPER, and the UNPAAERD.

APPER is an emergency program scheduled to last for a period of five years --1986-90. It is meant to accelerate the implementation of the LPA. It is specifically designed to address the critical economic situation in Africa and is to be implemented at different levels. UNPAAERD agrees with APPER's principal proposals for the food and agriculture sector. APPER rightly gives top priority to agriculture in recognition of the historical fact that today's developed countries, such as Japan and South Korea, went through an agricultural revolution before industrial revolution.

In order to remedy the situation, emphasis will be placed on substantially reducing food wastage, attaining a higher degree of food security, and increasing production. The chief means of achieving those targets is agricultural research. The costs of agricultural research will be more than compensated by the advances, improved techniques, and greater efficiency resulting from discoveries.

African governments recognize the importance of suitable and appropriate technology for the development of the food and agriculture sector. This awareness has been reflected in LPA, APPER, and the UNPAAERD, which stressed the fact that inappropriate research and the lack of improvement in available techniques, including the inadequate spread of improved technology, are among the major causes of the alarming deterioration of production and productivity in the food and agriculture sector.

It is clear, however, that the success of African countries in injecting and promoting appropriate and suitable technology in rural areas will depend upon their ability to develop adequate infrastructure facilities such as transportation, storage, handling and processing, and distribution systems, which are necessary software components of technology.

The hardware aspect of technology such as machinery, fertilizers, and seeds, must be supported by the software components, which will require massive investments. Equally important in the development and application of suitable technology in Africa is the creation of a conducive environment that encourages rural people to use their resources and skills effectively and to increase their technological competence in order to fully participate in and contribute to the process of change.

Research, pilot projects, seminars, and workshops are urgently needed to strengthen basic agricultural institutions. African universities are areas that have not been fully tapped for development and food production.

In a survey conducted during the middle of 1987 by the ECA and DAU secretariats on the implementation of APPER and the UNPAAERD, the 38
countries responding to the questionnaires indicated that a number of positive activities have been undertaken in relation to food and agriculture. For example, about half of the countries have already created or maintained national emergency preparedness mechanisms and established early warning and national food security systems. The food and agriculture sector has been accorded the highest priority. In addition, the survey indicated that measures have been taken in several areas to increase agricultural production and productivity. For example, 89% of the responding countries have instituted measures for the development, dissemination, and encouragement of the use of modern inputs and methods; 86% have adopted price incentives for agricultural products, and 85% have started re-afforestation programs. Other programs initiated include controlling deforestation (75%), protection of the environment (67%) and introduction of agricultural mechanization (67%). Measures taken in support of the food and agricultural sector include rehabilitating and upgrading the existing industrial plants; manufacturing and maintaining agricultural tools, implements, and feeder and access roads; and developing training.

Food self-sufficiency has become a major goal in the development plans of many African countries. Some member states have already reached this point (e.g., Zimbabwe in maize production and Botswana with respect to poultry meat and egg production). African countries know what to do, and have been doing their best. What they need now is resources, which are not forthcoming from the international community.

The search and the struggle for food, the fear and the reality of hunger, and the recurrent crop disasters brought about by drought, desertification, flood, locusts, diseases, and insect invasion --these have been an every-present threat throughout human history, so that starvation has long been a reality for a substantial part of humanity. Millions of men, women, and children are still paying the physical and mental price of malnutrition.

Looking ahead, we can be much more certain about the number of people that will need to be fed in the decades to come than about food supplies or about any other major factor in this life-and-death calculus. Approximately half of the total population of the developing world today is under sixteen years of age. This means that the number of new families being formed will be extremely high for the remainder of this century; and it means that the world population is destined to grow rapidly and massively at least until the early years of the next century, even if new parents have fewer children on the average than their parents did.

Most social and economic problems in our continent --such as poverty, unemployment, malnutrition, and illiteracy-- are to be found in the rural areas where, needless to repeat, about 80% of the total population live on subsistence agriculture. It is therefore imperative that the majority of our people should be provided with appropriate and adaptable technology if they are to effectively improve their lot.
The situation is now dire. The agricultural scientists stand alone as insurance that Africans will not actually be hungry in another generation. We are adding so many people, subtracting so many hectares, that only science can save us from the ultimate mass hunger predicted by Malthus years ago.

If our continent is to benefit from agricultural research, it is first necessary to evaluate the present state of agricultural research, visualize the future trend, and finally formulate the appropriate measures to remedy the situation in line with APPER and the UNPAAERD.

Our objective is simple: to free Africa permanently from the horrors of famine, misery, malnutrition, and the humiliation of dependency. If agricultural research is given the serious attention required, it can become the nucleus of African industrial development.
It is indeed a privilege, and gives me great pleasure, to address you on the auspicious occasion of the opening of this most important meeting, which I expect will be referred to later as a turning point in the history of African agricultural research and technology development. We are indebted to the Special Program for African Agricultural Research (SPAAR), the Government of the Federal Republic of Germany, the Bavarian authorities, the management of World Bank and to other members of SPAAR for convening this meeting, which culminates almost three years of hard and painstaking work by these organizations and the various consultants who have assisted them.

That agricultural research and technology development are essential tools in our struggle to salvage African agriculture from its present shipwreck is certain. However, the full response of the international community to the continent's present critical economic situation appears to depend on the continent being in possession of an efficient, coordinated, and responsive system for the development and diffusion of new, science-based, well-adapted, modern and grass-roots technologies in the agricultural sector.

It is not necessary for me to recapitulate here the course of Africa's series of multiple debilitating crises that have brought the continent to the brink of ruin. The background to the present situation has been sufficiently described in documents that are well known to you all -- the Lagos Plan of Action, adopted by the OAU Summit of 1980; Africa's Priority Program for Economic Recovery, 1986-90, drawn up for, and approved by, the OAU Summit of 1985; and, finally, the United Nations Program of Action for Africa's Economic Recovery and Development, 1986-90. All trace the origins of the present economic situation and point to suitable remedies. More recently, the Fourteenth Regional Conference of FAO held in Yamoussoukro, Côte d'Ivoire, in September 1986 analyzed in greater detail the agricultural crisis and its principal causes. This information, too, is adequately covered in the documents that you will be considering at this meeting.

Suffice it to recall that Africa, a continent that twenty years ago was able to feed itself, is no longer able to do so and is forced to import increasingly greater volumes of food, while its population continues to grow unabated. Recent projections have indicated that, if present trends continue, Africa's cereals gap would grow to an alarming 100 million tonnes by the year 2010; 58 million tonnes of this requirement would be for Sub-Saharan Africa. Total food imports for the continent, which cost
US$5.2 thousand million annually in the period 1982-84, would cost US$28.5 thousand million, at constant prices, in the year 2010, compared to export earnings of almost US$12 thousand million. No plausible combination of commercial food imports and food aid could meet these requirements, and such a situation could not be sustained — ecologically, economically, and politically.

Many developing countries already have an overstretched carrying capacity of land. In fact, according to a recent FAO study, 54 of the 117 developing countries had insufficient land resources to meet the food needs of their 1975 populations at low levels of input use. 1/ These critical countries, covering an area of 2.5 billion ha, in 1975 had 280 million people in excess of the supporting capacity of the land. At the same level of inputs, by the year 2000 the number of marginal countries will increase to 64 and the population in excess of the land’s potential carrying capacity may be over 550 million. Even if input use is raised to the intermediate level, which seems unlikely in view of the external indebtedness of many developing countries, 38 countries will still be marginal with 150 million people above the carrying capacity of land.

Modern agricultural production technology has raised the hope that hunger can be eliminated and the carrying capacity of the land increased through better use of soil, water, and air. However, the ecological sustainability and economic viability of new technologies are increasingly at stake. The rising population of humans and animals—with their ever-expanding need for food, fodder, and feed—exerts great pressure on the stabilizing elements of agro-ecosystems. As productive land becomes scarce, marginal farmers are pushed into fragile croplands and forest areas unsuitable for modern agriculture.

It is now sufficiently clear that any increase in food production must come primarily by raising the productivity of currently tilled soils rather than by bringing new land resources into farming or discovering a new world! A large portion of currently tilled marginal areas will have to be phased out of agriculture for economic and ecological reasons. Because some lands are taken out of production all the time and diverted to uses such as roads, housing, and industry, care of the soil is a task of high priority.

But Africa’s food crisis is part of a general agrarian crisis that is manifested in malnutrition, poverty, underdevelopment, and growing food dependency on industrialized nations. To end this crisis and place Africa firmly on the path towards sustainable development, governments, with the assistance of the international community, must make fundamental

changes in their development strategies in favor of agriculture. Among these reforms, that of the services responsible for agricultural research and technology development and its transfer to the end-users is one of the most important and most urgently needed. It is now widely accepted that a steady increase in agricultural productivity through technological change is indispensable to sustained economic growth; increases in productivity over the past 100 years have come largely from the application of science-based farm technology, and from changes in management and inputs developed through organized research.

The large amounts of money and trained manpower committed worldwide to agricultural research in recent years reflect, in part, the high actual or expected rates of return on such investment. Many studies confirm these returns. Although, unfortunately, few such studies relate to Africa, those undertaken elsewhere have consistently shown higher rates of return, generally two to three times greater, than likely returns from most alternative investment opportunities in the countries concerned. Economic returns to particular research activities typically exceed 20% a year and frequently are greater than 40%. The internal rate of return on investment by the International Rice Research Institute in rice research in 1975 was estimated to be about 80%, while roughly similar returns have been estimated on investment in rice research by the International Center for Tropical Agriculture in Colombia. Albeit not widely publicized, there are also confirmed success stories within Africa, in which research and technology development have played major roles. Examples are the expansion of hybrid maize in Zimbabwe in the 1950s and in Kenya in the mid-1960s, the breakthrough in oil palm yields in Zaire in the 1960s, and the introduction of many improved varieties of cotton, groundnuts, coffee, and tea into a number of countries over the years.

There also exists a mass of successful research results that have never reached the farmer and still await dissemination to generate further success stories; this betokens a "technology gap" between potential and actual production systems.

The present state of agricultural research in Africa, is well known to all of you here. It has been described in detail in the two reviews prepared by the World Bank's teams of consultants and, as far as Sub-Saharan Africa is concerned, is well summarized in the Bank's draft paper, "Strengthening Agricultural Research in Sub-Saharan Africa: Strategic Considerations." In short, Sub-Saharan Africa's systems for the generation and dissemination of agricultural research and technology are ill equipped and poorly focused, and in their present state cannot meet the requirements of the present crisis. Their main deficiencies have been diagnosed and analyzed insofar as they relate to the identification and establishment of priorities, to institutional and management arrangements, to funding, and to the provision of sufficient well-trained scientists and technicians, as well as to the dissemination of their findings where they are needed. In each of these areas the World Bank now proposes solutions to remedy the deficiencies and bring national services up to the standard required by the present situation; the Special Program for African
Agricultural Research (SPAAR) working group and the International Service for National Agricultural Research (ISNAR) have jointly prepared a set of Guidelines for Strengthening National Agricultural Research Systems in Sub-Saharan Africa, which were given wide distribution earlier this year. This document, along with the two reviews and the Bank paper already referred to, will provide a framework for discussion during the course of this meeting and may be the foundation on which a pan-African Strategy for Agricultural Research and Technology Development could be formulated.

Although we all hope that, with the adoption of such a strategy and its realization, in cooperation with the international community of funding agencies and agricultural research scientists, Africa would eventually benefit from its own "green revolution" as Asia has, we are forced to note some important differences between Asia and Africa: (1) African agriculture is characterized by extreme diversity of production systems in a fragile environment; (2) there is the special problem of a large number of small, sparsely populated countries, many of which lack the means to maintain a viable national research system; (3) because Africa urgently needs foreign exchange, too much attention is being given to export crops at the expense of much needed food production; (4) little effort has been made to exchange research findings among African countries; and (5) perhaps most important, the socio-economic circumstances prevailing in most of Africa--where real urban wages have been inflated by cheap, subsidized food policies and the land-tenure system has encouraged many households to retain rural links for nonfarm production reasons--contrast strongly with the situation prevailing in most Asian economies.

Thanks to new technologies that emphasize the cultivation of strains of crops that respond to irrigation and good soil fertility management, many developing countries in Asia and Latin America have made good progress in food production since the mid-1960s. Many traditionally food-deficit or food-importing countries have become self-sufficient and have even amassed food surpluses. The same cannot be said about the African continent! What is even more significant is that increases in food production have come mainly from increases in productivity rather than increases in area. Many African countries that are population-rich but land-poor need this type of technological breakthrough.

Even with a satisfactory situation in Asia and Latin America and with the world grain stock now increasing to more than 460 million MT, scientists and planners are still concerned. For them, accelerating food production to keep pace with population growth in the developing countries, especially in Africa, is still an unfinished task. Although most countries of the world are in the process of demographic transition, Africa's progress toward the ultimate stage of such a transition is lagging far behind that of others. In the opinion of J.W. Mellor, Director of the International Food Policy Research Institute, expressed in a 1985 paper, "The Changing World Food Situation", Africa's poor record on food production is largely due to the labor constraint combined with rapid urbanization, rising urban incomes, and rising remittances to rural areas. These factors all serve to reduce labor input into agriculture, slowing the
expansion of area cultivated as well as the expansion of yields per acre. These same forces have a much less negative impact on agriculture under the labor surplus regimes of Asia. To these factors we could add the policies of subsidized food in urban areas in Africa, reinforced by the policies of agricultural subsidies in industrialized countries.

Although this does not mean that the type of biological scientific research that solved Asia's food crisis of the 1960s has little relevance in Africa, it does mean that special emphasis also needs to be placed on socioeconomic research. To quote from a recent publication by Allan Low, southern Africa regional economist for the International Maize and Wheat Improvement Center, "In Africa it is likely to be more difficult to focus research towards technologies that are acceptable to African farm households, for whom increases in yields per area of land may not be the overriding concern... Technology alone will have limited impact while the broad socio-economic environment facing farm-households remains unfavorable for marketed production."

There is also a potential pitfall to be avoided: we tend to think more of mathematically immaculate methodologies and innovative technologies and less of people. The impersonal vocabularies of economics, politics, and industrial administration speak not of people but of human resources, numerical statistics to be crunched into computers, along with such others as investment and working capital, taxes, tariffs, and crop yields.

Many research networks have clearly demonstrated the central importance of people--that is the critical influence of human, social, and cultural attitudes to the acceptance and adoption of technological change. African research services have hitherto paid little attention to socioeconomic research, and the number of African agricultural economists trained for research is very low. Similarly, neither the International Agricultural Research Centers (with the notable exception of the International Food Policy Research Institute) nor the donor community have shown much interest in this field. A pan-African research strategy must redress this balance.

A pan-African strategy must also be aimed at equipping the continent to satisfactorily carry out research programs that have as their objective the increased well-being not only of the present inhabitants of the continent, but also those who are not yet born. Therefore one important objective of such a strategy would be to establish sustainable livelihood systems through the creation (to borrow the language of the World Commission on Environment and Development) of an agricultural symphony for the continent. The theme of this symphony must be food security understood in its broadest sense, as defined by the Committee on World Food Security at its eighth session held in Rome in April 1983.

The strategy must provide not only for agricultural research in its four aspects (basic, applied, adaptive, and maintenance research) but also for the transfer of the results of this research to the end-users in the form of applicable technologies. The reform of the continent's
National agricultural research systems must thus go hand in hand with the reform of national extension services and an effort to meet crucial financial needs.

National research systems, however, need to communicate with the end-users of technological innovations, not only in a one-way monologue in order to transfer results, but also in a two-way dialogue in order to understand farmers' problems, identify priorities, and include farmers and their environment in the design and execution of research programs.

We in the Economic Commission for Africa are pleased that the recommendations of the World Bank are aimed principally at building up Africa's own potential to generate new agricultural technology and not only at the transfer of technology from other parts of the world. Although we recognize the important role of the 19 international agricultural research centers as well as the many regional institutions and national research organizations in developed countries supporting African agricultural research, in the final analysis the unique needs of our continent must be determined and met within the continent itself. This is the main conclusion of a report prepared for the United Nations Economic and Social Council (ECOSOC) by the Secretariat of ECA and presented to the 22nd session of the commission and the thirteenth meeting of the Conference of the Ministers, which was held in Addis Ababa April 22 to 27, 1987 and entitled "International Year for the Mobilization of Financial and Technical Resources to Increase Food and Agricultural Production in Africa".

However, we should not forget the research findings that lie underutilized and undisseminated in the archives of institutes in Belgium, Britain, France, the United States, and elsewhere outside Africa. The results of past work done in and for Africa, but not available in Africa, need to be indexed and disseminated, perhaps through the services of the Food and Agriculture Organization of the United Nations (FAO) where it is needed. Such a task could well be a supplementary responsibility of FAO's Current Agricultural Research Information Service (CARIS) or the International Board for Plant Genetic Resources (IBPGR), which is funded by the Consultative Group on International Agricultural Research (CGIAR) and based in FAO's headquarters.

We think it is time for us to devote greater attention to economically and ecologically sustainable agricultural production systems where present economic progress and prospects for survival will not be in conflict.

Fortunately, the new generation of technologies is characterized by this welcome blend and should help us to exploit in a sustainable manner cubic volumes of soil, water, and air, thereby giving the African farmers the optimum return possible from the available soil, water, nutrients, air, and sunlight.
We in the Economic Commission for Africa strongly believe that any sustainable approach to increasing food production and protecting the environment in Africa must consist of three mutually supportive and harmonious elements:

1. Technologies must be economically viable, ecologically sound, and socially compatible. In fact, such technologies should aim at achieving the highest output possible per unit of land, water, time, and labor while not allowing any depreciation in the basic agricultural assets of land, water, flora, and fauna. Farmers should be able to choose the technology suited to their capacities and requirements. These technologies should also take into account sex-related roles in food production, since 77% of the food grown and eaten in Africa is produced by women.

2. Services should be set up to ensure equality of opportunity to the appropriate technology. Government and private agencies should be active in providing seeds, seedlings, fertilizers, and credit. Seed and seedling banks should be established at the regional level to ensure the timely availability of seeds and seedlings for farmers. Innovative policies for an effective and timely input supply scheme must be evolved by governments together with appropriate funding.

3. Government policies should be set up that can stimulate and sustain the farmer's interest in agriculture and food production. In fact, it is difficult to see how an agricultural technology could remain productive and sustainable without government support. For example, land reform and funding are major policy instruments needed in Africa.

At present there is a unique opportunity to design more efficient ecologically and socially sustainable technological systems by using the large foodgrain stocks intelligently. Technological systems designed to overcome physiological, biological, ecological, economical, and social constraints can help to enhance production efficiency. Technology must therefore be integrated into the mainstream of farming systems research. We need political will, we need professional skill, we need peoples' action, and we need financial resources.

This leads me to speak briefly about that debilitating phenomenon known as the "brain drain". A pan-African strategy for agricultural research must include a satisfactory "tourniquet" for this continuing hemorrhage of Africa's precious blood. The surest solution is to strengthen national research systems sufficiently to make them an effective means of transmitting innovative technologies to producers. This in turn would provide the researchers the degree of satisfaction that they can only obtain elsewhere at present. Although African researchers are no more immune to the normal human desires for financial betterment and public recognition than those of other continents, I believe that the majority would accept reduced material benefits for the satisfaction of working
among their own people and for the advancement of the well-being of their own people, once they saw that they were really contributing measurably to the latter. Meanwhile, I should like to take this opportunity to remind participants in this meeting that the Economic Commission for Africa has been collaborating, since 1983, with the Geneva-based intergovernmental Committee for Migration in implementing a scheme known as the Joint ECA/ICM Return of Skills Program for Africa, which has already identified several hundred qualified Africans residing in developed countries who wished to return home to practice their professions, found vacant posts for them to fill, and provided financial assistance to enable them to return and settle down again. This scheme could be extended to many more of the 70,000 such qualified "expatriates" that have been identified if more funds were available, and if conditions of work in Africa were more attractive.

At the same time that measures are being taken to halt and reverse the "brain-drain", the role of African faculties of agriculture in supplying the qualified scientists for national research services needs to be reemphasized and these faculties must become more suited to the tasks facing the continent. Without wishing to take sides in the argument over whether agricultural research scientists are better trained in agricultural universities or in agricultural faculties of multidisciplinary universities, I wish to note that the second Conference of Vice-Chancellors, Presidents, and Rectors of Institutions of Higher Learning in Africa, organized jointly by the Economic Commission for Africa and the Association of African universities at Mbabane from February 18 to 22, 1985, drew attention to the low level of enrollment at institutions of higher learning for courses concerned with agriculture, forestry, and fishing and called for the reform of university curricula to enable African educational institutions to rise to the challenge of Africa's social and economic crisis.

The idea has been put forward that Africa should have a regional, or several subregional agricultural universities of high, international standard preparing for postgraduate diplomas in the agricultural sciences. Rather than incur the high investment expenditure on new institutions, the secretariat of ECA considers that it would be just as effective to upgrade a number of existing institutions, each specializing in a particular field of agricultural science at the highest level to cater to countries of the continent or subregion; we hope that intergovernmental organizations with some influence will consider this proposal.

Although African students will still find it necessary, for some time yet, to study for higher degrees outside the continent, we would like to see more systematic efforts being made by universities, perhaps through special "twinning" arrangements, to ensure that these students' curricula and thesis and dissertation topics are more relevant to Africa.

My final remarks are addressed not only to those responsible for drawing up a pan-African agricultural research strategy, but also to the entire community responsible for implementing the strategy to be adopted. This community consists of the international donors, those responsible for
international and regional agricultural research centers, national research programs in developed countries in support of African agricultural research, African national research programs and African governments. All should see themselves as contributing to, and as integral parts of, a historic joint effort indispensable to setting Africa firmly on the road to sustainable development. To attain the long-term objectives of such an effort requires patience and stamina.

We in the Economic Commission for Africa have already started to prepare for 1991, which has been proposed as the International Year to end Hunger and Poverty in Africa. We shall continue to give our support wholeheartedly to all international intergovernmental and national initiatives that bring us closer to that goal.
STATEMENT ON BEHALF OF THE UNITED NATIONS DEVELOPMENT PROGRAMME

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A unique opportunity is being afforded us by the convening of this seminar, as it forces us to recognize the intractability of the problems that confront Africa. Too infrequently do we bring together policymakers, representatives of funding agencies and institutions, and technical specialists to deliberate issues which, if plausible solutions are advanced, could ultimately transform Africa in the twenty-first century.

We are greatly indebted to our host, the German Foundation for International Development, for providing this salubrious environment. Distant as we are from the harsh realities of Sub-Saharan Africa, we must not fail to adopt recommendations that will help to enhance the role of research and development in agriculture.

At various consortia the World Bank has addressed the problems of agriculture in the context of the overall policy framework and structural adjustment, and the convening of this seminar provides us yet another forum to advance the debate, and perhaps with resolve to formulate plans for action.

Continental Africa faces major challenges as we approach the twenty-first century. Without being unduly pessimistic, it is fair to say that political, economic, and social prospects are dismal, and for the countries of Sub-Sahara the choices are grim. After the buoyancy of the post-independence sixties and the shocks of the seventies, the eighties may well be characterized as a period of despair. Persistent drought erodes progress among the sahelian countries and envelopes Ethiopia, and famine is a constant threat; commodity prices remain chronically depressed; export earnings cannot finance the most modest imports; fiscal imbalances have become the norm, with the main hope for generations to come being perpetual dependence on external largesse, in a not entirely receptive international atmosphere. It is no wonder that talented young Africans seek extended sojourn in foreign lands, contributing significantly to building the human assets of many developed countries. Opportunities for technological advancement are unlikely to flourish in a national environment where excellence is stifled by the need to subsist. Professor Odhiambo aptly described the plight of African scientists during his recent acceptance speech at the First Annual Africa Prize for Leadership for the sustainable End of Hunger in New York. He stated that they have been ignored and have had to struggle to rise above the policy neglect and the abysmally low fiscal and institutional support for most of this century.
It is to the credit of African governments that they have not developed a pessimistic outlook. Instead, many of the countries have adopted recovery programs designed to transform their economies in structural terms. The Lagos Plan of Action (1980) and the UN Special Session on Africa (1986) that resulted in the UN Programme of Action for Africa Economic Recovery and Development (UNPAAERD), record in detail the policies, priorities, and financial commitments agreed upon by African governments. The Programme of Action not only recognized the need for structural transformation as immediate and urgent, but also noted that the rehabilitation of agriculture was of the utmost importance.

The performance of African agriculture has been disappointing, as it has not kept pace with population growth and the demand for food, raw materials, or export earnings, nor has it taken sufficient advantage of technological possibilities. Although agriculture is the major economic activity in Africa south of the Sahara, providing on the average employment for 70 to 80% of the labor force and accounting for upward of 40% of GDP and 70% of export earnings, it is disconcerting to note that its share in GDP has been diminishing steadily over the past two decades. The major causes are numerous and already well-documented. It is clear, however, that until governments make the revitalization of agriculture the centerpiece of adjustment policies, honoring the pledge made at the OAU in 1985 to devote 20-25% of public investment to the rehabilitation of agriculture, the rural sector of many African countries will remain chronically poor.

I now turn to the specific subject that has brought us to this colloquium. It would be presumptuous of me to attempt to lecture this group on the constraints experienced in utilizing research and development in agriculture in Africa. However, as a funding agency with an extensive field network, UNDP enjoys a special vantage point from which to view and participate in the development process by providing technical assistance in response to nationally dictated economic priorities. The dialogue with governments is advanced by pointing out the various policy options and opportunities for taking advantage of resources made available through the UN development system. By focusing on human resource development, UNDP remains faithful to the fundamentals of national collective self-reliance, institutional capacity building, and internalization of the process of economic management. From this perspective it can be understood that agricultural research and technological adaptation must be properly integrated within the overall macroeconomic policy framework. In this way, nationally dictated strategies provide the basis for external response.

Over the ten-year period from 1977 to 1986, UNDP disbursed approximately US$194 million for projects in agricultural research in Sub-Saharan Africa. On average this represents 35% of the total resources applied to agriculture, although the share has been decreasing, from 44% in 1977 to 29% in 1986. Research in support of crops received the lion's share with 48%, followed by livestock at 17%, forestry 14%, fisheries 12%, and land and water 9%. The major portion of funding was provided to
national research institutions (55%) through the country allocations, reinforced by global (38%) and regional (6%) program resources.

UNDP has been a constant partner with the Consultative Group for International Agricultural Research (CGIAR) since the early seventies, supporting the various centers (ICRISAT, ILRAD, ICPE, IRRI, IITA, CIMMYT, and IFDC) through annual contributions from the Global and the African Regional Program. Indeed, a sum of US$125,000 from the global program helped launch the funding of the Special Program for African Agricultural Research (SPAAR), and there is an understanding that an additional US$300,000 could be forthcoming from UNDP.

The Africa Regional Program for 1987-91 has already identified research and development in agriculture, particularly for food production, as one of the areas of concentration. The rationale here comes from the realization that despite the recent emphasis on food production throughout Africa, attention to export crops overshadows research, extension, and basic infrastructure designed to enhance food production. Innovative approaches are already being used in irrigated and rainfed crop production, pest management, fertilizer utilization, post-harvest handling, and staple food production. These efforts are designed to reinforce the programs of national research institutions maintaining linkages with the international centers. Over the last ten years some 902 trainees from 43 countries have benefited from such collaboration.

At the outset I stressed the need for action and the opportunity for action afforded this group. I would now like to suggest ways in which UNDP can assist, especially where we believe that we possess a comparative advantage. Although national priorities for research need to be clearly articulated, a variety of role players must also be given a chance to enter the game. UNDP works closely with national governments that have primary responsibility for creating a receptive environment. We also foster linkages with different national institutions and interested parties involved in the development process, such as universities, private enterprise, nongovernmental organizations, cooperatives, women's groups, as well as bilateral and multilateral donor institutions. This array of contacts, carefully nurtured through the UNDP field network, advances the argument in favor of coordination.

At the macroeconomic level, this is pursued by UNDP through its lead role in the roundtable process, during which the governments present their economic policies and programs to the donor community and seek agreements on joint strategies and resource allocations. Follow-up or sector meetings focus the attention of donors and national actors, for example, on various aspects of agricultural development, whether it is in support of self-sufficiency in food, a single commodity, or a program of research, aimed at reaching agreement on investment commitments. The important factor is that UNDP draws upon its unique relationship with the government to enhance the coordination efforts.
Research priorities must always be in step with macroeconomic policies; otherwise researchers and scientists run the risk of marginalization. Indeed, scientific efforts may become irrelevant if dictated by external demand and not scrupulously defined to address national needs. In the context of economic policy reforms, UNDP has been assisting governments in assessing how best to utilize technical cooperation to reinforce the national capacities for managing the development process. The NATCAP is a programmed approach by which governments and the scientific community could jointly assess their needs and direct technical assistance within a national framework. The donor community would therefore find it most compelling to adhere to the agreed priorities.

It is widely recognized that research and training for agriculture in Africa must be "relevant, targeted, sustained and essentially homegrown," as stated by General Obasanjo during this year's Annual Arturo Tanco Lecture. In this way, self-reliance becomes a more realistic and achievable goal. A more conspicuous effort must be made to strengthen and build up national universities to enable them to tackle research problems of national importance rather than invest in routinely sending students abroad at all levels. UNDP also supports the repatriation of talented nationals for short-term assignments through its TOKTEN program. Several nationals have made outstanding contributions in many fields, including research and technology application, but Africa is yet to exploit the use of this facility. Outstanding examples are China, Turkey, India, and Egypt, but only Guinea in Sub-Saharan Africa has developed this approach.

Although research must be homegrown, scientists must have access to institutions of learning, both within the country and elsewhere. Information must flow freely, and publishing must be unencumbered. The concept of "twinning" is not new, but it is highly desirable that such arrangements should be pursued as a priority on a south-south basis, fostering networks with similar experience, particularly in comparable agro-ecological environments, giving realism to TCDC.

Although it is ultimately the responsibility of governments to decide on their research policies, UNDP does have a viewpoint on areas that require attention as a matter of high priority. We start with the proposition that agriculture in Africa should be, as far as possible, intensive. This implies that more attention should be paid to research on high-yielding varieties of indigenous food crops, research on improved farm management practices, on farming systems, and on the optimal and effective utilization of water. Moreover, because much of Africa is semi-arid, we believe that greater attention should be paid to dry-zone farming: to the identification and production of species that can be grown in these fragile ecosystems, and to the management of scarce water resources in these areas. Finally, it is almost a truism to stress that effective extension systems and mechanisms must be established to ensure that the research results reach the farmers, for whom, after all, the research is intended.
UNDP support for the Gambia River Basin Development project has yielded useful data on farming systems, which are being extensively utilized in Mali, Senegal, and Gambia. Similarly, the work carried out through the West African Rice Development Association (WARDA) has been credited with increased rice production in Liberia, Sierra Leone and several other West African countries. Twenty years of successful collaboration with the Institute of Agricultural Research in Ethiopia point to the need for further efforts in small-scale irrigation and drainage of heavy soils under rainfed agriculture as being of major potential for the small farming sector.

I have chosen today to direct my attention to the means by which UNDP resources may be used more imaginatively to enhance research and development in Sub-Saharan Africa. The major contribution that we can make is to strengthen the capacity of governments to ensure that agricultural research is properly located within the macroeconomic frame; well coordinated in terms of financial allocations and national strategies, particularly where external donors are involved; that all national entities with a legitimate role are scrupulously involved, and to illustrate the point I refer here to the scientific community, private enterprise, and women’s groups, especially the latter, recognizing their significance in agriculture; that talented nationals will be encouraged to return for short assignments to their native land to contribute to specific research programs, and finally that networking of universities and research institutions on a south-south basis will be given high priority.

I believe that there are many opportunities for the advancement of research and development in African agriculture, but we must recognize the urgency of dealing with the persistent drought, destitution of many smallholders in the rural communities, and the paucity of resources available to national extension systems. Several areas require attention, but sustainable results can only be achieved if resources are pooled, talent is shared and the results disseminated widely and freely.
The statistical evidence is overwhelming: Agriculture in most African countries has not performed well by any standard since their independence. For the time before independence, we lack sufficient data for many of the African countries to make any meaningful statement. We know that in the past agricultural research did not provide significant inputs to agricultural development in most African countries, especially in the food crop sector. I believe that—with a few exceptions—research will not be a major factor in support of agricultural development for the next 10-15 years either—that is, until the end of the century. Agricultural research needs 10-15 years to achieve measurable results useful to farmers. Resources and expenditure for agricultural research were very limited during the last 10-15 years, so that few achievements were made, and funds earmarked for agricultural research today are still inappropriately small in most countries. If we require research to yield results by the end of this century, then it is high time to review the priority assigned to research and to agree on suitable and sufficient resource allocations.

With a few exceptions, agricultural research was given only limited priority by the colonial powers in the past. In some colonies, a few export crops received considerable support. Some superb research work and commendable research results are also known. Cocoa research in Ghana and wheat and maize research in Kenya and Zimbabwe before and after independence provide well-known evidence for what has been achieved. We must recognize, however, that in the past it was basically European not African research—Europeans determined priorities, their countries provided the researchers, and they worked in the research institutes that were copied from European models.

Since independence, most research institutes have not been able to attract and absorb either the required number of trained national personnel or the necessary financial resources to manage and improve these institutes and undertake meaningful research. The influence of the African farmers on research priorities is still very limited. Furthermore, the geographical distribution of the institutes over the African continent remains very uneven. Some countries (e.g., Kenya) have a relatively large number of institutes, whereas others (e.g., Chad) have no research institutes at all. Hardly any research institutes have commitments for sufficient resources on long-term technical and capital assistance in addition to national funds to meet their clearly identified needs and requirements.
Last year FAO published a major, widely acclaimed study, "African Agriculture--the next 25 Years." This study identifies four "i"s as the basis for development: incentives, inputs, infrastructures, and institutions. These must all be considered and strengthened, if we are to be serious about agricultural development in Africa. The problems connected with research and research results are that research is part and parcel of at least three of these "i"s, namely infrastructures, institutions, and inputs.

The life cycle, especially the academic life cycle, consists of listening and learning as a school child, of studying and discussing as a university student, and finally, if ever, teaching as a professor. Many of us who are not from the African continent unfortunately believe that the first two stages are not required—that is, the listening and learning as well as the studying and discussing—and we often attempt to start as teachers. It might be much more productive if, instead of attempting to teach our friends from Africa, we were to give them and ourselves the time and resources to learn and study. I hope therefore that this meeting will be a joint study period and that some of us will listen and learn.

Although I recognize that our knowledge of the natural and social conditions in most African countries is limited, I will attempt to identify five areas that will be important to the people of the twenty-first century, as they are the ones who will benefit from the results of agricultural research begun in the next few years. These are basically areas in which research results are a pre-condition for improvement and advancement in the entire continent. However, the order or relative importance of each might differ from country to country, depending on existing conditions on this very heterogeneous continent.

The first research priority is linked to traditional farming systems and husbandry, to traditional farming and animal management practices. These must be improved in all parts of the continent not only to sustain but also to increase food production and productivity of resources used in agriculture, to ensure long-term food security wherever possible, and to raise incomes in rural areas. Special emphasis must be placed on rangelands on the one hand and traditional crops on the other. In nearly all countries, land and labor productivity must be increased since reserves of high potential land are limited and labor is becoming scarce in many rural areas; it does not always meet peak, seasonal requirements.

The second research priority is export and cash crops. Many countries have no other way of earning foreign exchange, which is badly needed for any economic development and for the repayment of foreign debts, mainly to the traditional donors. Export and cash crops, their production and processing, must also keep people in the rural areas because urbanization will be a major, if not the major problem, in the year 2010. By then about 50% of all Africa's people (i.e., approximately 500 million), will be living in urban centers, many of them in very large cities.
The third research priority is energy, as solutions need to be found to meet the requirements of rural areas. At present, 450 million people in Africa burn about 300 million cubic meters of firewood each year. Consider, for example, that the total forest area in the Federal Republic of Germany is estimated to contain just over one billion cubic meters of wood, and that the African burn more than all the trees in this country in less than three-and-a-half years. In the tropical forest areas of Africa, biomass can be produced to meet the demand for energy. For the dry areas, other possibilities have to be found. About 50 million Africans today lack the energy they require. The search for energy is the reason that the capacity to produce food has been destroyed in some of the very dry areas. In rural areas up to one-third of the available labor, and in the cities up to one-third of the income, goes toward collecting or buying energy. Consequently, this labor is not available as an input to increasing agricultural production, and part of the possible cash income is not available to purchase agricultural commodities, to stimulate further production, and to eradicate hunger and poverty.

The fourth research priority is soil and water conservation. In recent times a man and his domesticated animals have interfered in an age-old biological balance and are responsible for the loss of soil and water. This process is irreversible in some areas and must be stopped in others. Research is needed to find ways to conserve valuable soil and water resources, to optimize production using marginal land and water, to prevent salinity from increasing further, and to stop large-scale desertification so that future generations will find water for man and animals and can cultivate the land that our ancestors farmed and that we still occupy. In Africa, this work--like some other tasks--involves not only applied research, but also some basic research.

The fifth research priority is plant and animal conservation. The need for long-term production sustainability requires that we conserve our plant and animal heritage. Collection and conservation of genetic material must be given high priority before any more such material is lost. These efforts should cover all types of plants and animals, including wildlife.

This meeting is not the right place to summarize previous work and the achievements or failures of FAO or other donors in their efforts to assist research in Africa, nor should we discuss the past activities of the four International Agricultural Research Institutes located in Africa and belonging to the CGIAR system--namely, ILCA, ILRAD, IITA, and WARDA. On the contrary, we must attempt to look forward. The future is challenging and without doubt will depend to a large extent on the results from agricultural research. Only the future will show whether we were willing and able to meet the challenges that await us.

The first challenge is to train more African researchers. Research must be given a high priority, and researchers must be recognized within society as having a special social status, with adequate terms and conditions of service.
Second, additional research institutes must be created. Others must be further expanded and, if necessary, supported with foreign aid. They must be guaranteed support and must receive long-term commitments for the necessary resources to meet recurrent expenditure as well as capital investment.

Third, research priorities in Africa must be established by African themselves,—for international, regional and national research activities—. The beneficiaries, the farmers, must be involved in this process.

Finally, most countries cannot afford to cover all aspects of agricultural research in their own institutes; therefore regional or subregional cooperation and coordination is required.

The generations to come will regard these challenges as the responsibilities of our generation, which we as decisionmakers had to face at the end of the twentieth century and which we succeeded or failed to meet. I appeal especially to those donors who have first-class research and training institutes, who have valuable research results and technologies and who have financial resources and technical expertise to accept the responsibility by sharing these resources with the less fortunate.

In conclusion, FAO as an intergovernmental institution, stands ready with considerable technical expertise and experience to assist its member countries, upon request, in strengthening national, regional, or international research systems; relevant institutes; or organizations in Africa. FAO together with bilateral donors and multilateral donor institutions will also continue to listen, learn, study and discuss. This approach will help us meet these challenges and discharge our joint reasonability.

Our thanks to the World Bank the Federal Ministry of Technical Cooperation, and to DSE for having organized the meeting and inviting us to Feldafing. It is now up to all of us to make the meeting a success and not just another meeting.
THE PRESENT STATUS OF
AGRICULTURAL RESEARCH IN SUB-SAHARAN AFRICA
It is very difficult to summarize the status of agricultural research in West Africa for a variety of reasons. To begin with, the environments in which the research is designed and carried out vary greatly in all respects -- historical, political, socioeconomic, and ecological. Furthermore, the national research systems range from the embryonic to semideveloped (as in the Côte d'Ivoire, Cameroon, and Senegal, with which I am somewhat familiar). As a result, each country must be viewed separately.

Generally speaking, however, it can be said that, despite recent efforts by national agencies (as well as by international research institutions) to promote agricultural research and substantial investment in the sector, the vast majority of West African countries have not been able to benefit fully from the enormous wealth of scientific knowledge in agriculture or to introduce cropping innovations that could help resolve the structural crisis in agriculture. Several key reasons are usually given to explain this poor performance,

Before discussing those reasons, I should like to review the factors that have affected the design, implementation, and development of agricultural research for more than half a century.

The first point to consider is that the scientific problems facing both agricultural research and agriculture in Africa, particularly West Africa are multidimensional and unusually complex compared to those of other regions of the world. The soils and climate are highly diverse and create numerous problems, crop disease and pests are common everywhere, and agrarian systems are extremely variable and fragile, with a tendency for the ecosystems to deteriorate.

The second point to note is that these problems are exacerbated by the fragmentation of land and its resources (there are some 20 countries and as many national research systems). Another problem in most countries is administrative fragmentation in the rural areas, with regard to agriculture, stockraising, water, forestry, and fishing, which should however, be treated as a unit; as a result, research has become fragmented (because it is conducted separately on agriculture, stockraising, water, forestry, and fishing).
A third significant factor is the lack of a solid tradition of research and education (especially in agriculture). Two decades after independence, the countries of the region still lack the conditions required for the emergence of viable research systems.

A fourth and related factor is the lack of genuine and effective political commitment to research. One of the reasons perceived in many countries is the absence of a top-notch, unified, and cohesive community at the political, administrative, and scientific level who are convinced of the critical role of research in development, having a clear vision of what should be the most appropriate policy for the country’s research system, and capable of effectively regulating the development of the system (structure, strategy, and resources) by participating in policy formulation, promoting public efforts, garnering foreign aid, and promoting the linkages between agricultural research and national and international development concerns.

Against this backdrop, consider now the experience of the 1970s. In West Africa, the 1970’s marked a break between the exogenous research systems of the pre- and post-independence periods and the emergence of national research systems.

In the pre-1970 period, several negative factors were at work:

- Agricultural research was designed and carried out by foreign research institutes.
- The planning and coordination of research at the national level were not organized.
- Research programs were seriously biased with regard to priorities as well as crops, approaches, and project areas.
- Research was largely concentrated at experimental stations and aimed at modernizing agriculture (animal and crop production) through the introduction of production systems favoring monetary inputs. The constraints on traditional agriculture and the adoption of new techniques by small farmers were not sufficiently taken into account.
- In the French-speaking regions, research, development, and education were made separate functions, and thus it became difficult to disseminate and implement the findings of research.
- None of the countries put much effort into developing human resources in sufficient quality or quantity.

Nevertheless, the pre-1970 period saw the establishment of national research structures (in Senegal, Côte d'Ivoire, Guinea, Nigeria, Ghana, and Sierra Leone), at least in terms of infrastructure and the acquisition of know-how and basic techniques in certain disciplines such as
veterinary medicine, soil science, and rural geography. Specific crops such as cotton, groundnuts, and oil palm benefitted from significant improvements in technical know-how.

After the 1970's, drought, a world economic crisis, and mobilization of the international community were decisive factors in making the countries more aware of the need to establish their own research structures. However, in the absence of certain necessary preconditions and a supportive policy framework, these efforts made little headway. Moreover, a number of constraints persisted, including the continued fragmentation of agricultural research, for example, in Mali, Côte d'Ivoire, and Nigeria. The continued separation of research, education, and rural extension was particularly serious in the French-speaking countries. Some countries had no research policy to speak of for the sciences. Another weak point was the inadequacy and instability of national support, particularly at the financial and institutional levels. Because the investments in human resources were also low, researchers tended to be inexperienced and there was an extremely high turnover within the institutes. Despite a substantial increase in foreign aid, it posed -- and still poses -- a number of problems for the national research systems. For example, foreign aid has been fragmented and of short duration (as opposed to long-term partnerships between the donors and beneficiary countries).

As already mentioned, another problem has been the high turnover of technical assistants, who are often inexperienced. All too frequently certain donors unduly influence the choice of structures and strategies. Regional linkages with national research centers and national linkages with international research centers and institutes are weak. In addition, international research institutes are needed to work on technological innovation that would stimulate countries to develop their national research systems. Where support by donor governments, has been effective there have been positive factors:

- substantial investment in human resources;
- the establishment of quality research infrastructure;
- better organization of research structures and units resulting from an integrated approach;
- improvement in the capacity to plan the development of the institutes and to program their activities in response to the needs of their agricultural sectors (Cameroon, Côte d'Ivoire, and particularly Senegal are good examples of this).

We have learned from the Senegalese experience that broad-based and rapid changes in our systems largely exceed the capacity for absorption and implementation. However, a plus at the subregional level is the fact that the countries have a point of departure for building a research
structure tailored to their particular circumstances. Outside research assistance should also be accepted and taken into account in this respect.

What lessons can be drawn from this difficult subregional experience accumulated in the last 25 years along with the more successful experience in other regions of the continent (in particular, Zimbabwe) and other countries facing similar constraints (in particular, India and Brazil)? What measures can and should be taken?

An important starting point would be to conduct an overall review of the countries and donors to determine whether there is political commitment at the highest level for building a permanent research national capacity, which is a vital precondition. In addition,

- All countries should have a research structure based on the nature of the population and agricultural activities that are prevalent rather than merely on size.
- Given the economic condition of the region, especially in the Sahelian countries, a unified research system is needed to integrate all sectors (farming, stockraising, and forestry) in a manner consistent with the unique nature of the rural sector and the multiple activities of agriculture in the region.
- If research is to be more effective, it must be taken into account in the formulation of rural development policy. This calls for close interaction between scientists and decisionmakers.
- Each country must establish linkages between development and research policies so that strategic decisions can be made regarding its research institutions.
- Countries need to increase and stabilize funding if they hope to foster successful subregional cooperation. Specifically, they should focus on the institutional and pragmatic strengthening of linkages between research, development, and education.
- Certain countries should also adopt policies that will promote the establishment of a stable, competent, and motivated body of researchers, technicians, and managers.

The international community, especially the donors, must make a long-term commitment to both the human and financial resource dimensions of national research systems. To this end, there must be consistency within each country and among the donors. The donors must also press for greater consistency in the funds contributed to research and other purposes. Without the assistance of the international community this African subregion will be unable to bring about effective subregional cooperation.
For the international agricultural research centers, the persistent conflict between the pursuit of innovation and the real development of a national research capacity must be resolved. Greater attention should be paid to promoting subregional cooperation through these international centers, especially through their work in appropriate technology. They should also become more active in training in order to strengthen the national research centers.

I had several ideas about the Sahelian subregion in West Africa regarding the technical challenges for the future, promises, and issues that could be usefully discussed in the days ahead. This may prompt enlightening contributions about other subregions in West Africa. For the Sahel, the following factors should be examined in order to rehabilitate the agricultural sector to increase farmer income:

- It is absolutely vital to strengthen systematic research because of its role in fostering an understanding of the environment and management of natural resources, which has always been overlooked in this subregion.

- Studies on irrigated crop intensification should be strengthened, particularly in the following areas: grain crops and horticulture; irrigation and community water management; and linkages between farming, stockraising, and forestry.

- More effort should be put into studying and developing techniques to stabilize and rehabilitate ecosystems that have deteriorated or are deteriorating under rainfed conditions.

This requires a sectoral inter-disciplinary approach with agro-forestry as the cornerstone, along with a concern for conservation and soil rehabilitation. There are also clear needs as regards the agricultural policy and development strategy for this region.

I hope that these random thoughts may be of some use.
THE CASE OF EASTERN AND SOUTHERN AFRICA

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Describing the position of agricultural research in Sub-Saharan Africa is not easy, but since some of the groundwork has already been done in last December's Cotonou and Nairobi meetings, and also by previous speakers, my task will be a little less difficult.

First, we should consider agriculture as a whole, so that the situation with regard to research will be better understood. The form of the activity that has predominated--and still does so in certain countries in the region--is subsistence farming, with few inputs used to increase production. Even though eastern and southern Africa have succeeded in feeding their population despite periods of food scarcity caused by droughts, this was not done by raising productivity, but by increasing the area of land under cultivation. In spite of all efforts, yields are constantly declining instead of increasing.

What has research done to improve the situation? During the colonial period, research concentrated on export crops, and little work was done on food crops, with a few exceptions such as rice, maize, and cassava. After independence, African governments faced a wide range of problems relating to industry, urban development, and the organization of social services and administrative structures, and did not devote the necessary time to agriculture, even though it is the foundation of our economies.

Unusually severe droughts in the Sahel, irregular rainfall in eastern and southern Africa, and the many other natural catastrophes that have afflicted the continent have all captured the attention of the African countries themselves as well as the international community. To these natural disasters must be added the specter of hunger caused by the growing imbalance between food production and population growth, since the rate of increase of output has remained lower than the rate of population increase.

In the 1970s, therefore, political leaders began to address the problems of agriculture, and of agricultural research in particular, because they were convinced that research could provide new technologies for increasing food productivity and raising the standard of living of the people. In spite of the efforts devoted to agricultural research over the last 20 years, the situation is deteriorating instead of improving. Yields are constantly declining, and an unprecedentedly cruel poverty is invading the rural areas. The following factors have contributed to this situation:

1. **Poorly conceived objectives:** In most cases either research objectives do not correspond to national objectives, or national
objectives cannot be reflected in research programs for developing technologies that would solve the farmers' problems. Consequently, research work has not been carried through to on-farm trials, or else the technologies developed have not matched the farmers' socioeconomic needs.

2. Inadequately trained research personnel and understaffed facilities: If positive results are to be obtained, a certain critical number of research specialists must be available to work on interdisciplinary studies. However, we are a long way from reaching this critical number, and not all the researchers now active have a high enough standard of training to enable them to design programs and thoroughly execute them. To compensate for this shortage, certain research organizations are obliged to use young expatriate researchers, but these lack the necessary experience. Research specialists who possess such experience remain in their own countries or work in international organizations and are therefore not available to work permanently in our countries. This problem is made worse by a shortage of support personnel and maintenance technicians.

3. The failure to coordinate research in rural and agricultural development projects: In most African countries many development projects have a research component. Unfortunately, these components are not coordinated at the national level, often depend on the involvement of expatriate personnel, are consequently excessively expensive, and come to a standstill as soon as the expatriates leave or when project financing is no longer provided (i.e., before the research programs have produced concrete results).

4. Inadequate equipment: Available laboratory equipment is obsolete, or else the various pieces of apparatus that have to be used together are of different makes, because they are financed from different sources. This makes maintenance difficult.

5. Limited financial resources: Agricultural research has not received the hoped-for funding because political leaders have not been able to see any immediate return on investment in research. It must also be emphasized that the researchers themselves have not made an effort to influence decisionmakers by implementing short- and medium-term programs as means of demonstrating the profitability of research, while simultaneously undertaking long-term projects. In certain cases, financing has not been released in time to carry out trials or provide the necessary maintenance.

6. The lack of institutional links: Many research programs are dispersed among different ministries without any coordinating mechanisms having been established. Even when coordination is provided for at the national level, supervisory responsibility is
frequently switched from one ministry to another. As a result, programs are not executed according to plan, and research and extension are not always properly linked.

7. The lack of socioeconomic studies: Emphasis has been placed on studies leading to genetic improvement, but the need to study the socioeconomic constraints affecting the target areas has been neglected. Consequently, certain technologies developed in research centers have been rejected, either because they were no more productive than traditional methods, or because the technological package supplied to the farmers was not sufficiently complete to enable them to achieve their potential output.

I could go on with this list, but that is unnecessary. The important point is that we must look to the future and see what should be done in agricultural research and determine the preconditions for success. Foremost is the need for a properly structured national research system that is capable of introducing, selecting, developing, and adapting technologies for the various agroclimatic areas. Therefore, national systems must be strengthened. The prerequisites for this strengthening are as follows:

- All research organizations must be integrated at national level.
- All human and financial resources must be mobilized.
- Active links must be established between research, extension, and the farmers.

Attempts are now being made to restructure the research system in eastern and southern Africa, so I will confine myself to the last two points.

Human Resources

In 1985, scientific research personnel in eastern and southern Africa consisted of 2,538 research specialists and 2,895 technicians. These totals are clearly inadequate. According to an August 1986 World Bank consultants' report by Burton E. Swanson and Wade H. Reeves, the totals should have been 15,500 scientists in 1986, rising to 22,600 in the year 2000, assuming an investment in research equivalent to 1% of agricultural GDP. We do not even come close to this figure. Thus far, only six countries in the region (Botswana, Kenya, Malawi, Seychelles, Zambia, and Zimbabwe) invest slightly more than 0.1% of agricultural GDP, topped by Mauritius, which leads the way with 0.40%. The remaining countries fall short by a considerable extent.

The World Bank calculates that 440 scientists and 844 technicians must be trained annually until the year 2000 to reach a total of 6,576 scientists and 12,651 technicians; the annual cost of training would be
US$27.5 million. This figure should be kept in mind, because agricultural research in individual countries will produce results only if a certain minimum number of research and support personnel can be provided. Therefore, an effort must be made at the national and international level to train these personnel. As far as possible, this training should be provided within the region, so that research specialists completing their higher education will not be taken out of their environment and will be able to conduct research on subjects of direct importance.

In order to increase the capacity for research, professors from universities and other institutions of higher education should be integrated into agricultural research. Currently, African universities possess highly qualified faculty, but unfortunately they seldom participate in this area of research. Their teaching would be improved if it were based on work carried out in cooperation with research institutes, the advantage being that their teaching would have a practical dimension. In addition, the links between higher education and the research institutes would be strengthened.

Because so much is invested in promoting the work of research specialists, it must be made to produce a return. This can be achieved only if those specialists are granted a professional status clearly defining their working conditions and the advantages to be derived from research work. Thus, if conditions were made favorable, research specialists would not be tempted to give up their posts for better-paid positions elsewhere. Some countries—although very few—have already established a professional status for research specialists. Those countries that have not yet done so should produce one as soon as possible, so that research specialists will feel encouraged, and will be more productive.

To increase the creativity of research specialists, a special fund should be established to provide an annual award for the best research work having a real impact on development. In Rwanda, such a fund already exists. It is called the Habyarimana Fund, and is financed with a US$120,000 annual budget appropriation. Private citizens may also contribute. A committee selects the best examples of research work and chooses the annual winners.

The benefits of research must be disseminated among farmers, who are the main beneficiaries. Consequently, the links between research and extension must be strengthened. Research must provide the extension services with the information to be disseminated, and this material must be reliable enough to be accepted and simple enough to be understood and used, and must also demonstrate to the farmers the economic advantages that it offers. In return, the extension services must furnish research specialists with all data resulting from the introduction of new technologies into rural areas, and relay to them the views of the farmers.

Every research institute should, therefore, include an efficient service for disseminating findings, specialized scientific publications,
and technical messages for extension agents. The institutes should also organize study days for extension agents, in order to introduce them to the new technologies that are to be disseminated. This would also provide the agents with an opportunity to present useful suggestions to the researchers. The agents could participate in the diagnostic surveys used by the research specialists for identifying constraints, and also in field trials of the adaptability and acceptability of technologies. Thus, the researchers would cooperate closely with the extension agents during the pre-extension phase and in the various contacts between research specialists and farmers.

As we have seen, agricultural development has been slow, and in certain countries has not responded to the ever-increasing food needs of the population. The rate of population growth has always exceeded the rate of increase of agricultural output. In order to achieve food security, this trend must be reversed, with harvests being doubled or, if possible, tripled, because even if action is taken on population growth the effects will not be felt for another 15 or 20 years, by which time the population will probably have doubled.

Because land in certain countries is becoming a rare resource, agricultural research must concentrate on productivity per unit of area, developing technologies that make optimum use of biological and chemical inputs and mastering irrigation techniques so as not to be exclusively dependent on rainfall. By increasing the productivity of family farms, a tradable surplus can easily be generated, which would thus provide agriculture with some revenue.

In the past, research has been concerned much more with export crops than food crops. Although investment in export crops has been very large, the area devoted to them has been kept within reasonable bounds.

It has been proved that poverty is one of the major causes of lack of food security in households that cannot produce enough or earn sufficient money to afford food easily. That is why overcoming poverty in rural areas must be one of our objectives. If this is to be achieved, support must be provided in the form of research on cash and export crops, which both increase family income and save foreign exchange for governments.

The international prices for our export goods (such as coffee, cocoa, tea, and cotton) have been falling, and the chances of recovery are uncertain. Consequently, there is no longer any justification for increasing the areas devoted to these crops, and research must concern itself once again with increasing productivity as a means of lowering production costs and improving the quality of our products so that they can remain competitive. Although quality must remain a prime concern, some goods face strong competition from synthetic products. An obvious example is pyrethrum. For almost four years, Kenya, Tanzania, and Rwanda have no longer been able to export pyrethrins because synthetic pyrethroids have flooded the market and are selling at extremely low prices. Research must
therefore identify other products for diversifying exports and providing
governments with permanent inflows of foreign exchange.

Research on import substitute crops must also be carried out,
notably on rice, wheat, sugar, and barley. It is unfortunate that
countries in the region that were once rice exporters must now be
importers, even though they possess all the necessary output capacity.

With respect to wheat, we do not share the same agroclimatic
conditions for producing it as the developed countries. A rapid
calculation would probably show that production costs in Africa are higher
than import costs (i.e., taking into account climate, soil, and the low
rate of input use). However, is it really necessary to eat bread, both in
town and country? Is it wise to accustom people to eat the sort of food
that they can never grow for themselves, simply because food aid is
available? Do we really have to drink beer made with barley? I believe
that there is scope for developing those grain crops that are best suited
to our countries, because that will enable governments to save foreign
exchange and provide work for more people.

Food security is intimately related to storage capacity. There
is evidence that at least 15% to 20% of crops harvested are lost because of
inadequate storage. If we add to this the losses caused by diseases and
pests during the growing season, farmers lose more than 40% of their
production potential.

Agricultural research should therefore develop disease- and
pest-resistant varieties, together with effective methods of integrated
control. Support for these measures could be provided by issuing an
African charter for the protection of plants and animals, whereby
governments would individually and jointly take the necessary steps to
eradicate diseases and pests. Each country should be urged to introduce
strict legislation on phytosanitary control. At the same time, research
specialists should develop simple technologies that would enable farmers to
store their output at low cost, thus making it unnecessary for them to sell
off their entire output immediately after the harvest, often at extremely
low prices, and to have to buy back the same products later at exorbitant
prices. Cooperatives and other organizations for collecting and
distributing foodstuffs should be provided with larger storage facilities.
These facilities should be built throughout the country, so that long
distances would not have to be traveled at distribution times. In
addition, the technology used should be kept simple, in contrast to storage
facilities that are offered by some unscrupulous firms and that break down
the day after they are put into use. Increased storage capacity would
assure farmers of a permanent supply of food, and would enable countries to
reduce their food imports.

Processing also helps to improve methods of food conservation.
Unfortunately, very little research has been done on food technology, so
that large quantities of vegetables, fruits, and dairy products are lost
because the total output cannot be consumed while it is fresh.
Consequently, research institutes should give serious attention to this problem so that we will no longer have to import canned varieties of the food we produce ourselves.

I would like to touch on the problems associated with the high tropical plateau lands. These problems are numerous and I will not be able to deal with all of them. I will confine myself to those that affect the environment.

The high tropical plateau lands are characterized by their altitude, adequate rainfall, agreeable temperatures, poor to moderately fertile soils, and steep slopes. Most of high plateaus are located in eastern and southern Africa, and have a very high population density with a growth rate upward of 3%. This means that the populations of certain countries will double over the next 15 years. In an effort to meet its food needs, the population places great pressure on natural resources. Where demographic pressure is high, people practice a form of agriculture that excludes fallowing and do not use manure, and thus reduce soil fertility. Others search for new land and are forced to settle on marginal areas with very fragile soil and thus contribute to erosion. Consequently, pastures have been turned into marginal farming land.

The growing need for construction timber and fuelwood is contributing to the gradual deforestation of large areas. This practice creates imbalances in already fragile ecosystems, seriously threatens river basins, and often causes the groundwater table to fall and springs to dry up. Once the plant cover is lost, the soil is subject to erosion. Where the wood shortage is very acute, people use crop byproducts and dung cakes, thus depriving the soil of much of the organic matter and minerals that could help crops to grow.

Research should also be concentrated on soil and water conservation, improvements in soil fertility through a judicious integration of stock raising and agriculture, and appropriate agroforestry methods. Reforestation programs should be launched to reduce the pressure on natural forests and to protect the most vulnerable areas.

International cooperation is crucial to the implementation of various programs. Donors and IARCs should play a decisive role in strengthening national research systems by preparing medium- and long-term research master plans, by providing research and by carrying out certain research programs. They must avoid any uncoordinated action and financing programs that do not properly address the problems of the various countries, or that create large imbalances within the various national systems. The management of research projects financed by the donors or by the IARCs should involve national leaders, so that they can monitor execution and participate in the selection of investment objectives.

Certain donors make commitments for comparatively short periods. However, research work must be sustained over at least 10 years.
IARCs actively participate in the advanced training of research specialists and provide national centers with high-quality genetic material. However, they should coordinate their activities and be more concerned with strengthening national systems than with their own programs, which are otherwise likely to monopolize all available resources, at the expense of national organizations.

The points I have covered—the relevance and importance of past, present, and future research programs; meeting the need for research personnel, and the incentives that should be provided; the links between research and agricultural extension; the technical challenges to research arising from the increasing demand for land and the need to diversify cash and export crops; and the problems of the high tropical plateau lands, increased storage and processing capacity, and, finally, relations with aid donors and international research institutions—are too complex to be examined thoroughly in such a short time. I therefore do not claim to have exhausted the subject, and I hope that the aspects of the question which have not been dealt with can be discussed in the various working groups.
SOME OBSERVATIONS ON AGRICULTURAL RESEARCH IN THE SAHEL

Mahamane Brah

Executive Secretary, Permanent Interstate Committee for Drought Control in the Sahel (CILSS)

Since 1968 the Sahelian region has been experiencing a dry period marked by a general decline in rainfall, two successive very dry years (1972 and 1973), irregular rainfall since 1974, more or less normal years alternating with dry years, two successive years with very poor rainfall (1983 and 1984) of which 1983 was worse than 1972, two years of relatively good rainfall (1985 and 1986), followed by a dry year (1987). During this 20-year period there has also been a rise in the region’s food dependence. The figures for grain imports (commercial plus food aid) are most revealing, as shown in the following table.

<table>
<thead>
<tr>
<th>Years</th>
<th>Grain imports</th>
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<tbody>
<tr>
<td>Early 1960s</td>
<td>200,000 t</td>
</tr>
<tr>
<td>Average for 1970-71</td>
<td>540,000 t</td>
</tr>
<tr>
<td>1974 (acute drought in 1973)</td>
<td>1,060,000 t</td>
</tr>
<tr>
<td>Average for 1975-76</td>
<td>660,000 t</td>
</tr>
<tr>
<td>Average for 1977-79</td>
<td>800,000 t</td>
</tr>
<tr>
<td>1982</td>
<td>1,180,000 t</td>
</tr>
<tr>
<td>1983</td>
<td>1,230,000 t</td>
</tr>
<tr>
<td>1984 (acute drought in 1983)</td>
<td>1,730,000 t</td>
</tr>
<tr>
<td>1985 (acute drought in 1984)</td>
<td>1,640,000 t</td>
</tr>
<tr>
<td>1986</td>
<td>925,000 t</td>
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Not only do these figures point to the region’s vulnerability to climatic variations and the increase in its dependence on food imports, but they also indicate that production is not keeping pace with the growing needs of the region, (which are mounting with the high rate of demographic growth). They also indicate that production is not keeping up with the needs of the urban populations (which are consuming more rice and wheat, yet the Sahel produces only 50% of its rice requirements and 10% as regards wheat, so that whether it is a good or bad year we still have to import over 650,000 tons of these grains), and that the Sahelian countries no longer have the means to pay for the imports needed.

The pattern of foodcrop production is largely due to the persistence of traditional extensive production systems. These systems are very vulnerable to drought and use up the limited amount of arable land that is available. In other words, they cannot be characterized as productive. They have not adapted in either quantity or quality to the needs of a population that has doubled over 25 years (from 18 million in 1960 to 36 million in 1985) and of an urban population that has increased...
more than fivefold over the same period (from 1.3 million in 1960 to 7 million in 1985).

The picture with regard to the pastoral production system is very similar. For example the data for livestock reflect a rapid increase in herd numbers up to the acute drought of 1972, owing to a combination of favorable factors, notably the control of epizootics and the opening of new watering points, which rendered previously unused pastures accessible and led to overgrazing. This was followed by a sharp decline in 1973 (loss of over one-third of stock), more because of lack of pasture than lack of water; a reconstitution after 1973; and another sharp decline in 1983 and 1984 (losses were of the same order as in 1973). In other words, the Sahel’s stagnant pastoral production systems coupled with the policies followed to date, have caused Sahelian stockraising to fluctuate greatly.

All the current production systems are affected by phenomena in the Sahelian environment that reflect the destruction of the ecological balance: pasture deterioration, decline in soil fertility, and the disappearance of forest.

Sahelian agriculture is no longer able to meet the needs of its steadily growing population. It cannot safeguard against malnutrition and the consequences that flow from it. This situation is largely due to persisting unfavorable climatic conditions, misguided national development policies, rapid population growth (2.8%), increasing migration into the towns to the detriment of the active rural population, archaic cultivation practices, and tradition-bound production systems based on centuries-old techniques, all of which point to one inevitable outcome.

It has been claimed that population pressure spurs technological progress. This presumes that the agriculture being practiced is based on agricultural research aimed at improving and/or maintaining the productive capacity of the land and enhancing yields by appropriate techniques (improved seed, rational fertilizer use, and technology compatible with the farmers’ means). Unfortunately, this is not the case in the Sahelian countries, where the specter of famine is far from being exorcised. Despite the fact that a certain number of research findings have been incorporated and new agricultural policies implemented, the dominant characteristics of Sahelian agriculture remain unchanged, even though rainfall has been relatively good these last two years.

It is not my purpose to make an inventory of agricultural research in Sub-Saharan Africa, a job that has already been done extremely well by others, but rather to record the modest regional contribution represented by the CILSS toward instituting operational and effective agricultural research (in the broad sense) in the Sahelian context. It is hoped that such research will serve as support for an already weakened Sahelian agriculture, so that the obstacles Sahelians face in their quest for food self-sufficiency and their struggle against drought and desertification can be overcome.
Sahelian Agriculture and Present Level of Research

I have already noted that by and large, Sahelian agriculture still employs traditional methods, particularly in the foodcrop sector. This situation has evolved from the colonial development strategies, which emphasized cash crops (cotton, groundnuts) to the detriment of foodcrops and therefore focused all their research and development programs on the former. This trend has unfortunately continued to this day, albeit to a lesser extent. Thus, for the past 25 years, the Sahelian countries have given little priority to investments in research on local foodcrops (millet, sorghum, maize, cowpeas, tubers, and legumes), or forestry, a sector in which financial return was not so evident. It is noteworthy that cotton production reached a record level in 1983, a year of acute drought. The exceptional development of cotton production demonstrates that the Sahelian farmer is not hopelessly set in his ways, but can expand his output surprisingly quickly: at a rate of over 11% per annum up to 1979 and 3% thereafter. The war in Chad and the deterioration of the terms of trade explain the shrinkage in the area under cotton, although this very shrinkage has not prevented yields from rising further.

Agricultural research can only serve as a primary instrument for development in the wider sense if it is backed by structures that will enable it to deal with the problems connected with the increasing agricultural production and population growth, two of the Sahelian region's major concerns.

The agricultural research structures in the Sahelian subregions are characterized by:

- structural inadequacy;
- a low level of practical application of research findings, notwithstanding the significant amount of knowledge built up by national, regional, and international organizations;
- lack of coordination among the activities and programs of the national research institutions, the result being duplications, owing to the very limited possibilities for communication between these institutions and those of a regional or international nature;
- poor integration of research with extension programs and the overall grain plan policies, in particular price incentives, marketing, and optimum utilization of investments (labor, inputs); and
- lack of financial resources, which prevents research efforts from expanding.

Nevertheless, much of what has been learned could now be put into practice by means of various programs, which could be ranked according to
the time needed for their implementation, the priority assigned them, or the means required:

- In the short term, a large amount of knowledge could be transferred to the Sahelian farmers and development workers if it was simply organized into a usable form. Of course, it would have to be coupled with technology transfer (improved seed, fertilizer use, cultivation practices, etc.).

- In a number of areas in which a considerable quantity of more or less recent data are available, but dispersed over various sources, these would have to be compiled and codified to ensure that they would be used efficiently and would contribute more effectively than at present to the development of techniques.

Innovations can be introduced either by applying the findings of research conducted elsewhere or by using data obtained locally but needing limited trials for adaptation or refinement purposes, or else by means of techniques that are well known but whose application would require some measure of perseverance if the global objectives of food self-sufficiency are to be achieved between now and the year 2010. However, some needs can only be met by means of specific long-term research programs.

The foregoing demonstrates the complexity of the problem and also serves to underscore the work that has already been done to learn more about the Sahelian environment, its potential, and the possibilities for bringing about progress.

Despite what has been accomplished to date, a considerable amount of research still remains to be done, particularly with respect to new or insufficiently adapted practices, fuller utilization of existing data, the application of knowledge already available, and perseverance with programs that have not yet reached the stage of producing usable results or that need to be reactivated. The task of compiling, analyzing, and disseminating these findings—which presents some problems for the national organizations—could be assigned to a subregional structure.

Quantitative and Qualitative Research Needs: Priority Issues

Research on Production Systems. Comprehensive research on production systems is greatly needed. This means taking into consideration complex sets of environmental factors and other circumstances. Its importance and priority need no emphasizing, because implementation and the adoption of technologies by the farmers remain the weak link in the production chain. This research must be multidisciplinary and designed to solve the problems encountered by farmers in the production process.

Specific Sociodemographic and Economic Research on Migratory Movements (Population, Health, Development, etc.). This research requires special attention. It has been clearly established that the social
factors, more than the technical factors, are primarily responsible for the failure of the policies applied in the different development sectors.

The CILSS has accordingly formulated a new strategy centered on three key aspects: man, the economy, and ecology and land. The object is to restore man to his motor role in development while paying sufficient attention to the social framework that is a prerequisite for any change in Sahelian production systems.

Research on Crop production, with Special Emphasis on Millet, Sorghum, Maize, Cowpeas, and Tubers. The decline in rainfall and the irregularity of the rains with respect to both when and where they come greatly affect crop production. In view of these constantly shifting conditions, which reduce the growing season and limit the crops that can be grown while also aggravating the risks to the farmers, research ought to focus on finding formulas that will offer the farmers a selection of strategies. They can then choose the appropriate one, depending on the fluctuations in rainfall, that will enable them to maintain a permanent stock of seed of the different species and varieties.

Multiplication of improved varieties for all these crops must be undertaken without delay. An adequately funded program for the production of better adapted varieties and better quality seed would be of immediate benefit to the farmers. The research objectives should be to devise techniques suited to the varieties raised and to the soils and climates concerned and to rethink cultivation practices followed with irrigated crops in order to obtain better use of the existing systems and facilities. Research on irrigation should be accelerated as it is one of the most effective means of boosting production.

Research on Livestock Production and Integration of Stockraising with Agriculture and Forestry (Agrosylvopastoralism). This sector needs sustained attention as the drought has destroyed extensive areas of pastureland and has exhausted watering points, with the result that 25% of large livestock have been lost and more than 13% of sheep and goats. In addition to traditional research on pathology, breeding, nutrition, milk production, and fattening, special studies should have been undertaken on stockraising systems, and combined studies of cropping, livestock production, and forestry.

Research on Forestry Production, Fauna, and Game Resources. The fact that the Sahel’s forestry resources are seriously imperiled by the drought and by reckless overexploitation points up the pressing need for research and appropriate action to safeguard the tree species and fauna of the region.

Research on Pests and Diseases (Integrated Research). Harvests have been greatly reduced not only by the exceptional drought, but also by the depredations of various pests and diseases. In view of the fragility of the Sahelian ecosystem and the need to maintain it in equilibrium, research on foodcrop and harvest protection should be undertaken on an
integrated basis, focusing on control of migratory pests (locusts, grasshoppers, and seed-eating birds), rodents, and diseases.

Research on Fishfarming. Research is also needed to collect basic data and identify technologies that can be used to enhance fishery production and thus help meet the food needs of the population.

Other Fields of Study. Agrometeorology, soil science, hydrology, and agricultural water supply are other fields in which research needs to be intensified.

Training Needs. In view of the lack of qualified personnel who are capable of planning and carrying out research programs, the Sahel countries will have to pursue and intensify their education and training efforts between now and the year 2000, since there is a need for about 1,720 scientific personnel (see World Bank "Inventory of Agricultural Research in West Africa").

Need for a Subregional Strategy for Research in the Sahel.

Although overall the Sahelian countries have similar soils and climate and similar causes are responsible for the present crisis in agriculture as well as the increasing desertification, the ethnic, physical, and biological parameters are quite different in each country. There is therefore little likelihood that a social organization tied to a particular production system would be completely transferable between countries. Thus a basic requirement of research in the area would be to determine the important parameters to be studied and to define which factors have a constant value under which conditions in order that results can be usefully compared when one or another of the surrounding factors varies. Coordination of research work and the gathering and dissemination of scientific and technical information at the subregional level would be of great benefit to the individual countries in several respects:

(a) Such an approach would ensure that anything potentially useful and usable developed elsewhere would be accessible via an efficient system of gathering, analyzing, and disseminating scientific and technical information among the national, regional, and international research institutions. What is needed at the regional level in particular is a bibliographic information system to which the national, regional, and international research organizations would be linked. The Sahelian countries also need help in setting up their national information systems, and integrating the procedures used in gathering and processing data in order to ensure full compatibility between the national and regional systems.

(b) Research networks set up to work on the foodcrops of the Sahel (millet, sorghum, maize, cowpeas), forestry, agrosylvopastoralism, plant protection, and drought resistance constitute the best method of promoting research in the region,
based on strengthened national institutions. Moreover they would make it possible to regionalize research activities while promoting synergistic work at the level of the national research institutions. To be effective, these networks would have to be integrated with the national organizations but coordinated by a small community team. The advantages of such a system are many: it would not be necessary to establish large-scale structures, yet the states could be involved in the life of these networks, which would ensure better adaptation of the programs to the countries' needs.

(c) Training programs would be rationalized by improving and strengthening the training of rural leaders and managers in the running of their organizations and activities and by training decision-making staff and the development workers in the global approach.

Place and Role of the Sahel Institute (INSAH)

The drought has dramatically revealed the fragility of the Sahelian economies and their vulnerability to climatic conditions. This disaster led the Sahelian states to combine their efforts in order to counter the adverse effects of the drought and desertification. One important step they took was to form the Permanent Inter-State Committee for Drought Control in the Sahel (CILSS) in 1973. Its principal objectives are (a) to coordinate measures to relieve the drought in the Sahelian region and to arouse awareness among the member states and the international community so that they will together take up the challenge posed by drought and desertification; and (b) to mobilize the resources needed to implement the programs identified by the member states.

The magnitude and diversity of the activities that needed to be carried out simultaneously to control drought and desertification prompted the CILSS to set up research and training organizations as of 1975.

INSAH (the Sahel Institute) set up by the CILSS member states in agreement with their partners in the international community is intended to coordinate, harmonize, and administer research programs of regionwide scope. It directs these programs in accordance with the priorities laid down by the CILSS member states.

In its 12 years of existence, INSAH has made a considerable contribution in terms of agronomic research, training, information/documentation, and demographic research on behalf of the member states. In agronomic research, for example, INSAH has helped to establish a Sahelian varietal evaluation network designed to explore as fully as possible the different ecological zones of the Sahel (it has been the means of identifying several varieties of millet, sorghum, maize and cowpea); set up an operational testing network in rural areas; establish a multiplication program for breeder and foundation seeds of the best varieties, selected following multisite tests; obtain direct support for
national research organizations by providing them with a part of the basic equipment needed for on-station research; and establish an integrated pest/disease control system.

INSAH has further contributed to the basic and advanced training of a thousand Sahelians in specialized areas of rural development. Through RESADOC, INSAH has established coordination mechanisms in every CILSS member state and has organized participation in this network of information dissemination organizations specialized in the CILSS's spheres of activity by supplying them with equipment. At the regional level, RESADOC has coordinated data gathering and processing methods and has set up a bank of literature references with nearly 10,000 entries. In addition, sociodemographic research has been carried out (USED-CER-POD) and numerous scientific reports have been published.

Despite these positive accomplishments, the credibility of this specialized institute is very low. In view of the serious crisis situation, the twenty-second session of the CILSS Council of Ministers instructed me that no effort was to be spared to redynamize INSAH, which is viewed as an essential component of the CILSS system. In conjunction with our partner in the international community, a joint ad hoc committee made up of Sahelian and non-Sahelian experts has already been formed with a view to revitalizing INSAH. The aim is to formulate the innovations and reorientations necessary in the institute while defining its internal and external spheres of competence, taking into consideration the environment of subregional, regional, and international research.

Conclusion

The present state of agriculture and agricultural research in the Sahel is such that the facilities for agronomic research are limited and too little effort is made to apply research and development findings or to study how to transfer techniques from the research setting to the farmers' environment. This means that at present it is not possible to have available all the technical, human, and economic resources necessary to bring about comprehensive intensification of agriculture in the Sahel. It is nevertheless true that action on the subregional scale in the Sahel supported by the international community could mean savings for the Sahelian countries and could breathe new life into research by encouraging exchanges of experience among the Sahelian states on the one hand and among Sahelian and non-Sahelian states on the other, and by promoting the dissemination of scientific and technological information.
STRENGTHENING AGRICULTURAL RESEARCH IN SUB-SAHARAN AFRICA
INTRODUCTION

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Mr. Wyss has already provided background on the origins and aims of this meeting, and in so doing has described the steps taken in the World Bank by the staff concerned, in collaboration with colleagues responsible for agricultural research in Africa, whether in the national, regional, or international systems. Before I elaborate on the draft statement on Strengthening Agricultural Research in Sub-Saharan Africa and suggest issues upon which your views would be especially appreciated, I should like to take a few moments to provide a further perspective, as it were.

Much that is in the Bank's paper is not new to those of us concerned with agricultural development. But our familiarity with the subject matter does not make it any less important or less valid; and it may well not be so familiar to those outside of agriculture or research who are responsible for decisions on whether to allocate funds for that purpose, rather than for highways, or primary education, or industrial development, or other important activities. These are the people who clearly need to be convinced of the importance of national agricultural research and to whom the paper is essentially directed.

The essence of the approach proposed is that strengthening agricultural research in Africa, if it is to be sustained and successful, must be a partnership process, and must be seen as such. The donor community, with its scientific capacity and other resources, must be sensitive to African aspirations; we must all understand the difficulties being faced by African governments and their people; and we must always remember that building sustainable national research systems and the indigenous capacity to run them will take a long time.

Experience in countries such as India and Brazil, both more favorably endowed with physical and trained human resources than many in Africa, demonstrates clearly the length of time needed to set effective and sustainable research systems in place. Yet time is running out in Africa. Rapidly increasing populations, deteriorating ecological environments in the absence of sufficiently productive and sustainable farming systems, and generally adverse terms of trade all underscore the need for urgent action. It is hoped that this meeting will provide the fillip needed to facilitate and accelerate the collaborative steps that African governments and the donor community must take to formulate and subsequently implement the planning/institutional/financial/and other measures required to strengthen agricultural research, and thus help resolve these issues in a timely
manner. With these considerations in mind, I should like to take you rapidly through the paper.

First, it is necessary to:
- set the stage;
- emphasize the central role of agriculture in stimulating economic development;
- highlight the importance of developing and applying appropriately tailored technology to the many and diverse ecological and sociocultural needs of the countries of the continent;
- draw attention to the inexorably increasing population pressure on frequently fragile land and water resources; and
- identify the perceived deficiencies in agricultural research in a region comprising, with some notable exceptions, a large number of diverse resource-poor countries.

The paper identifies four principal areas of concern in the existing research situation: priorities, institutions and management, funding, and manpower. It concludes that they can best be tackled by strengthening national agricultural research systems through improved coordination of donor assistance, the development of regional cooperation between national research programs, and the continued active involvement of the international agricultural research centers working at the frontiers of strategic and applied research and in collaboration with regional and national research and training endeavors.

With respect to research priorities (see paragraphs 2.1 through 2.6), the paper notes that much currently available technology has limited relevance to the planning choices imposed by comparative economic advantage and to national economic, social, and political imperatives. Because such choices have a bearing on national macroeconomic and social policy, the paper argues that informed national economic planners should be involved in setting agricultural research priorities and notes the overall importance of promoting greater land productivity and enhanced absorption of labor into productive, agriculture-based employment. Other general priorities are also listed, and although all are thought to be important in varying degrees in different countries, social and economic research is considered an essential complement to technical investigations.

The paper then suggests how agricultural research capability might be strengthened, especially through planning for the short, medium, and long terms. This section (paragraphs 2.7 to 2.16) draws heavily on the experience and publications of a number of institutions, including the International Service for National Agricultural Research (ISNAR), whose director general is attending this meeting, and the Special Program for African Agricultural Research, the SPAAR group's guidelines issued earlier this year and made available to you. Mr. Schurig, the acting chairman of
the SPAAR, will provide background on the other activities of the group later this afternoon.

The paper points out that all countries already have institutions with some research capacity (see paragraphs 2.17 to 2.25), and emphasizes the need to tailor organizational and institutional developments to measures that are shown to be essential and that can be sustained. I should like to draw your attention to the importance of the linkages between researchers, extension workers, and farmers referred to in paragraph 2.19 and explained elsewhere in the paper.

At the two regional workshops in Kenya and Benin referred to earlier, strong support was voiced for the creation of separate, autonomous research institutions that would not have to operate under the constraints of civil service procedures imposed on ministry research departments. Such developments may well be appropriate in certain cases but, the paper argues, national planners must consider specific country conditions in weighing and selecting this and other options, including self-financed commodity research.

In all cases, however, a clear mandate should be defined and the requisite funds earmarked and disbursed to enable the national university community to contribute to the national agricultural research agenda as well as to manpower development in the fields of agricultural and related sciences. Estimates of the resources applied to national agricultural research systems in Sub-Saharan Africa indicate not only apparently significant underfunding on the basis of the conventional norm of 1 to 2 percent of agricultural GDP, but also an inversion of the ratio of funds directed to agricultural research and extension compared to other regions of the world. Although there may be definitional problems, especially in respect of extension expenditures in some countries, available data clearly indicate the need for substantial increases in the volume of funds devoted to agricultural research -- provided of course that such funds are invested in line with rationally conceived plans based on feasible agricultural development priorities.

A central issue that deserves prominence concerns the importance of sustained funding for research. The long-term nature of many research activities argues for the careful selection of priority programs, clear targets, flexibility to adapt to changing circumstances, and sustained commitment by national and external funding agencies. The paper suggests general ways in which planning might be carried out effectively, and indicative factors governing institutional arrangements for the implementation of research plans. It does not suggest specific ways in which this might be attained in what is known to be a difficult area, since most research activities extend beyond the normal tenure of many national decisionmakers within the countries concerned. The situation is compounded by a not dissimilar situation in many external assistance agencies. The anticipated need for heavy and continuing external assistance to African agricultural research over at least the medium term emphasizes the importance of developing mechanisms for ensuring such sustained assistance.
However, with some exceptions, research results in Africa have not produced the type of discernible impact—on production or incomes—that fires the imagination of those responsible for dispensing funds from generally slender public purses having many competing, high-profile and comparatively short-term demands made upon them. In short, in many countries in Africa, national agricultural research activities generally have a credibility problem with decisionmakers responsible for finance and planning. This manifests itself in irregular and/or inadequate funding, which in turn prevents the successful completion of research programs, and so the vicious circle continues.

Given agreement by governments, systematic planning of research, as advocated in the paper, provides the framework into which funding commitments, both internal and external, can be fitted. Fora are required for the process, whether as separate national consultative groups on agricultural research (as suggested by the SPAAR) and also perhaps as advisory bodies to UNDP Round Tables, or similar mechanisms designed to coordinate development assistance to individual countries.

Appropriate phasing of agricultural research plans with a provision for regular review and updating permits the tranching of funding and thereby facilitates commitment by national governments and donors to continuing and coordinated support over a more meaningful time frame than the conventional three- to five-year project period. As far as the World Bank is concerned, this approach has been followed successfully in supporting national agricultural research in countries such as Brazil and India, and there is every reason to believe that it could be pursued more actively in Africa where, indeed, action is proceeding in this direction, as in Senegal.

Notwithstanding the long-term nature of much agricultural research, many opportunities exist for testing and applying knowledge and techniques that have already been developed by agricultural research workers in most countries of Sub-Saharan Africa. In other words, opportunities exist now for farmers to benefit from past investments in agricultural research. Every country and most agro ecological zones have research results or other sources of knowledge that can be formulated into practices that are superior to those being used by much of the farming population. It is imperative that these are identified and pursued concurrently with the longer-term interventions proposed in the main body of the paper.

For this reason paragraph 2.14 of the Bank’s paper makes reference to one approach (outlined in Annex 1 of the paper) that seeks to merge the efforts of researchers with extension staff and farmers to devise simple improvements in production practices that farmers can rapidly adopt. It also argues that such an approach may well provide insights for use in planning longer-term improvements.

As the paper emphasizes strongly, agricultural research in Sub-Saharan Africa is heavily dependent on African scientists. Although
external training at the postgraduate level will continue to be needed for some time to come, means must be found to accelerate and, where necessary, redirect agricultural science teaching in the countries of the continent. The value of the international agricultural research centers in the training field is clearly appreciated by African research managers and scientists, a circumstance that argues for consideration of a larger training role for these institutions.

The possibilities of expanded and more focused twinning between African and developed country institutions concerned with agricultural science teaching and research also deserve close scrutiny on a country by country basis.

In conclusion I draw your attention to the Proposed Actions contained in Chapter III of the paper. This emphasizes the central role of African governments, a role to which their leaders have made clear commitments in such documents as the Lagos Plan of Action and the OAU Declaration on the Economic Situation in Africa. However, these commitments are not likely to go beyond the stage of rhetoric without the support and encouragement of the development community.

Bilateral, regional, and international development agencies have made their various commitments to Africa and many are actively involved in funding national and regional research initiatives. What is needed is further concerted action by national governments and the development community to clearly define their respective roles and thereafter to rationalize their involvement in national and regional agricultural research systems on the basis of soundly conceived research plans, in order to maximize their impact and accelerate the solution of the major problems facing African agriculture now, and in the coming generations.

Although agreement on general principles can be reached in fora such as the OAU, UN, CGIAR, and the SPAAR, concrete action is unlikely until national problems are considered in a national context with the national leaders and decisionmakers directly concerned. It is hoped that this paper will help provide a framework to facilitate such a process.

You will have noted from the program that we are to devote an entire day to group discussions of some of the points raised in the paper. The topics are thought to represent the key issues facing decisionmakers from different institutions, training, and background who are concerned with strengthening national agricultural research systems. These issues pertain to:

- the role of agricultural research in national development strategy;
- technical and research programming;
- financial problems;
education and training;
organization and management; and
regional collaboration, networking, and international agricultural research centers.

The organizers hope that you will all participate fully in these discussions to give us the benefit of your views on the issues raised as you see them as decisionmakers. I should emphasize that the views expressed will not be for attribution -- unless explicitly requested. Rather, they will be used as inputs to the groups' deliberations and findings since they are expected to add to our knowledge of the complex questions we are asking you to consider.

It is hoped that the conclusions and recommendations emanating from these group discussions will strengthen the positions taken, or perhaps cause them to be modified, so that when we go back to our respective managements, we shall be able to state with confidence that the proposed Strategy for Strengthening Agricultural Research in Sub-Saharan Africa indeed has the support of those most actively concerned with this and with the many other related activities involved in promoting sustained development in the continent.
PARTICIPANTS' COMMENTS ON THE INTRODUCTION TO THE WORLD BANK STRATEGY PAPER

Commentary on the World Bank's strategy paper was limited in part because of time constraints and in part because key issues were to be addressed in later working group sessions.

Nevertheless, questions were raised and disappointment was expressed concerning the comparatively limited representation from African planning and finance agencies. Delegates observed that ministers of agriculture or science and technology did not need to be convinced of the priority that should be attached to agricultural research. Ministers of education, being aware of the human resource development aspects and generally beneficial university impact, also tended to be supportive. However, most ministers of finance and planning needed to be convinced of the wisdom of investing public funds in agricultural research. In many instances they appeared to be unaware of the adverse impact of irregular, ill-timed, and inadequate budgetary allocations for improving the efficiency of agricultural research activities. Thus they needed to be educated and the Feldafing meeting would have provided an excellent opportunity.

Two principal reasons were given for the poor showing from those representing finance and planning agencies. First, although many of the African countries represented had been invited to send such officials, a proportion had not recognized the importance of their role as arbiters of funding for national agricultural research activities and were not prepared to have them attend. Second, and perhaps more significant, the meeting was held at the same time that preliminary discussions were taking place in preparation for the annual meetings of the International Monetary Fund and the World Bank, which were to be held in Washington the following week.

The appropriateness of holding the meeting in a developed country was also questioned. However, when attention was drawn to the fact that preliminary meetings had been held in both western and eastern Africa, it was agreed that the site chosen--that is, Feldafing--was entirely appropriate. Participants subsequently expressed their full satisfaction with the choice of venue and the opportunity that the Food and Agricultural Development Center provided them to focus on the issues with minimal distractions.

Attention was drawn to the lack of coordination of donor assistance for agricultural research in the past. The paper's attention to this question was commended, as was the collaborative mode chosen by the World Bank in developing its strategy.
A delegate expressed concern that the paper addressed itself only to the Sub-Saharan region of Africa, and not to the continent as a whole. This division, it was argued, is arbitrary and takes no account of the totality of the continent, nor of the several organizations that have been trying to address the problems of Africa as a whole. World Bank staff responded that the division of Africa into areas north and south of the Sahara could indeed be construed to be arbitrary. However, it was the way in which the Bank, with the agreement of its governance (which consists of its member countries), had chosen to arrange its geographic operations. Further, it was submitted, notwithstanding the heterogeneity of Sub-Saharan African countries, those north of the Sahara are by and large significantly different agro-ecologically and ethno-culturally and thus warrant the administrative alignment chosen. Participants were reminded that the Bank had, in its recent reorganization, merged its Western, and Eastern and Southern Africa regions into a single operational unit headed by one Vice-President. Participants agreed that this realignment would be beneficial in many respects for all parties, not the least in facilitating dialogue on issues of common interest and concern.
STRENGTHENING AGRICULTURAL RESEARCH IN SUB-SAHARAN AFRICA: 
A PROPOSED STRATEGY

Summary

This paper proposes a strategy for strengthening national agricultural research systems in Sub-Saharan Africa. It is based on extensive reviews, workshops, and discussions initiated by the World Bank and involving senior African scientists and research managers, as well as officials of bilateral and multilateral donor agencies—the last at the May 1987 meeting of the Special Program for African Agricultural Research (SPAAR). The proposed strategy is now addressed to high level decisionmakers in African governments and the donor community, and seeks their comments and suggestions for improvement. The present meeting aims to reach a consensus on key elements of a strategy that decisionmakers at the highest level can endorse, and then cause to be implemented.

Agricultural research is vital to the economic recovery, long-term progress, and future prosperity of Sub-Saharan Africa. There is now an extensive network of regional and international institutes capable of generating new agricultural technology for the region; but few national systems are currently strong enough to complete the vital step of adapting this technology to the needs of their local farmers. As a result, much past government expenditure on research has had little impact. The proposed strategy seeks to improve the tangible benefits from past and future research expenditures to the levels that African governments, and the donors who support them, are entitled to expect.

Key elements of the strategy are to:

- improve the correlation between the objectives of agricultural research and national macroeconomic and social goals;
- reform and strengthen the institutions responsible for agricultural research and improve their interaction with extension and agricultural education agencies;
- stabilize research budgets at levels consistent with the current and planned contributions of agriculture to the national economy, with an appropriate balance between essential research operating costs and other expenditures;
- improve education and career opportunities in agricultural research and give increased emphasis to preparing existing and future researchers for the practical problems of adapting new technology to farm-level conditions in their country.

To adopt the strategy, countries would need to prepare an overall plan, specifying the future national role of agricultural research, key
technical objectives, and, consistent with this, the practical steps to be taken in the short, medium, and long term to strengthen the national system. The plan would then provide a framework for defining subsequent government funding, and for incorporating coordinated donor assistance and support.
Introduction

Background and Objectives

1.1 A coherent strategy to reverse downward economic trends in Sub-Saharan Africa (SSA), to improve human welfare, and to arrest land degradation is sought both by African governments and the international community. The central role of agricultural improvement in any such strategy is now widely accepted. The Lagos Plan of Action, endorsed by the OAU Summit of 1980, stressed the African governments' "strong political will to channel a greatly increased volume of resources to agriculture." In the OAU Addis Ababa Declaration of July 1985, the African Heads of State adopted a 1989 budgetary target of 20% to 25% for this purpose. In 1986, the UN Special Session on Africa again focused worldwide attention on the vital importance of agriculture for the African future.

1.2 Research is vital if agriculture is to progress. New policies and farmer-support services -- some of which are already being put into place can help, or have started to help, in the short term. But in the longer term, if the productivity of agriculture is to reach and sustain the levels required for future food security and overall economic development, new technology must be found. It must be more reliable. It must be more efficient in the use of the local factors that constrain production -- whether these are purchased inputs and other materials, or labor, or land. And it must be sustainable. One such innovations depend the gainful employment, the incomes, and the welfare of the entire future population.

1.3 Agricultural research in pursuit of new technology can be divided into four categories:

(a) Basic or strategic research generates new fundamental knowledge or new research methods, which can subsequently be used in seeking solutions to specific practical problems.

(b) Applied research creates new technology capable of solving these problems, using the results of basic and strategic programs.

(c) Adaptive research molds this new technology to the specific needs and agro-ecological conditions faced by producers in a given locality, to permit its practical application.

(d) Maintenance research continuously adjusts the technology already used by producers, in response to such factors as the evolution of pest populations and agents of disease, to prevent productivity from declining.
1.4 Basic and applied research are reasonably well supported, principally through the extensive network of International Agricultural Research Centers (IARCs) both within and outside the coordination of the Consultative Group on International Agricultural Research (CGIAR). The output of bilateral programs (notably that of France) and the international research by the private sector is also very important.

1.5 Adaptive and maintenance research—an essential ingredient if the results of basic and applied programs are to find practical use—are less well supported. Both have to be done on a local basis, which in practice means that they are handled largely by national agricultural research systems. But despite the good intentions of African governments and donors, in most of SSA the national research systems remain too weak to complete the process of generation and adaptation of new technology. National agricultural research has thus become the weakest link in the chain of innovation. National systems are now the most in need of strengthening.

1.6 In 1985 the World Bank began a search for a strategy to improve the effectiveness of national agricultural research systems in Sub-Saharan Africa. Through consultants' reviews, workshops with African scientists and research managers in both western and eastern/southern Africa, as well as through the Special Program for African Agricultural Research (SPAAR) forum for donor coordination, a consensus has slowly emerged. This paper summarizes a proposed strategy for strengthening African agricultural research, based on that consensus. 1/ Those who contributed to the formulation of the strategy believe that it offers an important prospect: that the resources allocated by African governments and external development agencies to agricultural research in the future will produce the tangible benefits that governments and the donors who support them have the right to expect.

1.7 But strategies, however carefully agreed upon by technicians, research managers, and officials of donor agencies, can only be applied if they are also endorsed at the political level. The purpose of this paper, with its supporting documents, is to offer the suggested strategy for review, modification if necessary, and possible approval at the political level. Further, it is hoped that, in association with this review,

agreement can be reached on practical steps to put the strategy into practice in specific circumstances. This paper is therefore addressed to ministers of finance, planning, agriculture, education and equivalent high-level decisionmakers in African governments. It is also intended for the attention of those responsible for technical assistance policy and funding decisions in donor governments and aid agencies.

The Benefits of Agricultural Research

1.8 Agriculture dominates the economies of most countries in SSA. It will continue to support most of the population, which is expected to double between now and the year 2010. Past weaknesses of the agricultural sector have led, and continue to contribute, to such consequences as:

- declining per capita food production;
- inability to finance food and other imports;
- low productivity of rural labor;
- low rural incomes relative to the urban sector, which contribute to rural poverty and encourage people to drift toward towns;
- dissatisfied populations, bringing risks of civil or political strife;
- degradation of land and water resources.

Because of poor economic performance, increasing numbers of people earn too little to afford an adequate diet, even when food is available in their own country.

1.9 New technology, by improving the productivity of the factors that contribute to agricultural production (land, capital and labor, individually or in combination) gives benefits that spread widely through the economy and contributes to important macroeconomic goals. By lowering production costs or increasing output, new technology can help reverse some of the adverse trends listed above. For instance, it may permit:

- initial increases in farmer incomes, until markets adjust to the cheaper production cost of the commodity concerned;
- subsequent decreases in consumer prices as production increases;
- in the case of staple foods, differentially greater benefits to the poor, since they spend a higher proportion of their incomes on food;
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increased marketable surpluses, which, depending on whether they are import substitutes or exportable commodities, may allow governments to conserve or augment their foreign exchange reserves and to service their international debts.

Current Deficiencies and Future Needs of African Agricultural Research

1.10 Expecting benefits such as those listed above, African governments, aided by multilateral and bilateral donors, have already supported agricultural research on a substantial scale. A recent estimate suggests that the equivalent of over US$300 million is being spent annually. However, results have been disappointing, for a variety of reasons:

- The technical priorities adopted for research have not always been well matched to national macroeconomic objectives, nor have they reflected natural geographic advantages; they have also tended to be inappropriate to the needs of Africa's many small-scale, often subsistence, producers.

- Institutional arrangements have frequently failed to provide agricultural research systems with good access to national planning or finance ministries. Standards of day-to-day management and scientific leadership have often reflected the weakness of institutions.

- Funding has usually fallen short of the 1-2% of agricultural GDP that is often considered desirable. Salaries have frequently consumed most of operating budgets, effectively paralyzing research operations for the lack of complementary items such as laboratory materials or fuel to keep researchers mobile. Continuity of research funding has been hard to sustain, and even where donors have been prepared to commit themselves in principle to programs spanning 15 years or more, in the present macroeconomic situation many African governments have had great difficulty in allocating essential counterpart funds, especially foreign exchange.

- Despite recent increases in the number of African researchers, turnover of senior staff remains high and creativity low. Few scientists have sufficient technicians to assist them in their work. Selection and training seldom give adequate emphasis to the practical contribution required from researchers, with personnel policies tending to reward academic publication or seniority rather than contributions to economic development.

1.11 Because of the apparently limited tangible benefits, priority for agricultural research funding has, not surprisingly, tended to be
downgraded by government finance and planning ministries, during a period when belts have had to be tightened.

1.12 From the reviews, workshops, and discussions cited earlier, a consensus has emerged that, if agricultural research is to make its needed contribution to economic and social progress in SSA, strengthening of national systems must focus on five general areas.

(i) Better selection of national research priorities; only by reference to overall national economic and social goals can the correct technical choices be made.

(ii) Upgrading of national research installations; improved levels, stability, and balance of operational funding; and more cost-effective management of national systems.

(iii) Focussed training and development of scientific manpower for national research.

(iv) Development and greater use of "centers of concentration", to lead work on commodities or resource management problems of high common interest to African countries. Although such work is at present usually under regional or international management in IARCs, it should increasingly be led by national systems in the future.

(v) Closer and more effective collaboration and technology exchange between such centers and national research services.

1.13 Many of these improvements require considerable time to achieve their full impact, especially the upgrading of human resources and institutional strengthening and reform. Meanwhile, Africa's problems become ever more urgent. Some shorter-term measures are therefore also needed, which can make better use of the researchers or possible technological improvements which a country already has, while medium and long-term improvements are put in place. The rest of this paper proposes a strategy for strengthening in the longer as well as in the shorter term. It considers the commitments that those at the highest levels of African governments and donor agencies will need to make if agricultural research is to benefit their nations on the scale required in the future.
II. Strategy Proposals

Identifying Priorities

2.1 National agricultural research priorities can only be framed on the basis of detailed knowledge of the country concerned—its natural resources, its people, its markets, its economy, its institutions, and the present state of development of its agricultural research system. For each country, the priorities will be unique and will always represent a compromise between what might be desirable and what is possible given the research manpower and funds available. Priorities will change over time in response to internal or external circumstances. Initially, the adaptation of relevant imported technology to local conditions and maintenance research are likely to be the main thrust of national research efforts.

2.2 Several factors make the setting of national research priorities for African countries especially difficult. The first factor to consider is the diversity of Africa—not only in terms of mean annual rainfall, soil fertility, and topography, but also in terms of the range of agricultural systems and cultures that have evolved as a consequence. Arbitrary territorial divisions by colonial powers have left a legacy of often quite small countries that may span areas of great agro-ecological diversity, endowing each country with a wide range of technical potential and therefore varying research requirements. Second, a minimum "critical mass" of resources needs to be deployed before practical research progress can be expected on a given topic. With a minimum-sized technical team costing upward of US$200,000 per year, the smaller countries will in practice be restricted to a very few research targets, regardless of the range of problems that may call for attention. Third, much of the technology available for importation and local adaptation, with its emphasis on increased expenditure on bought-in materials and services, does not meet the requirements of many African farmers, who often have little or no spare cash to risk on unfamiliar innovations. Fourth, there is frequently a conflict between the urgent need to meet rising food demand—often for wheat and rice, which have to be imported—and the comparative economic advantage of the country, which may be climatically more suited to producing coarse grains, rootcrops, or exports such as cotton or coffee.

2.3 Such planning choices raise questions of national macroeconomic and social policy that are far removed from the routine concerns of the research scientist. National planners must therefore give guidance. But detailed technical knowledge of the main agro-ecological zones is also required before their policy choices can be translated into a coherent research program with specific and relevant objectives.

2/ Seven of the countries in the region spend less than US$1 million per year on agricultural research and a further 15 spend between US$1 and 5 million.
2.4 Technical priorities for African agricultural research are derived and discussed in much more detail in the supporting documents cited earlier, to which interested readers are referred. Among topics likely to find their place in the priorities for many national systems, are the following:

- **Low-cost, reliable technologies to benefit small-scale, frequently subsistence farmers**, often living in marginal areas. Emphasis needs to be given to improved returns on family labor, which is often the principal input of such farmers (many of whom are women) to agricultural production.

- **Commercial production systems**, based on locally adapted, input-responsive crop varieties or livestock types, for producers with the land, financial, and other resources at their disposal to intensify and expand commercial farming.

- **Import substitution**, for those commodities for which the country has a comparative economic advantage over potential outside suppliers.

- **Means to maintain the competitiveness of African export commodities** in world markets. In what may be a prolonged period of depressed prices, raising quality or lowering production costs may be at a premium.

- **Soil and water related research**, often involving closer integration of crop and livestock production, to arrest resource deterioration. This may be a prerequisite for any other technological improvement.

- **Social and economic research**, in order to better understand the constraints and opportunities of potential beneficiaries and to design technical programs accordingly; also to monitor changing farm-level profitability and market opportunities and steer research and sectoral policy; and to maximize the economic efficiency of the changes being sought by technical programs.

2.5 In view of the generally fragile ecological environment of many African countries and the accelerating abuse of this environment, close attention must be given to ensuring that the new technologies emerging from research programs are sustainable. As populations grow and land pressure rises, two additional priorities are becoming increasingly urgent: to achieve greater productivity per unit area of land, and to absorb more labor into remunerative employment.

2.6 The general priorities cited above cannot be transformed into specific programs unless the details of the local climate, soils and other physical resources are taken into account, along with the socioeconomic circumstances of the producers who are to apply the new technology. At
this level of planning, agro-ecological zones, with their usually greater homogeneity of development potential and production systems are likely to be more relevant for setting research priorities than administrative boundaries. (Research priorities for different agro-ecological zones are discussed in more detail in supporting documents).

Planning the Strengthening of National Systems

2.7 Investments in agricultural research mature slowly. It takes 10 years to breed and introduce a new variety of cereal and perhaps 20 to launch a new tree crop or an improved breed of cattle. Research systems must be structured and funded with this in mind. Without the necessary stability—of institutions, personnel, and budgets—research degenerates into a series of false starts, with no finishes. Even technology that is already close to commercial application may be jeopardized by a short period of neglect in experimental operations, records, or care of plant collections or breeding stock. Because of the long-term nature of agricultural research a sudden increase in expenditures will not provide instant solutions to pressing national problems such as declining food self-sufficiency, reduced export earnings, or low rural incomes—problems that tend to be high on the agenda of today's macroeconomic planners. But in the long term, without the underpinning of effective agricultural research, the impact of other remedial measures will eventually falter for lack of efficient production technology.

2.8 Planning to strengthen national agricultural research systems should proceed in two phases.

2.9 The first should begin with an overall review of national economic and social goals, and the comparative economic advantage of various regions of the country for agricultural production. These goals should be the basis for identifying the aims for and the past and potential contributions of agricultural research. To ensure realism and avoid the production of an overambitious "shopping list" for strengthening the national research system, countries must prepare an explicit statement on the level of national funding to be allocated to research. The planning team should therefore be given an indicator, consistent with national resources and agricultural GDP, from which to work, or they should elaborate a realistic funding scenario or scenarios to present to political decisionmakers.

2.10 The plan should then include the following elements:

- A description of the present national setting summarizing the country's technical potential and comparative economic advantage for agricultural production, key economic and social indicators, main agricultural production systems and trends, and institutional responsibilities within the agricultural sector.
A summary of overall national development goals and strategies in line with the picture given above. A clear statement should follow of the role that different agricultural commodities, producer categories, zones, or regions are expected to play in national plans. Any relevant targets for agricultural or rural development should be quoted.

An indication of the contribution that agricultural research is expected to make toward meeting agricultural and rural goals. This statement should first review opportunities and constraints for development, separating technological factors that are therefore susceptible to improvement via research from those that need to be approached by other means, such as export focus, import substitution, and producer price policy adjustments. A section on rationale and concept should then indicate and justify the choice of the main commodities, producer categories, farming systems, zones, or regions on which national research efforts should be focused.

The funding assumptions given to or used by the planning team for agricultural research. Total assumed allocation, in relation to agricultural GDP or some other national indicator, and the assumed government and external contributions to capital and operating costs, should all be stated.

2.11 The second part of the plan should present a scheme for the progressive development of the research system itself. This scheme should be based on the rationale given in the first part, and should show which of the general technical priorities will be taken up in the short (up to 5 years), medium (5 to 10 years) or long (over 10 years) terms, and therefore what rehabilitation or reinforcement of the research system will be needed over time. It should also indicate what will be done to maintain the momentum of any relevant existent programs and to prepare existing research staff for the future while proposals for institutional reform and other major changes are being planned and brought into effect. The second part of the plan will typically include the following elements:

- An indicative research program, describing the principal technical approaches to be followed in pursuit of the objectives allocated to research in the national context. The main research objectives should be listed and quantified for the short, medium, and long term. If they represent a continuation of existing work, this should be noted.

- A section on strengthening the system should describe the present state of development and the strengths and weaknesses of the agricultural research system. It should then catalog the main incremental items (staff, fixed
installations, equipment and vehicles, and especially operating funds) that would be needed over the short, medium, and longer term in order to implement the indicative program. The support needed for expansion or reorganization (education, training, libraries, information and data handling systems, networking, external technical assistance, external finance, etc.) should also be quantified. The total costs of these items should be consistent with the financial limits given in the first part of the plan. The future arrangements for planning, managing, executing and reporting the indicative program should be described, as well as the means by which new technology would be transferred to producers.

The final section should summarize the measures the government intends to take to ensure the continuity of research and the utilization of results. It should provide an explanation of macroeconomic policies (e.g., agricultural pricing, credit, and taxation); the norms and procedures that would be applied to ensure the allocation and continuity of research funding on the scale assumed in preparing the plan; and any commitments to the maintenance or improvement of other government supporting services in the agricultural sector, especially for extension, input supply and marketing.

2.12 It will be important to review both parts of the plan and update them from time to time (perhaps at intervals of two to three years) to reflect changing national and international circumstances.

2.13 It will seldom be possible to tackle the whole research agenda at one time. Although even the smallest countries will need some adaptive and maintenance research, the extent to which broader aims are included in the development plan will depend on the resources expected to be available. In allocating research resources, the rehabilitation of existing facilities and upgrading of existing staff should be given priority over the expansion of either. In every case, it is essential to include, and separately quantify, adequate operating expenditures: as a general rule, salaries should not exceed two-thirds of total estimated operating costs. Often there will be need for a phased approach, separating strengthening in the short term from the wider changes needed if the system is to perform adequately in the longer term. For the shorter term—the horizon of most immediate interest to national budgetary authorities and potential donors—indicative costs should separate assumed rehabilitation costs for existing facilities from the costs of any new facilities, staff or equipment.

2.14 Special organizational measures may be useful at the field level while the central planning and institutional reforms of a major reorganization are in progress—particularly if it is considered crucial to retrain existing staff for a future adaptive research role or if any
interruption in seeking new technology for producers would be unacceptable. The Annex gives an example of one such approach, under which researchers might be temporarily required to merge their efforts with those of field development staff in a priority area. In such cases, they, and any external technical assistance staff supporting them would be challenged to devise, in the shortest possible time, at least some simple improvements that small-scale producers could readily adopt. Acceptability would be assessed mainly through on-farm tests. Such interim measures can help existing researchers rapidly become familiar with practical problems and simple adaptive research techniques, as well as ensure that all available ideas—including those of farmers themselves—continue to be tested with minimum delay. Furthermore, they may provide insights concerning use in planning longer-term improvements.

2.15 Any plan to develop a national agricultural research system should also indicate:

- the role to be played by higher education, both in manpower development and in research itself;
- the means to be used to transfer new technology to producers;
- the budgetary norms or fiscal measures that the government intends to apply to ensure the continuity of research funding at the assumed levels, as well as the means by which the government will encourage the farm-level profitability needed to promote the application of research;
- assumptions regarding the external contacts, technical assistance, and training support on which system development would be based;
- the expected contribution of the private sector to national agricultural research;
- the organizational structure of research and institutional responsibilities.

2.16 Clearly, the preparation of such comprehensive schemes will be a major challenge both for the national planning office and for the leaders of the research service. They may wish to make use of the extensive background advice on strengthening national systems, which is available from a number of sources. 3/ In addition, governments can obtain

3/ See, for instance, ISNAR, "Considerations for the Development of National Agricultural Research Capacities in Support of Agricultural (Footnote Continued)
practical assistance with the planning of upgrading from CGIAR institutes, the World Bank, FAO, and bilateral development organizations.

Organizational and Institutional Factors

2.17 Even the smallest countries, which limit themselves only to adaptive and maintenance research, require at least a central national experiment and testing station, probably headed by a general agronomist, to import and test promising new plant varieties and other production technology. It is vital that the researchers participate in regional and other relevant workshops; these will be their main sources of information and ideas on new technologies to test. They must also be mobile within their own country, if they are to become familiar with conditions in the different agroclimatic zones. The national station needs to serve as a meeting point with extension staff and probably as an initial multiplication center for new varieties of crops, when they are considered ready for release.

2.18 Better endowed countries may be tempted to allocate their resources to a wider range of topics on a central station. However, many will still need to concentrate on technology imports and adaptive trials. If the country covers several agroclimatic zones, they may be better advised to use the available funds to set up a series of zonal field testing stations, so as to adequately cover this diversity of conditions with their programs. Initially, it may be more economical to staff zonal stations with technicians who are closely supervised from the center. In this case, reliable transport is essential for the scientists from the center to make regular supervisory visits. Only at a later stage in the development of the national system, or in larger countries, may it be justifiable to upgrade zonal stations into regional centers, each with its resident corps of scientists, supporting staff, and facilities. Eventually, such national systems may graduate to applied research and finally basic programs, and thus become regional centers of excellence able to generate new technology not only for their own country, but for the region as a whole.

2.19 Whatever the physical distribution of research facilities, close contact between researchers, extension workers, and farmers is essential. Information needs to flow in two directions: while research may propose new methods for recommendation or on-farm tests, it is essential that extensionists and farmers tell researchers their reactions, problems, and future needs via regularly scheduled meetings, at appropriate levels, between all parties involved.

(Footnote Continued)
2.20 Institutional structures, as well as the arrangements for planning, management and reporting of research within the system and its linkage with external and other national agencies, should also build on what exists. Many of the desiderata for a successful institutional structure have already been implied and others are easy to state. But experience shows that the ideal structure may be hard to attain in practice because of political or other constraints. Compromise is usually necessary. However, it is possible to specify the most important characteristics of a successful structure. It should:

- facilitate the clear expression of national macroeconomic and social goals in research programs;
- provide feedback on technological constraints and opportunities to set policy for the agricultural sector;
- ensure budget allocations for research that are both realistic and stable;
- permit easy and beneficial interaction with external sources of new technology, technical assistance, information, and financial support;
- have close links with the government services or others responsible for transferring new technology to producers, and with the higher education system responsible for meeting research manpower needs;
- provide adequate rewards and stimuli to its graduate staff, thus fostering their individual creativity and encouraging long-term career commitment;
- evolve within the time needed (often 15 to 25 years) for a national agricultural research system to mature.

2.21 For smaller systems that initially focus on adaptation of imported technology, it may be more appropriate to concentrate resources on the practical aspects of technology transfer; the research and extension services may be combined, under a ministry of agriculture. But as the national research system develops, the constraining effects of working under civil service procedures may begin to jeopardize the effectiveness of its operations. Governments may then wish to create a separate autonomous, research institution--perhaps a parastatal company--with greater freedom in its budgetary and administrative operations and with better rewards for the creativity of its personnel.

2.22 For important cash crops, especially the major export commodities, research may be self-financed through a cess on crop earnings. In this case research may be directed by a governing body that includes representatives of the producers and processors who pay the cess, as well as by relevant government agencies. Where there is independent private
sector research—for instance on cereal breeding, oilpalm, or tobacco—institutional structures should provide for liaison or partnership with the private sector, but the government should avoid duplicating work that the industry is prepared to finance.

2.23 Under any structure, the national university or universities should be given a clear mandate and the resources needed to make their contribution, preferably to at least part of the national agricultural research program, as well as to manpower development. It is also vital to ensure that the structure includes arrangements to multiply the genetically improved crops and livestock coming from research programs. Whether this is done initially by the research service itself, entrusted to a parastatal affiliate, or contracted to the private sector, institutional arrangements must provide for independent control both the quality and the quantity of output.

2.24 All institutional structures must establish clearly defined procedures and individual responsibilities, which may often be based on an annual or seasonal cycle. These should cover the following essentials:

- program planning, monitoring, and technical reporting;
- budget preparation, monitoring, and audit, with separate accounting for each major program and, if requested by donors, for their individual contributions;
- external peer review of the quality of programs and standards of implementation;
- independent evaluation of research impact on relevant development problems;
- performance evaluation of research staff.

2.25 It is often difficult for governments to plan the strengthening or restructuring of their national research systems unaided. External assistance (see para 2.16) is useful, but communication with government staff and policymakers must be open and at a sufficiently senior level. Plans that reflect external preference and/or do not command full political support within the country will hinder rather than help the development of the system.

Financial Implications

2.26 The situation of the individual country will determine what level of spending is appropriate for its agricultural research. However, if funds can be used efficiently, an annual outlay of 1-2% of agricultural GDP is often considered an acceptable norm.

2.27 Whatever target is adopted by an individual country, some of the additional finance will obviously come from donors. To avoid fragmentation
of programs it is essential that the past tendency towards piecemeal assistance by donors is replaced by coordinated support, given in the framework of the agreed national plan for development of the research system. But donor finance should only be a complement to, and never a substitute for, a government's own financial commitment. As part of every plan for system development, the core funding that the government itself proposes to provide--especially nonsalary operating costs--must be quantified, at least for the short term.

Training and Human Resource Development

2.28 The productivity of a national agricultural research system ultimately depends not only on institutional arrangements nor even--given a reasonable minimum--on funding, but on the creativity and skill of its scientists. The skills of existing staff can be upgraded in various ways: by short courses on specific topics; by closer interaction with IARCs and other national systems through networking; by special interim arrangements to involve them more closely in practical development programs (para. 2.14); and by formal postgraduate studies. If the currently high losses of graduates from national systems (estimated at 7% annually) can be reduced, available formal training resources can be concentrated on academic quality rather than quantity. Even so, most undergraduate as well as postgraduate training systems will still need to be rehabilitated and improved.

2.29 To respond to these training needs, not only for graduates but also for more technicians and other qualified supporting staff who are at present in much shorter supply, African universities and colleges require better facilities for practical experimentation, and improved libraries. Teachers need to be familiar with, and preferably involved, for part of their time, in national agricultural research programs. Since not all countries will be able to afford the necessary upgrading they should explore the possibility of admitting more undergraduates from other African countries to existing agricultural universities--for instance in Nigeria, Senegal, Kenya, Ghana, Cameroon, Ethiopia, or Cote d'Ivoire.

2.30 But students need not only a better academic grounding in biology, chemistry, physics, social sciences, and mathematical techniques. Manpower development programs must also encourage them to use these skills productively. In most countries, for some years to come, a broad outlook is likely to be more important than narrow specialization. To prepare young scientists to contribute effectively in what will frequently be an adaptive or maintenance research role, a greater portion of training must be spent in the field, close to farmers and extensionists. An entrepreneur's flair is needed to spot new ways in which science can help producers to meet their aims--whether for money, food, security, or social improvements to their lives. To acquire the necessary local knowledge of rural life and strengthen the generally weak data bases in this area, it is desirable to involve undergraduate and postgraduate students actively in applied research, field testing and socioeconomic surveys, in a supporting role.
2.31 Some African governments already regard the satisfactory completion of a period of off-station fieldwork by young graduates as a necessary prelude to a postgraduate degree course. More may wish to follow. If they do, then thesis and dissertation topics are more likely to reflect the farm-level problems that young scientists encounter early in their training. Such measures will also expose their academic supervisors to practical problems and add further to the pool of local scientists involved at a practical level in the improvement of Africa's complex agricultural systems.

2.32 If postgraduate studies are to focus even more firmly on local problems, African countries must become less dependent on overseas universities for M.Sc. and Ph.D. courses. Since local facilities are few in number, the transition will inevitably be slow. But a start should be made now on further upgrading postgraduate courses in selected African universities. Assistance is needed from senior African and developed country educators, as well as from other regions, in deciding how the necessary standards can be achieved. Possible measures include "twinning" with established postgraduate training centers overseas, greater use of IARC staff in a co-supervisory role, and more active involvement of African university academics themselves in international research programs.

2.33 Research managers and administrators are also needed. It must be accepted that the ability to lead young scientists and encourage entrepreneurial research attitudes in them is part of the research management task. More thought must be given to the best means of expanding training capacity for research management and leadership, and to the appropriate course content for those who are to lead national agricultural research efforts. Although over a dozen African institutions give management training, so far only one offers courses for managers of agricultural research.

2.34 To reduce the currently high researcher losses, national systems must offer recruitment on scientific merit, promotion based on performance, safeguards to ensure continuity of research, frequent in-service training, and flexibility to retain those with particular talent as scientific innovators or entrepreneurs. This must be linked to management and leadership more conducive to creativity and job satisfaction. In order to facilitate staff interchange and collaboration, researcher salaries should be equivalent to those offered by agriculture faculties of universities and given to subject-matter specialists in the extension services. Exchanges between research, extension, and the academic world should be normal part of career development for agriculture graduates.
III. Proposed Actions

3.1 To implement the strategy summarized above will be a major and complex undertaking. Clearly, African governments have the central role and responsibility. But with finance and research manpower likely to remain in short supply, extensive regional and international collaboration will be required—between governments, donors, and international centers. Moreover, it should involve public and privately funded research, higher education, and extension agencies.

Actions by African Governments

3.2 To prevent the further decline of their research systems, African governments must re-commit themselves to providing manpower and resources, on the scale, of the type, and with the continuity appropriate to their national needs. As a first step, they need to evolve relevant national strategies for agricultural research, from which plans for system strengthening would be prepared. The approach suggested would combine long-term adjustment of national agricultural research systems to the challenges of the future, with pilot exercises in the shorter term to re-train staff for a largely adaptive role and to accelerate the testing of new technologies. On the basis of these commitments, governments would make a core budgetary allocation of national resources to agricultural research with an appropriate balance, which must be maintained, between short and long term, between investment and operating costs, and between salary and nonsalary costs within operating expenditures. It is suggested that the nonsalary element of operating costs should never be less than a third of their total.

3.3 A major effort will also be needed to mobilize the necessary human resources. The first task will be to upgrade the skills and productivity of present research managers, leaders, and technical staff. New staff, qualified and trained in the skills called for in plans for system development, may also need to be recruited. Academic upgrading must go hand in hand with greater direct involvement of existing researchers and future potential recruits in the practical problems of African farmers. Various national bodies—research institutes and extension agencies, agricultural universities, and other institutes of higher education, as well as private and industry-financed research bodies—must contribute to manpower development. Interchange of staff between these participants should be encouraged. It is particularly important to review, and if necessary adjust, conditions of service and research funding arrangements for national scientists, to reduce the currently high losses of senior, well qualified staff.

3.4 National needs for external technical cooperation, assistance, training and outside financial support must be made clear in plans for the strengthening of agricultural research. Institutional structures should be adopted that facilitate interaction with external agencies; funding should allow for personal contacts to be made and maintained, and for technologies suited to local conditions to be imported along with scientific literature.
and other useful information. While intellectual property rights must be safeguarded, political restrictions on the free flow of scientific results into, out of, and between countries must be minimized.

**Actions by International Agricultural Research Centers and Outside Universities**

3.5 The IARCs and universities outside or elsewhere in SSA can make an enormous contribution to the national strengthening process. The IARCs will be a major source of technology for local adaptation by national systems, for some time to come, often through their role as network coordinators. IARC contacts should be used as well to promote quality control and peer review of national programs, to increase the awareness of national teams of wider developments outside their countries, and train employees on the job and develop manpower. Co-supervision of postgraduate students by "twinning" an outside body--IARC or university--with a national university can benefit students and the national university alike.

**Actions by Donors**

3.6 Donors, as well as regional and international technical agencies, must tailor their outside financial and technical support to the national plans for system strengthening. To avoid giving conflicting signals to African governments, donors should continue to make use of coordinating mechanisms such as SPAAR and work with regional associations like SACCAR, IGADD, or CILSS. Initially, the role of donors should be to support governments in the elaboration of national agricultural research strategies and development plans. Subsequently, their country financial support should be tailored to complement national core funding allocations under those development plans. Country technical assistance should be designed to provide the training, scientific information, networking, and other professional contacts on which strengthening of the national systems will depend. Similarly, donors involved in regional or international programs should review and revise them as necessary to maximize their contribution to the strengthening of national capabilities for agricultural research.
Annex

SOME OPERATIONAL SUGGESTIONS TO STRENGTHEN AFRICAN AGRICULTURAL RESEARCH IN THE SHORT TERM

Introduction

1. An extensive series of reviews, workshops, and discussions on the strengthening of national agricultural research systems in Sub-Saharan Africa has been summarized by the World Bank. A strategy is suggested for the strengthening of national systems which is based on

   o improved selection of research priorities, by more systematic reference to national macroeconomic and social goals;

   o reform, strengthening, and improved management of the institutions responsible for research, as well as better links between them and the national agencies responsible for extension and agricultural education;

   o stable budget allocations to research at levels consistent with the importance of agriculture to the national economy;

   o improved education, practical training, and enhanced career prospects for agricultural researchers.

2. The framework for such strengthening would be set by a major initial review and planning exercise. It is noted that considerable time (perhaps over 15 years) may be needed for many of the proposed measures to have their full impact—particularly improved staff education and training, and the design and successful installation of new systems of research organization and management. Meanwhile, the agricultural, economic, and social problems of Africa become ever more pressing. For the high level decisionmakers—the ministers of agriculture, finance, planning, or their equivalents—whose endorsement is needed before the proposed strategy can be implemented, this raises an important question: Can research contribute anything that will have a more immediate impact on the problems of today?

3. This annex highlights some interim actions that could meet more immediate development needs. Although their main aim is to re-train existing researchers to make the increased contribution to development that is called for under the proposed strategy, this would be done through greatly intensified testing of any improved practices, however simple that might be readily and quickly applicable by farmers. Hence the interim actions would tend also to accelerate the flow of new technologies into practical use. This could proceed while many of the medium and longer-term
improvements advocated under the strategy are being readied for implementation, without interfering with the process of overall reform.

Rationale and Concept

4. The strategy is designed to strengthen African agricultural research, not to create it de novo. Most countries have some ongoing research, which may already have generated findings worth bringing forward into adaptive trials and/or testing for their acceptability to farmers. In addition, all countries are free to make use of existing technology imported from elsewhere. And all have some small-scale farmers who are more skilled, knowledgeable or successful than the average in their region; they also possess technology that may be ready for wider testing. Thus, although a research program that is launched today may not produce an improved crop variety for 10 years or an improved breed of cattle for 20 years, most countries already have, or have access to, technologies that are potentially much closer than this to practical application.

5. What is most often lacking, however, is the staff able to devise and conduct programs to exploit these possibilities quickly enough. Even if existing researchers have the skills and experience, they frequently lack the means and incentives (vehicles, operating budgets, equipment, adequate salaries, and travel allowances) needed to test the options at the farm level. In addition, they seldom have comprehensive information on what is available for import from outside their country, nor data on what the best farmers within the country are doing in different agroclimatic regions; finally, they may be reluctant to get involved in on-farm testing at all, if it involves uncomfortable travel and separation from their families and the amenities of their home bases.

6. It follows then, that African governments could take short-term advantage of underexploited knowledge and their underutilized professionals if they were to

(i) provide existing researchers with the resources, incentives, and information they currently lack;

(ii) put more pressure on their researchers to use the resources provided more effectively, in programs of adaptive research and, more particularly, on-farm testing.

7. The second item amounts to involving most researchers much more intimately in practical aspects of rural development, during the period that longer-term reforms are being worked out. To ensure that this happens, it is suggested that a challenge be issued to them: that their future in the longer term would be determined by their success in mounting and executing such simple testing programs in the interim.
8. Efforts would need to focus first on a few objectives of indisputably high national importance. Researchers would be required to test their best suggestions for practical farm-level improvements—culled from existing programs, imported or based on observations of what more successful farmers are already doing—against the present practices of the majority of producers, mainly in on-farm tests. Evaluation criteria for the researchers involved would be their energy and originality in seeking a new technology that might be readily adoptable by producers, appropriate for the scale and quality of their trial programs, experimental records, and reporting/interpretation of results.

9. If these interim measures were adopted there would be four main benefits.

(i) Existing national research staff would receive rapid, on the job re-training in adaptive research which, under the strategy, is likely to be their main future role in the longer term.

(ii) Farm-level testing of the new technology would be expanded and intensified with maximum urgency, even as preparations for more time-demanding changes under the strategy go forward.

(iii) The motivation and aptitude of individual researchers for adaptive research would be assessed, and clear indications obtained as to the nature and level of their future responsibilities in the reorganized agricultural research system.

(iv) Additional practical experience would be gained, particularly in methods of interaction with field-level production support services and farmers, and in techniques of adaptive research. This information could be fed back into plans to strengthen the research system in the longer term.

10. With the adoption of these interim measures, the initial approach to strengthening agricultural research would become very similar to that already used for strengthening extension services under the training and visit (T & V) system; existing staff would be trained in their new responsibilities and the short-term practical benefits of the new system demonstrated while the rest of the strategy is being implemented. This would contrast favorably with what many elements of the research strategy currently offer—promises for the long term but no immediate benefits.

Operational Proposals

11. It is proposed that the interim measures described above be taken in the form of pilot exercises, similar to those already often used when
T&V extension is to be introduced. The arrangements suggested below are not intended primarily for countries with large agricultural research systems that have already received a large amount of external support. They are suggested more for medium or smaller, poorly developed, systems. They would be applied only until longer-term plans for the institutional reorganization of agricultural research are ready for implementation however long that may take.

12. The following operational steps would be taken:

- The government, with any external advice or assistance that it may wish to enlist, would select only a few, indisputably obvious, priorities for adaptive research in support of national development goals.

- A reasonably uniform pilot area or areas would be selected, where improved technology on one or more of the priority adaptive research topics is expected to be most needed and/or most readily accepted by typical producers, and where there is some prospect of early technical success.

- Some or all existing researchers (the proportion depending on the extent to which the research service has existing programs that are to be maintained unaltered), would be required to work on a day-to-day basis with the government's designated development authority or authorities serving the chosen pilot area(s), until longer-term strategic plans for reform of the research service have been agreed and are ready to implement. This period is likely to last two to five years.

- Depending on national circumstances, the development agency might be a strong or weak extension service, a producers' association or cooperative, or simply a village or traditional community. Mechanisms for interaction with the agency would have to be worked out in the field and clearly tailored to whichever exists. If necessary, the development agency itself would also be assisted or strengthened.

- The seconded researchers would be required to devise for the development authorities, via consultation with them and with local producers, seasonal trial programs for comparing producers' existing practices with the researchers' own best suggestions for improved alternative technology. Suggestions might include locally developed or imported technology that has not yet been offered to farmers. Where neither exists, it would be the job of researchers to develop test ideas, however simple, with representatives of the development authority and local farmers for subsequent testing.
Trial programs would give maximum emphasis to paired comparisons on farmers' fields between the farmer's standard treatment and the researcher's best suggested improvement. Limited use would also be made of trials on research stations or substations, if they are in or have the same agro-ecological conditions as the chosen pilot area(s).

The results of trials would be evaluated jointly with the development agency, participating farmers, and researchers. Farmers' subjective ratings of the acceptability of suggested improved technology would be systematically recorded for all on-farm trials.

To the extent that this can be arranged, the acceptability ratings given by farmers and the development agency to the new technology tested by researchers would also be independently monitored and separately reported to the planning, finance, or other lead ministry responsible for deciding national resource allocations to agricultural research.

13. External donor and assistance agencies would have a variety of opportunities to contribute to such pilot adaptive research exercises. Support is likely to consist mainly of

- helping suggest initial adaptive research priorities and pilot areas;
- providing researchers seconded to pilot areas with the vehicles, simple equipment, allowances, and other operational funds needed for them to work effectively;
- suggesting external technology worth introducing into the program and putting government teams in touch with possible outside sources of ideas;
- helping formulate treatments to be compared with the farmers' standard practices, and providing advice on the design, implementation, evaluation and interpretation of the experimental program;
- independent evaluation of the acceptability to local farmers and the development agency of the new technologies tested under the program.

14. The future deployment and levels of responsibility of the researchers involved, once the pilot exercise ends, could be based on the quality of the experimental programs and the results that they have achieved. Assessment would take into account the researchers' own experimental records and reports (for which a standard format would have to be devised at the outset), their intellectual contribution, the views of
the head of the development agency with which they have been working, and any independent evaluations of program quality and impact. Depending on performance, aptitude and personal preference, at the end of the pilot exercise researchers might

- continue in adaptive research, either in on-farm testing or in a commodity team;
- return to more academic work;
- form the nucleus of new pre-extension, farming systems or technology transfer teams;
- move over to extension work, as subject matter specialists or in an executive role;
- be paid off.

Level of responsibility, and hence salary, in the selected field, could be made to depend on performance during the pilot exercise.

Benefits

15. The primary benefit of the approach suggested would be in preparing the staff of the research service for the more effective, largely adaptive, role likely to be demanded of them under the new strategy. This benefit would accrue whether or not they are successful in the purely technical sense. Secondarily, the approach would ensure that possible new technologies--whether existing, new, imported, or based on the local ideas of researchers, extensionists, or farmers--are tested with minimum delay despite the ongoing reorganization of the research service. Finally, a pilot exercise would provide valuable information to help further elaborate the longer-term research strategy and system reorganization.

Issues and Risks

16. The operational arrangements suggested raise two main issues for governments and donors. The first question is whether or not they are prepared to commit themselves at all. The second is whether or not there is a development agency capable of cooperating effectively with adaptive research.

17. Clearly, the proposed approach would be easy to apply where there is already an effective extension service, but less so where there is not. In cases where development is entrusted to--for instance--a traditional or political authority, a major challenge could be posed to those planning such a pilot exercise. In extreme cases, the government might wish to give
the research service full responsibility for farm-level R&D in the pilot area, on an annually renewable basis, until an effective extension service can be created independently.
INSTRUMENTS FOR STRENGTHENING AGRICULTURAL RESEARCH
IN SUB-SAHARAN AFRICA
A COMMENT ON THE STRATEGY PROPOSED BY THE WORLD BANK

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The paper

The paper before us is solid. It is based on sound diagnosis and rigorous analysis. It is action-oriented. It moves beyond ideas, concepts, and catchwords. The strategy statement is followed by action proposals addressed at three groups of actors: African governments, collaborating institutions, and donors. In short: It means business.

We, at ISNAR, endorse the strategy proposed for the buildup of research capacities in Africa. It is broadly in line with our thinking on institution building. However, we have some reservations regarding the research agenda presented in the annex to this paper.

The planning process

We welcome the Bank's initiative in producing this paper. It addresses a real and urgent need: we depend on technological progress for economic and social development; and we depend on strong research capacities for the supply of adequate technologies. Experience has shown us that there is no short cut.

We are aware, of course, of important parallel initiatives in identifying research needs and research strategies for Africa. FAO, ECA and others have made important contributions. They complement this effort by the Bank.

The sequence of events has been correct in this planning exercise:

- first, the diagnostic and systematic reviews conducted for eastern and western Africa (ESAARR and WAARR);
- second, a series of consultations with those directly involved, the NARS leaders of African countries;
- third, strategy development--building on the synthesis of findings;
- fourth, this workshop--to discuss the relevance of the strategy proposed, to reach agreement on action needs, and to generate what is most needed in Africa: political
commitment and support for technology-based progress in agriculture and hence for agricultural research.

The actors involved

I need not impress upon this audience how important it is for any planning exercise to seek the full participation of those to whom the strategy is ultimately addressed. Our experience in numerous research planning efforts in Africa (and elsewhere) has shown that the success of any strategy ultimately depends on the conviction and commitment of those who are expected to implement it. National research leaders will implement their strategy.

This meeting

This meeting has the potential to make an impact on future technology supplies for Africa: It can be a turning point for the region's research and technology generation capacities; it can get us out of the chicken-and-egg situation we are in; and it can generate what is most critical for technology-based progress in agriculture--political commitment to agricultural research.

This situation we are facing is like a vicious circle. The sequence runs like this:

- Low overall priority to agriculture.
- Lack of real commitment to research. In many countries the role of research and its potential contribution to development are not recognized.
- Insufficient support for agricultural research.
- Low productivity of research systems--poor efficiency in the use of resources.
- Low levels of output.
- Lack of impact on development.
- Lack of political support.

To get out of this dilemma we need to work at two levels simultaneously--at the levels of policy and research systems.

At the policy level, we need to build up commitment to research. Governments need to define clearly the tasks and functions assigned to research in the development process; to articulate the nations' demands from research--in terms of expected research output; and to increase the flow of resources--in line with those tasks and demands.
At the level of research we need to build up the productivity of research systems--to increase their capacity to respond to those challenges. To assist developing countries in this complex task of strengthening their NARS is--as you know--the mandate of ISNAR.

The strategy before us addresses these two critical tasks.

**The Proposed Strategy for the Buildup of Research Capacities in Africa**

My comments are based on ISNAR's experience in working with some 15 NARS in SSA over a six year period.

Before highlighting some of our main findings in terms of principal constraints and action needs, let me stress four points. They will place my comments in context.

First, the strategy presented here for the buildup of research capacities is largely in line with the strategy we developed at ISNAR for strengthening NARS. Hence my comments will not reflect any radically different points of view. I will emphasize some of the critical issues.

Second, a word of caution regarding excessive generalizations in the African context. We know that Africa is heterogeneous--more than any other region. There is enormous diversity in agroecological terms, in production potentials and in technology requirements. There is equal diversity in terms of research institutions. NARS differ in size, state of institutional development, resource endowment and performance potential. Hence the difficulty (rather, the impossibility) of coming up with a common research strategy for Africa. A number of FAO studies has made this clear.

Third, despite this diversity, some common issues can be discerned. Particularly in the areas of research policy, organization and management, problems tend to be similar for most countries.

Fourth, I wish to emphasize that whenever we talk about strategies for the buildup of African research capacities we mean efforts aimed at strengthening existing systems and programs. Africa is not starting from scratch.

- Systems are in place. We need to upgrade their productivity. In doing this, we build on existing strengths.

- Resources are flowing to these systems from both national and external (donor) sources--at times substantial resources. Our primary challenge is to increase the productivity of these existing resources. We need to increase the systems' efficiency.

- And there is output. There are numerous examples of successful research programs. Maize in southern and eastern
Africa is one example. We need to learn the lessons of success and strive to apply them more broadly.

**Building effective NARS—the critical factors**

Let me give you a brief overview now of what we at ISNAR consider the critical factors in building effective national research systems in Africa.

Through our collaboration with a broad range of NARS—15 in Africa and well over 30 worldwide—we have found that strong and effective research systems depend on 12 critical factors. These 12 factors are interdependent. They can be grouped according to broad areas: the policy environment of agricultural research, the organization of research systems, and the management of agricultural research. Together, they determine the productivity and impact potential of research systems. Problems are likely to occur at all three levels: at the policy level, at the structural level and the level of management. I would like to say a few words about each.

**A. Policy environment of agricultural research**

All of us assembled here know the importance of a favorable policy environment which allows research to play its role and to have an impact on development. I believe that three issues clearly stand out:

- Building national commitment to agricultural research.
- Developing national research strategies.
- Sound planning and priority setting.

**Building national commitment to agricultural research.** In the absence of genuine commitment we tend to perpetuate the situation that I described earlier—the vicious circle:

- Research will not have the recognition that it requires to play its role in the development process.
- Countries will continue to underinvest in agricultural research.
- They will not reach the target level of 1-2% of agricultural GDP.
- Governments will continue to overuse the options of easy money with all its consequences. This means buying time and postponing the hard decisions that many of the Asian countries took long ago in their times of crisis.
On balance, they would miss an important opportunity. After all, research well done offers attractive returns to investment.

**Developing national research strategies.** To be successful, to make an impact, and to contribute to national development, the research system needs orientation. It needs a sense of direction—a clear definition of its mission.

This understanding of the system's role and its expected contribution needs to be shared by both policymakers and research leaders. Policymakers must help to create a productive environment. They must protect the system from the many unrelated tasks that are often dumped on public sector research agencies, such as the pursuit of employment objectives or social welfare functions. Research systems must be free to hire (and fire) in accordance with their needs.

Research leaders, on their part, must define their systems' goals, develop a coherent strategy and thus provide the framework for sound planning and the buildup of strong programs.

We often find that in the absence of clearly formulated strategies and plans, research programs tend to be fragmented, lack continuity and are only superficially linked to national priorities and development objectives. Such programs are vulnerable to external pressures. Donors' priorities also dominate or seriously distort the research agenda. On the other hand, experience shows that donors are willing to integrate their contributions or assistance in the framework of a national research plan.

The cases of effective donor coordination around a well articulated national research strategy are still limited in number. But we know that it is feasible and there is no reason to believe that this should not become common practice before too long. One thing is clear: the basis for this is the existence of a sound strategy and long-term plan.

This brings me to the third issue in the policy area.

**Sound planning and priority setting.** Effective planning and priority setting are rare in African NARS. Yet they are of paramount importance, particularly for small and resource-poor countries. Such countries need clear choices to guide the allocation of their scarce resources. Long wish lists have to be replaced by well-argued priorities. Hard decisions are needed to match those priorities with available resources.

The central question for any country is: What kind of research system can it afford? As the World Bank paper points out, a decision to concentrate on technology imports and adaptation for some of their commodities may be a wise choice for many of the smaller systems.
Organization of agricultural research

When looking at organizational factors, we are concerned with the internal structure of research systems and with the organization of their external linkages. Both are important. Together, they provide the institutional framework for research. They determine how the system functions and how effectively research links up with its broader social, political, and economic environment—in particular its clients, collaborating institutions, and sources of funding. They influence the mobilization of support, the flow of research results to farmers (via extension), and collaboration with other scientific organizations.

Four challenges stand out:

- Consolidation of research structures;
- Concentration of research efforts—achieving critical mass;
- Creating an organizational setting conducive to productive research; and
- Strengthening linkages and enhancing scientific collaboration.

Consolidation of research structures. Most African NARS are young. Yet, many inherited structures and station networks are from past colonial systems. These structures were set up for different objectives. The economic, social and political context was different and targeted commodities were different—essentially export crops.

The challenge now is to adjust the existing structures to fit their new mandate which is to generate technologies for sustainable production systems that will feed the growing populations of African countries. In practice this means:

- Nationalizing inherited systems through the buildup of a solid base of scientific manpower;
- Rationalizing the use of existing station networks;
- Consolidating those networks to a size and complexity that are manageable with existing resources; notably scientific staff and operating funds; and
- Preventing those scarce resources from dispersing.

An important concern is the long-term viability of these young and growing systems. In planning future size and projecting research capacities, research leaders must be guided by a realistic assessment of what is feasible and what can be sustained from national resources.
It is important to avoid overcommitment. All too often we see over ambitious plans for the expansion of station networks beyond what is sustainable.

We tend to recommend consolidation and concentration of effort.

**Concentration of research efforts--achieving critical mass.** Building a critical mass around the key problems is a priority for any research system. It is a particular challenge for many of the younger systems in Africa.

In practice, the task is to

- Overcome the present fragmentation of efforts;
- Mobilize all scientific capacities in a given country (they are likely to be dispersed in a variety of institutions);
- Strengthen linkages and collaborative arrangements with national universities and other institutions of higher education;
- Establish a mechanism or procedure that facilitates collaboration among those autonomous and largely unconnected institutions.

As the World Bank paper points out, there are two kinds of benefits from such concentration and integration. In the short term, it is necessary to reach the critical mass. In the longer term, better researchers are required. The universities also benefit from such collaboration. As a consequence, they will produce better scientists.

**Creating an organizational setting that is conducive to productive research.** We know that the key to research productivity is good science. If good science is to yield results, we need the proper setting. Most agricultural research in Africa is conducted by the public sector. The organizational model most commonly found is the "Ministry-model"; i.e., direct dependence of the research set-up from a Ministry.

Clearly, large public sector bureaucracies do not normally provide the best organizational environment for a productive research institution. To be productive, these institutions need, among other things, a personnel management system that enables them to hire the best scientific staff, retain that staff, and motivate the scientists. This implies recruitment on scientific merit, promotion based on performance, incentive structures, and a compensation system that is competitive and helps to keep productive scientists on staff.

NARS in other regions are struggling with the same set of problems. In Latin America this led to important organizational changes.
Most countries there moved from the ministry model to that of the semi-autonomous institute.

Although I am not pleading for any drastic organizational change, I am stressing the need for some adjustments. Research systems need some managerial flexibility. This will increase their productivity and hence their payoff.

**Strengthening linkages--enhancing scientific collaboration.** African NARS are part of an emerging global research system. This system is composed of a broad range of institutions conducting research at different levels in both developing regions and the industrialized world. It offers opportunities for collaboration and assistance. To increase their own effectiveness and maximize the impact of their limited resources NARS are making use of these opportunities. The challenge is to make even better use of external assistance and collaboration.

Opportunities occur at three levels:

- **National.** The need to link up with universities and their scientific institutions that I talked about.
- **International.** The International Agricultural Research Centers (IARCs) of the CGIAR System are making a serious effort to tailor their work to the specific needs of Africa. Among the IARCs outside the CGIAR system, the International Center for Insect Physiology and Ecology (ICIPE) and the International Council for Research in Agroforestry (ICRAF) are based in this region. A host of other institutions and universities outside the region are offering collaboration or would be able to do so.
- **Regional.** Collaboration among NARS on a regional or subregional basis offers great potential for a rational division of labor--for reaching the critical mass on a regional basis. Again, this is particularly crucial for the smaller systems. Yet, apart from a large number of commodity-specific networks that are mostly funded and managed by external agencies, the concept of horizontal collaboration is underutilized. An exception is SACCAR--the Southern African Center for Cooperation in Agricultural Research. SACCAR is a young and dynamic institution with great promise. The concept lends itself to application elsewhere.

**Management of agricultural research**

I now turn to the third set of critical factors, namely those related to the management of agricultural research. Here we have identified six essential management processes. Three relate to the management of the research process. They determine quality and relevance
of research programs and hence the system’s effectiveness and impact. The other three relate to developing and managing the system’s resources: their human, financial, and physical resource base. They determine the system’s efficiency in terms of resource use.

Looking at African NARS and the potential for increasing their productivity, we see two key challenges: to upgrade the productivity of scientific manpower; and to ensure adequate levels of support.

Upgrading the productivity of scientific manpower. Clearly this is the single most important factor in research management. The task is complex. In quantitative terms, African NARS have undertaken a massive effort over the last two decades to build up the number of scientific staff. Progress has been good by any standard, and systems have grown substantially.

In qualitative terms, there is scope for improvement. ISNAR data show that less than 5% of the staff of a large number of NARS hold Ph.D.s. Moreover staff are often young and inexperienced. The need for training is obvious. In addition, attrition rates are high. In the absence of career incentives, qualified scientists are attracted by better opportunities elsewhere. To retain their staff and reduce excessive rates of turnover, NARS need to develop the kind of incentive structures I mentioned earlier.

Another key concern holding back the productivity of scientific staff is the lack of adequate operating funds. Rapid growth in staffing, accompanied by stagnation in overall budgets has led to serious distortions of the resource mix in many systems. An excessive share of total resources is allocated for salary payments. Funds available for operating costs have fallen to levels sometimes as low as 5% of total resources. The results of this distortion are obvious; low productivity of the system’s most precious resource, its scientific staff; and low productivity of the entire system.

Ensuring adequate levels of support. I have already mentioned the policy dimension of this problem. From a management perspective, the task NARS face is five fold:

- To raise overall levels of support for research programs and counteract the present decline in financial support per scientist.
- To balance the resource mix and increase substantially the share of operating funds.
- To strive toward stability of funding; excessive fluctuations--as high as 50% between years--are particularly detrimental to research programs in view of their long term nature.
- To improve the disbursement of funds.
To improve the handling of external funds from donors.

Summary

I mentioned a long list of challenges facing NARS. All are important constraints to their overall productivity. All can be solved, depending on two factors: the political will to use agricultural research; and a sustained effort to build up the productivity of national research systems. This implies a serious effort to develop the kinds of improved management tools, mechanisms, and procedures these systems need to function more effectively.

The Plan of Action Proposed--The Research Agenda

I have no basic disagreement with the plan of action proposed in Annex I to the Bank's paper. The operational suggestions are based on solid criteria. I am concerned, however, that the view presented here may be excessively constrained. It places heavy emphasis on resource limitations, on the constraints of small and less-developed systems, on downstream/adaptive research. And it is short term.

I miss the vision that I think we need to mobilize commitment and support of African governments, donors, and NARS themselves. The challenge we are facing is such that we need to think big. To satisfy the pressing technology requirements for transforming African agriculture, we need a long-term strategy, innovative approaches at all levels, and the involvement of all partners in the process.

Here are a few brief comments on the research agenda ahead of us:

- Research history on most of the African food commodities is relatively short. The knowledge base is thin. This is a major complicating factor.

- The supply of improved technology for African food production systems is scarce. The shelf is close to empty. There is not much to adapt.

- Technology imported from other regions does not work. Mostly attempts to use or adapt high-yielding varieties (HYVs) from elsewhere have failed. Conditions elsewhere are different.

- Future technology supplies have to be developed in Africa under African conditions. These conditions are extremely diverse--as pointed out before. Research has to be targeted at specific ecologies and specific socioeconomic environments.

- Much of the basic research required for successful technology development in Africa has not been done. African
dryland farming systems are not well understood. We need upstream research as urgently as adaptive research.

- Although I agree that attention should be paid to on-farm adaptive research, we need to stress that this should be a normal part of a standard research process. The paper before us appears to over-emphasize adaptive research. At present, there is not much to adapt. We need to generate the new technologies. And that requires hard work at both upstream and downstream levels.

- Overall research needs are such that there is heavy demand on basic research to generate the necessary knowledge base. There is equal demand on applied/adaptive research to develop improved technologies for African dryland farming systems. Therefore, on balance, we need to focus on both ends of the research process. The difficulty lies in striking the appropriate balance.

- To cope with this extremely demanding agenda, we will clearly have to mobilize all available capacities in the global research system. Only a joint effort will yield the required results.
SOME ISSUES IN REGIONAL COOPERATION IN AGRICULTURAL RESEARCH
LESSONS FROM THE SOUTH AFRICAN REGION

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The adoption of new varieties of wheat, rice, and maize and the related crop management practices in the 1960s by farmers in Asia and Latin America brought about a "green revolution" that turned net importers of cereals into exporters. This dramatic change bypassed Africa. As a result, most of the countries in Africa continue to import food, and many of their citizens are either malnourished or in some cases actually dying of starvation.

The reasons for this are complex and based in historical, sociological, and economic as well as technical circumstances, but a major factor is the failure to apply technology stemming from research both within and outside Africa.

It has been argued by observers of the African scene (Eicher, 1986) that "problems associated with agricultural development are location specific and there must be a critical mass of agricultural scientists to generate or adapt technologies to solve these problems". 1/

Africa has not invested adequately in the training of scientists. It is a fact that the stock of human capital in scientific fields per million of the population in Africa in 1980 was only about one-fourth of that in Asia in 1970. It has been observed (New Scientist, June, 1987) 2/ that the developing world has three-quarters of the world's population, but just 6% of its scientists, and that in Africa, where the need for scientists is most acute, governments must invest more in training scientists and making the most efficient use of those that have already been trained.

Regional cooperation in agricultural research is one of the ways in which the available human capital can be most effectively utilized in the task of generating the technologies needed to help farmers at all levels raise their agricultural productivity. Of course, such measures have to be backed up by efficient extension systems at the national level,

appropriate economic and marketing infrastructures at the farmer level, and adequate support for research equipment, library, and information services and other resources. The lessons from regional cooperation in agricultural research in southern Africa is discussed in the following paragraphs.

A Historical Account

At a meeting in 1980, the nine majority-ruled countries of southern Africa—Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia, and Zimbabwe—established the framework for joint collaboration in the region, now known as the Southern African Development Coordination Conference (SADCC). At this meeting, these countries declared their commitment to pursue policies aimed at economic liberation and the integrated development of their national economies. They identified areas in which, working in harmony, they could gear national development to providing goods and services presently coming from outside the region and thus weave a fabric of self-sufficiency and development through regional cooperation. It was recognized that most of the people of southern Africa depended on farming as their principal employment and means of subsistence and that their future was threatened by environmental degradation. It was further recognized that environmental protection and food security were major challenges both nationally and regionally.

It was therefore decided that agriculture should be a principal sector for regional cooperation, with food security and agricultural research (and later research manpower and training) as the main subsectors for action. After examining various mechanisms for achieving cooperation in agricultural research, it was concluded that this could only be done through the medium of a coordinating center. Accordingly, in 1984 the Southern African Centre for Cooperation in Agricultural Research (SACCAR), was established as a SADCC Unit to provide the organizational basis for regional cooperation and to provide technical support for national research systems.

In accordance with the philosophy of the Southern African Development Coordination Conference (SADCC), namely that of keeping the regional institutions small but efficient, SACCAR was expected to remain small in staff numbers and facilities.

Activities of SACCAR

Historically, agricultural research institutions in the region in the colonial era were mainly concerned with servicing the needs of cash/export crops for both small and large-scale producers. The research in question was undertaken almost exclusively by expatriate staff.

In confronting the problems of agricultural production in the post-colonial era, SADCC initially identified sorghum and millet as the first target for a series of regional collaborative programs to be executed with aid from donor funding. This first program also marked a change of
priorities, away from emphasis on cash crops and toward the production of food crops, and the needs of the traditional small farmer as opposed to the commercial sector. This change in emphasis was greatly reinforced by the succession of drought years and the consequent serious food shortages experienced in many of the SADCC countries in the 1980s.

Subsequently, further regional programs were initiated for grain legumes, land and water management, in-service training in research management, agroforestry, crop and forest germplasm collection and conservation, a maize improvement network, and utilization of sorghum and millets for food and beverages. These projects are in various stages of planning and execution. More projects and programs of interest to two or more member states will be formulated in the future.

Maize self-sufficiency in about four member states has demonstrated the need for a revised comprehensive regional agricultural strategy. Since rural poverty is a central cause of malnutrition and household food insecurity, SADCC's regional research program has been broadened to include cash, export, and industrial crops. The product of such a range of regional research programs is, of course, the technology generated by each. But equally important is the catalytic effect of these programs, and the training, workshop, and other collaborative activities associated with them in stimulating and strengthening the national research systems in the region. In this way, the cause of national self-sufficiency is served, and new location-specific and income-generating technologies are generated. The net effect is to promote rural employment and raise per capita income in rural areas.

The following are the overall objectives of SACCAR:

- to promote and disseminate available technology;
- to promote and implement studies of problems common to all or to several member states and to initiate cooperative research to overcome them;
- to generate new technologies needed by farmers to raise the productivity of food and non-food crops, livestock, fisheries and forestry through regional collaborative projects and inter-country liaison;
- to strengthen national agricultural research systems and capabilities;
- to promote rapid and continuous provision, interchange, and utilization of scientific and technical information, both old and new;
- to provide such regional support services and functions as may be necessary to assist and inform national and regional research activities;
To develop a blueprint to train students within the region at B.Sc. level and to strengthen postgraduate training in agriculture in the region.

To implement these objectives, SACCAR has undertaken both service and coordination functions.

Service

The center (SACCAR) serves as the secretariat of its board, which comprises directors of agricultural research, deans of faculties of agriculture, forestry and veterinary medicine and directors of agricultural extension. The board reviews developments in world and regional agricultural development and formulates policies and strategies for agricultural development for the SADCC region.

The center is a depository for the agricultural development plans of member states. In this way it provides a basis of awareness both for itself and for its clients (national, international, and donor communities) concerning national and regional plans, targets, and programs for agricultural research and development. This awareness, in turn, makes it possible to assess current research efforts in the region in relation to national and regional development goals.

The center maintains an inventory of national and regional research systems. The purpose of this is to provide the necessary factual and statistical basis for assessing national and regional research capabilities in respect of the needed research inputs to develop the technology required to meet national and regional development targets. This includes manpower resources, projects, and support for research.

Through its board and some of its cooperating partners/donors the center has sponsored an agricultural research resources assessment study with a view to having basic data on the strengths and weaknesses of the member states' national research systems. The study revealed that the lack of adequately trained research manpower was common throughout the region. The center addressed this as a core issue and function. It cannot work in isolation, without the collaboration of member states, in trying to solve this issue. However, it assists by engaging in the following related activities: awards travel grants to enable scientists to make professional visits so that they can benefit from the experience and expertise of colleagues or more senior scientists in the region; awards research grants for work on problems of broad interest; and holds training workshops on selected topics.

Information gathered through this and other activities is used to identify the needs for collaborative studies of regional problems, workshops, seminars, and so on; determine regional deficiencies in research; and identify areas of focus for the SACCAR/SAREC small research grants program.
The center reviews national and international research programs with a view to strengthening national research programs and, in particular, to enhancing the effectiveness of regional cooperation. The center staff also participate in reviews and evaluations of current and planned regional projects involving the International Agricultural Research Centers (IARCs).

The center publishes a letter giving information about its own activities and other items of regional interest, such as forthcoming meetings, technical notes, and so on. The center is also formally responsible for the production of an agricultural research journal in cooperation with one of the SADCC member states, Zimbabwe.

A highly important activity in which SACCAR has a leading role is to initiate, organize, and sponsor workshops either independently or in collaboration with regional research programs, the IARCs, donors or donor agencies, or other agricultural institutes. These workshops have a major role in assessing the state of development in specific subject areas of common interest to the region, leading in some cases to the initiation of new research programs or networks, and in strengthening awareness in general in the national research systems.

Cooperation

Within this category of functions, SACCAR has a facilitating role that involves assuming responsibilities to the government of Botswana and to the SADCC Council of Ministers for overseeing the various regional programs in the agricultural research subsector. It also coordinates relations with donor agencies and with the various IARCs and other bodies responsible to SACCAR for executing the regional programs. SACCAR also has an important coordination role as a clearinghouse and referral point for information for the region.

Regional Cooperation in Agricultural Research, Related Experiences in the Past and Prospects for the Future

The joint report by the International Service for National Agricultural Research (ISNAR) and the Special Program for African Agricultural Research (SPAAR), sponsored by various donors, observes that research efficiency can be enhanced if research linkages across borders in Sub-Saharan Africa make full use of opportunities arising from the regional activities of international agricultural research centers, linkages between African researchers and their counterparts in other countries, especially if institutionalized by twinning. The report also refers to past regional organizations such as the East African Agricultural and Forestry Research Organisation (EAAFRO) and similar organizations in West Africa that ended in failure. This was because they had better facilities and conditions of service than national research systems (NARS) and therefore attracted better staff and received more regional and international attention than the NARS, and so aroused envy. It is also stated that another reason for the failure was the perception that the host country benefited out of proportion to its financial inputs. The report notes that governments in
various regional areas recognize the importance of regional cooperation in agricultural research and if this activity is to last, they must avoid the problems perceived as inherent in past cooperation endeavors.

In addition to setting limits on staff numbers in SACCAR to avoid the creation of a top-heavy bureaucracy, SADCC has also encouraged SACCAR to aim for the maximum dispersion of regional programs and projects around the region within the limits of ecological suitability. This ensures the maximum spread of benefit to the national agricultural research systems in the region.

SADCC itself is a relatively new initiative and, as a framework for promoting cooperation in different economic sectors of the region, has many aspects of wider interest, not the least of which are its decentralized mode of operation. In turn, SACCAR is evidence of the strong political commitment of the member states of SADCC to regional collaboration as a major route to serving both their individual and their collective interests in developing strong and efficient agricultural research capabilities.

The roles and functions of SACCAR in this context have been defined at the center, which will shortly move into its own accommodation built for the purpose and is now through its formative phase and into its fully functional mode.

It has been accepted by member states and donors alike that if lasting benefits at regional and national levels are to accrue from regional programs, the commitment to such initiatives must be long term. The task for SACCAR in discharging its leadership role is an arduous one—namely, to promote cooperation, ensure that it remains thoroughly well informed about both regional and national developments and needs, and maintain its service functions.

At the same time it is too early to assess the impact of SACCAR in the region. It is anticipated that support for SACCAR at the political level in SADCC and through funding by donors and by SADCC member states will continue for the next 15-20 years, which will give ample time for its impact to be come apparent.

There are many issues that relate to the development of agricultural research capability and that should feature in future action agendas. It is also certain that the performance of SACCAR as a coordinating and activating center will be closely observed both from within and outside the region, not the least because, in common with SADCC itself, it represents a new and potentially very productive model for collaboration between countries on the world stage.
AGRICULTURAL RESEARCH IN SUB-SAHARAN AFRICA: THE ROLE OF INTERNATIONAL AGRICULTURAL RESEARCH CENTERS

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The experience and success of the Ford and Rockefeller Foundations in special agricultural development assistance projects in Mexico and the Philippines led to the founding of the International Maize and Wheat Research Center (CIMMYT) and the International Rice Research Institute (IRRI). These two international agricultural research centers (IARCs) spearheaded the "green revolution" in Asia, Latin America (Mexico), and parts of the Middle East (e.g. Turkey). This led to the establishment of more IARCs, including CIAT and IITA in the late 1960s at Cali, Colombia, and Ibadan, Nigeria, respectively. Today, there are 13 IARCs under the aegis of the consultative Group for International Agricultural Research (CGIAR). Four of these -- IITA, ILCA, ILRAD, and WARDA -- are located in Africa.

Objective of the IARCs

The main objective of the IARCs is to execute multidisciplinary problem-oriented research of sufficient scope on mandate crops and/or problems with a critical mass of resources in partnership with national agricultural research systems in order to quantitatively and qualitatively increase food production in the developing countries of the world. These countries, especially those in Africa, have been experiencing a decline in per capita food production over the last two decades and are unable to satisfy the increasing demands of the rapidly growing population or cope with urbanization and other pressures of modernization. Most national agricultural research institutions lack the manpower and financial support needed to attain the critical mass, level of excellence, and scope of research that can effectively address the problems limiting agricultural productivity. More specifically, in their research, training, and outreach activities, IARCs interact with national agricultural research institutions to:

- quantitatively and qualitatively increase the production of major food crops grown by the majority of low-resource farmers, who produce over 90% of the food in LDCs of SSA;
- develop national capabilities to more effectively tackle location-specific problems limiting agricultural production by acquiring more adequate manpower and institutional capacities through training at the IARCs;
- ensure that the desired objectives of increasing production, which extend beyond the mandate of individual IARCs, are achieved.
through institutional linkages in research, training, and outreach activities that facilitate more effective tapping of the world's knowledge base and information systems in achieving the noble goals of mutual benefit to IARCs and NARS.

The objectives, activities, and program thrusts of the CGIAR under which the IARCs function are presented in Figures 1 and 2.

Ways in Which IARCs Beneficially Interact with NARS to Fulfill Objectives for Increasing Food Production

The various research, training, outreach, and related activities whereby IARCs in partnership with NARS help to increase agricultural productivity on a sustained basis include (1) germplasm exchange and sharing in progress made in genetic improvement of food crops; (2) farming systems research (FSR); (3) training; (4) cooperative projects or outreach; (5) documentation, information, and communication services; (6) multilocal testing and networking; (7) institutional linkages and twinning and related collaborative activities; and (8) field days, visitors, and miscellaneous services. These are briefly discussed in greater detail below, with specific examples drawn from IITA's experience.

Germplasm Exchange and Genetic Improvement

All IARCs whose mandates include one or more of the major food crops usually maintain germplasm collections of many accessions of these crops and their wild relatives. These accessions are made available to breeders worldwide and are also used in developing new varieties that are high yielding and possess one, two, or more desirable characteristics. The NARS benefit from genetic improvement programs of IARCs in various ways:

- NARS or individual breeders obtain breeding lines with specific desired commodity characteristics (e.g. supply of sources of streak-resistant maize or bruchid-resistant cowpea lines to collaborators in SSA and elsewhere).

- Promising improved cultivars are developed for multilocal testing trials (e.g. rice varieties from IITA, IRRI, WARDA, and NARS evaluated in the International Rice Testing Program for Africa, IRTP-Africa). Improved cultivars are developed that directly become new varieties and are released as such by NARS or are used as foundation seed (e.g. TZPB maize varieties released in its FARZ series by the National Cereals Research Institute, NCRI, in Nigeria).

- New crop varieties are developed jointly with NARS in cooperative or outreach projects -- for example, iron-toxicity resistance varieties of rice (SUAKOKO 8) released in Liberia and cassava cultivars resistant to cassava bacterial blight (CBB) and cassava mosaic virus (CMV) by the PRONAM program in Zaire (the last two
Figure 1: CGIAR Objectives and Activities

CGIAR GOAL
Contribute to increasing sustainable food production

Integration of Efforts

Strengthening National research capacities

Improving the Policy environment

Human nutrition

Commodity conversion and utilization

Crop productivity

Livestock productivity

SOURCE: Swaminathan, (1937)

Figure 2: The Program Structure of the CGIAR

CGIAR GOAL
Contribute to increasing sustainable food production in developing countries in such a way that the nutritional levels and general economic well-being of low income people is improved.

OPERATIONAL OBJECTIVES
PROGRAM THRUSTS

Enhancing sustainable agriculture through resource management and conservation

Increasing the productivity of commodity production systems

Improving the policy environment

Strengthening national research capacities

SOURCE: Swaminathan, (1937)
examples were both accomplished through bilateral programs funded by USAID).

**Farming Systems Research (FSR)**

Farming Systems Research consists of research programs aimed at developing more efficient production systems designed to increase agricultural productivity on a sustained basis and ensure more efficient resource management and the development of appropriate component technologies that are economically viable, ecologically sound, and culturally acceptable by being relevant to farmers' needs and circumstances. FSR involves (1) upstream diagnostic studies that improve knowledge of the farmers' overall environment, production systems, and constraints to increasing production as a basis for determining strategies and priorities in (2) on-station research, which evaluates viable alternative packages of technology for relevant commodity-based farming systems in selected environments, and (3) on-farm adaptative research (OFAR) or downstream FSR phase in which new technologies are evaluated with the farmers participating at the farm level and the adoption process monitored in such a way as to provide feedback to on-station scientists, identify constraints to adoption of technologies, and make it easier to introduce necessary modifications.

FSR provides many benefits:

- generates new knowledge and improves existing knowledge and data on traditional and prevailing farming systems or practices;
- facilitates the identification of preferred and desirable commodity characteristics that are useful to crop improvement programs in ensuring that local preferences and needs of producers, consumers, and processors are satisfied while also adapting these new crop varieties to different production systems;
- facilitates the design and testing of alternative production systems and their component technologies;
- enhances fine tuning of technologies developed in IARCs and research stations to the more location-specific conditions, farmers' needs, and circumstances;
- promotes the linking of research at the IARC and national agricultural research institutions with extension and the farmer at different phases of FSR, thereby enhancing relevance and rapid adoption of new technologies;
- through constraints research that makes it possible to quantify constraints that contribute to the yield gap between research stations and farmers' fields and determines ways of narrowing it;
provides opportunities for IARCs, NARS, and farmers to interact.

Training

Training at the IARCs covers a range of activities that help NARS develop manpower, and develop capabilities in agricultural research and in institutional building. Significant progress has been made in training through cooperation between IARCs and NARS involving courses at the IARCs, at offsite stations outside IARCs, and through various in-service or on-the-job experience opportunities. About 5,000 agricultural research scientists, technicians, and agriculturists have been trained by IITA, of which over 80% are from tropical Africa. A recent report on training indicates that about 20,000 participants worldwide had received various levels of training at IARCs by the end of 1984. Of this group 6189 or 33% are Africans (see Tables 1 and 2). The various categories of training provided at the IARCs include:

- postgraduate thesis-related research training under joint supervision of IARC scientists and professors of universities in Africa and elsewhere (this ensures that reasonable balance will be maintained between basic and applied research, and that training will be relevant to national needs and research priorities);
- commodity production courses, including courses in soil management, crop protection, tissue culture techniques, statistical methods, etc.;
- special skill training for technicians and supporting staff in agricultural research;
- vacation studentships that motivate promising undergraduate students to go into agricultural research as a career;
- postdoctoral fellowships that allow Ph.D. holders to gain relevant on-the-job experience that prepares them for work in the tropics, especially in Africa;
- visiting scientistships, which in addition to encouraging collaboration among experienced scientists at IARCs and various institutions, provides some on-the-job experience in research management (at present only ISNAR and ICIPE have programs that somehow address this problem).

Various aspects of training at the IARCs provide opportunities for life-long, individual, and institutional linkages between IARCs and scientists in NARS, including scientists and universities in developing countries working on problems of mutual interest.
Table 1: NUMBER OF PARTICIPANTS FROM DEVELOPING REGIONS OF THE WORLD
THAT HAVE TAKEN COURSES OF VARIOUS CATEGORIES IN IARCS BY
THE END OF 1984 (TAC/CGIAR, 1986)

<table>
<thead>
<tr>
<th>Region</th>
<th>Post Degree-Related</th>
<th>Visiting Scientists</th>
<th>Courses Training</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>doctoral</td>
<td>M.Sc.</td>
</tr>
<tr>
<td>Latin America</td>
<td>4,922</td>
<td>43</td>
<td>369</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>6,189</td>
<td>69</td>
<td>231</td>
</tr>
<tr>
<td>Near East &amp; North Africa</td>
<td>1,391</td>
<td>12</td>
<td>53</td>
</tr>
<tr>
<td>Asia &amp; the Pacific</td>
<td>6,275</td>
<td>275</td>
<td>648</td>
</tr>
<tr>
<td></td>
<td>18,777</td>
<td>399</td>
<td>1,261</td>
</tr>
</tbody>
</table>
Table 2: NUMBER OF PARTICIPANTS FROM DEVELOPING REGIONS OF THE WORLD THAT
HAVE TAKEN COURSES AT THE INTERNATIONAL AGRICULTURAL RESEARCH
CENTERS BY END OF 1984*

<table>
<thead>
<tr>
<th></th>
<th>Latin</th>
<th>Sub-Saharan</th>
<th>&amp;</th>
<th>Africa</th>
<th>North Africa</th>
<th>Asia</th>
<th>Totals</th>
<th>Developing Countries</th>
<th>Developed Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIAT</td>
<td>2,396</td>
<td>35</td>
<td>6</td>
<td>90</td>
<td></td>
<td>90</td>
<td>2,527</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>CIMMYT</td>
<td>1,281</td>
<td>478</td>
<td>490</td>
<td>792</td>
<td></td>
<td>792</td>
<td>3,041</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>CIP</td>
<td>850</td>
<td>477</td>
<td>395</td>
<td>746</td>
<td></td>
<td>746</td>
<td>2,468</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>IBPGR</td>
<td>201</td>
<td>147</td>
<td>109</td>
<td>363</td>
<td></td>
<td>363</td>
<td>820</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>ICARDA</td>
<td>3</td>
<td>40</td>
<td>326</td>
<td>64</td>
<td></td>
<td>64</td>
<td>433</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>ICRISAT</td>
<td>52</td>
<td>453</td>
<td>12</td>
<td>395</td>
<td></td>
<td>395</td>
<td>912</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>IFPRI</td>
<td>6</td>
<td>10</td>
<td>4</td>
<td>50</td>
<td></td>
<td>50</td>
<td>70</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>IITA</td>
<td>55</td>
<td>2,606</td>
<td>7</td>
<td>143</td>
<td></td>
<td>143</td>
<td>2,811</td>
<td>127</td>
<td></td>
</tr>
<tr>
<td>ILRAD</td>
<td>10</td>
<td>280</td>
<td>6</td>
<td>19</td>
<td></td>
<td>19</td>
<td>315</td>
<td>3</td>
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<tr>
<td>ILCA</td>
<td>1</td>
<td>280</td>
<td>4</td>
<td>1</td>
<td></td>
<td>1</td>
<td>268</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>ISNAR</td>
<td>-</td>
<td>147</td>
<td>-</td>
<td>-</td>
<td></td>
<td>-</td>
<td>147</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>IRRI</td>
<td>67</td>
<td>128</td>
<td>32</td>
<td>3,612</td>
<td></td>
<td>3,612</td>
<td>3,839</td>
<td>104</td>
<td></td>
</tr>
<tr>
<td>WARDA</td>
<td>-</td>
<td>1,128</td>
<td>-</td>
<td>-</td>
<td></td>
<td>-</td>
<td>1,128</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

*Source: TAC/CGIAR (1986) Training in the
CGIAR Systems. Rome: TAC/CGIAR/IRRI
International Cooperation on Outreach

These are special bilateral or multilateral cooperative projects in which IARC's collaboration with NARS is funded by donors of agricultural research and development projects in different countries. Such projects:

- afford IARCs opportunities to test and evaluate their technologies at the farm level;
- enable national institutions to more finely tune technologies developed at IARCs to the location-specific conditions of individual countries;
- provide opportunities for IARCs to become involved in the development of national capabilities in agricultural research and development;
- provide opportunities for IARCs to pool resources, integrate their technologies, and test them in relevant environments, thereby determining whether their technologies are compatible in different production systems;
- facilitate collaboration in multilocalational trials, net working and FSR.

Figure 3 shows the extent to which IITA's programs were involved in different outreach programs in SSA in 1986.

Documentation, Information, and Communication Services

Progress in scientific research is most rapid where researchers are able to communicate among themselves through documentation and by sharing information on advances and problems being encountered in scientific research. The IARCs are engaged in a wide range of activities that provide documentation, information, and library services and that facilitate publications, dialogue, and exchange of information among their scientists and others interested in or working on similar problems. Activities and services involved include publishing, which at IITA produces the following categories of publications: annual reports and highlights; conference, seminar, and workshop proceedings some of which are sometimes published as reference books by reputable publishers; training manuals for courses in crop production, soil management, conservation, analysis, etc.; research bulletins and reprints of staff publications in scientific journals; newsletters; cooperative or outreach project reports; and bibliographies, such as those on yams, cowpeas, and so on.

Publications by IARCs are usually distributed free or at reduced prices to those who need them worldwide, especially to those in developing countries. Libraries and relevant research institutions in developing and developed countries are on the regular mailing list of IARCs, but some individuals are also included. Note that when IITA was founded, one of the
Figure 3: Main Special Projects of IITA Coordinated by the International Cooperation Program (ICP) in 1986

Note that ICP ensures integration and linkage of IITA's programs with NARIS and the farmer, thereby ensuring testing, evaluation, adaptation and adoption of technologies and feedback to researchers (B.N. Okigbo / F.M. Gatmaitan, Jr., IITA, 1987; Okigbo, 1987).

NCRE: National Cereals Research & Extension
CNRPCP: Cameroon National Root Crops Improvement Program
GCF: Gatesby Charitable Foundation
AGCD: Administration Générale de la Cooperation au Developpement
IDRC: International Development Research Centre
USAID: United States Agency for International Development
WB: World Bank
CIDA: Canadian International Development Agency
RAV: Recherche Applique et Vulgarisation (Applied Agricultural Research and Outreach)
SAFGRAD: Semi-Arid Food Grains Research and Development
reasons it was located at Ibadan was to facilitate use of the good library facilities at the University of Ibadan. With the unfavorable economic conditions in Nigeria and other countries in Sub-Saharan Africa the demands on our library facilities have escalated to the point where they sometimes have adverse effects on the institute’s work. The same is true of computer services.

Conferences, workshops, seminars, meetings, and special lectures organized at IARCs and sometimes jointly with IARCs and other institutions also facilitate communication and the sharing of information.

**Multilocational Trials and Networks**

These provide opportunities for interaction and the exchange of information on genetic materials and the sharing of data on technologies emerging from research at the IARCs and NARS. As a matter of policy, the IARCs usually do not formally release crop varieties developed by their scientists in genetic improvement programs. All relevant data about improved cultivars that have been shown to give high yields through multilocational trials, that possess various desirable characteristics, and are otherwise adapted to environments of client countries, are usually made available to all who require them. Formal releases of such varieties are then usually carried out by national institutions. Multilocational trials also allow IARC breeders and their counterparts in NARS to participate in joint testing and comparative evaluation of promising new crop varieties developed in all collaborating institutions. For example, the International Rice Testing Program for Africa (IRTP-Africa) provides opportunities for testing promising rice varieties -- developed by breeders at IRRI, IITA, WARDA, and NARS in SSA at selected sites in many parts of Africa.

Similarly, networks promote collaboration among IARCs, institutions, and individual scientists on selected research problems, where the progress made facilitates sharing of information on technologies, materials, practices, and alternative production systems being developed by all the institutions in the network. Scientists involved in multilocational trials often engage in evaluation visits, publish newsletters and special reports, and participate in field days, conferences, workshops, and so on. Useful networks in which IITA is involved include one in alley cropping and the West African Research Cooperative on Plantains/Starch Bananas (WARCOP).

**Institutional Linkages and Twinning**

The IARCs are all involved in different collaborative projects with NARS and institutions or centers of excellence, including universities, in both developed and developing countries. For example, IITA collaborates with ICPE in breeding for insect-resistance in cowpeas and maize. IITA has collaborated with the Commonwealth Institute of Biological Control (CIBC), CIAT, and other institutions in Africa and Europe in the development of the Africa-wide Biological Control Program.
Figure 4: How IITA Interacts with National Research Systems and Other Research Institutions in Research, Training and Related Activities (Okigbo, 1987)
(ABCP) on the cassava mealybug and green mite. IITA collaborated with the University of Reading in cowpea physiological and crop ecology studies that facilitated progress in breeding improved cowpeas. Linkages with special institutions have been found necessary in virus indexing and related virological studies and in tissue culture work, to facilitate distribution of virus-free planting materials to collaborators worldwide. IITA is also giving some consideration to forging linkages with institutions engaged in certain aspects of biotechnology in which IARCs are not likely to be involved but from which they could benefit in their work.

International agricultural research centers interact with policymakers, farmers, the public, politicians and other IARCs and NARS in other ways as well, notably field days, visitors services, and consultancies in which "expert" opinions are required on technical issues or feasibility studies for agricultural development projects involving the use of technologies and information being developed at the centers, including data being collected by IARCs such as IFPRI and ISNAR, which are not available elsewhere. IARCs are involved in expert consultations of FAO and as resource personnel in certain workshops and conferences. The institutional linkages in which IITA interacts with other IARCs, NARS, and various institutions are shown in Figure 4.

Problems Encountered by IARCs in Their Work

The international agricultural research centers are relatively new, as is the CGIAR. So far they have difficulty establishing their role in relation to those of other regional or international institutions and national agricultural research institutions and organizations. Collaboration among individuals and institutions is like marriage, which is easily contracted but can only be successful if continuous effort and compromise are devoted to making it work. This is especially the case when IARCs have to collaborate as big brothers with NARS in activities funded by the same donors or organizations that also fund national research and agricultural development programs in many countries of SSA. IARCs should therefore be sensitive to the fact that NARS sometimes regard themselves as underdogs in competing for funds with IARCs in the donor market. NARS scientists should exhibit greater understanding of activities of IARCs and scientists, and both institutions should do their best to encourage collaboration and understanding in such a way as to more synergistically establish fruitful and lasting partnerships. Problems that have reared their heads so far are briefly reviewed below:

- The extent to which technologies developed by IARCs are adopted and the objectives of their partnership with NARS realised have been found to depend largely on the capabilities of NARS, their extension services, and agricultural development policies. Since many NARS in Africa are weak, it follows that unless they are strengthened very limited progress in increasing agricultural productivity can be achieved from collaboration with IARCs.
The weakness of NARS as a result of deficiencies in funding, manpower resources, facilities, and commitment accounts for the fact that NARS often regard IARCs as being in a preferred position for obtaining donor funds at the expense of NARS. Therefore donors should give higher priority to staff and physical resources development in NARS in bilateral and multilateral foreign assistance programs.

Whatever the nature of the partnership between IARCs and NARS and the scope of research, training, outreach, and other related activities, the extent to which the full potential of this partnership is realized depends on whether the individuals involved are able to strive to make it work.

The IARCs are not mandated to provide agricultural research management training for NARS, except to the extent that ISNAR assists in doing so or advantage is taken of the training programs of such institutes as ICIPE that offer courses in this area.

IARCs have forged fruitful collaborations in manpower development with universities in SSA, but in many countries, universities function in isolation and have little to do with the government agricultural research institutes or extension and development programs. More emphasis should be placed on developing stronger collaborative mechanisms that effectively link institutes and faculties of agriculture, including departments of fisheries, forestry, and faculties of veterinary science in the NARS, where these exist.

Although IARCs in their activities in Africa have developed mechanisms for harmoniously collaborating with each other, the intensification of IARCs and donor interest in assisting with efforts aimed at finding solutions to the African food crisis sometimes breeds what appears to be unnecessary competition among IARCs, which confuses researchers in NARS. Continuous effort should be directed toward eliminating this confusion.

Oftentimes participants in programs at IARCs are not given an opportunity to work in the area of their training, when they return to their home countries. Furthermore, sometimes when they are employed in projects related to their training, they are unable to utilize their skills and experiences owing to the lack of logistical support and deficiencies in institutions and infrastructure.

The above list is by no means exhaustive, but it does indicate some of the problems that need to be eliminated if the effectiveness of IARCs in their interaction with NARS is to improve significantly. I should also mention some things that IARCs are not in a position to do, even
though NARS may wish them to do so and may stand to benefit from such activities.

- Many times IARCs cannot fulfill NARS demands when they involve activities outside or in peripheral areas of their stipulated mandates.

- IARCs cannot do much about inconsistencies in policies, strategies, and priorities of individual countries of SSA in agricultural research and development, nor can they do much to eliminate the undesirable political changes and deficiencies in infrastructure that adversely effect technology adoption and success of programs aimed at increasing agricultural productivity. However, IARCs in farming systems research, which identifies constraints to increased production, and studies of IFPRI, ISNAR, and other institutions, identify deficiencies and inconsistencies in agricultural research and development programs of individual countries in SSA.

- IARCs cannot do much to bring about more effective coordination in NARS or the regional collaboration of individual African countries in such organizations as WARDA. However, IARCs have developed successful linkages and collaboration among SSA countries in such programs as SAFGRAD, IRTP-Africa, and so on.

- It is the responsibility of individual countries to create the links between education, research, extension, and the farmer that are essential for agricultural development. It is also a national responsibility to ensure relevance of curricula and to ensure that more qualified intelligent students get into agricultural research. IARCs have limited roles to play in this regard. For example, the extent to which IARCs can redress the current serious imbalance in training at IARCs in favor of women depends on individual SSA countries.

- The package of technologies in various production systems that are required to increase agricultural productivity in many countries of SSA or in different ecological zones may involve commodities, practices, and components that any one IARC is working on, as stipulated by its mandate. Only through collaboration among relevant IARCs, special arrangements with the appropriate national and international institutions and agencies that have relevant components of such technology packages, and components of sustainable production systems can the full components of such packages of technology be assembled at any one time.

- The focus of donor-country projects and priorities in agricultural research and development programs cannot be determined by IARCs, but IARCs can assist in recommending priorities, strategies, and guidelines in bilateral and
multilateral agricultural research and development programs, especially those in which one or more IARCs themselves are involved. IARCs, of course, have the responsibility to stipulate conditions under which they can best participate in such programs.

- When technologies such as improved crop varieties or appropriate mechanical devices gain widespread adoption or popularity, there is often an escalation of demands for seed multiplication and input supply, which the IARCs cannot directly satisfy. IARCs can only render assistance to NARS to meet such demands and even then this will depend on available resources and the extent to which they can do so without adverse effects on their approved mandate.

- Certain aspects of post-harvest technologies such as food processing, are not covered in the mandates and activities of IARCs, but may be crucial in ensuring ultimate nutritional impact or realization of higher income. IARCS can only assist in this regard through linkages with more development agencies such as FAO, and special institutions such as universities in developing and developed countries to ensure success.

Concluding Remarks

Sub-Saharan African countries must face the fact that the most serious problem in the world today is the inequality in their capabilities to compete with the developed countries of the world and with each other in sharing limited, scarce, and the unequally distributed natural resources required to produce food or satisfy other human needs. There is a limit to which they can rely on donors and IARCs in ensuring greater self-reliance and commitment, formulating adequate policies, and executing programs for increased agricultural productivity on a sustained basis in order to achieve adequate levels of food security and self-sufficiency.

A historical review of the development of national agricultural research systems in Africa shows that the botanical gardens and research stations in Africa--of which there were about 343 at the time of independence of most African countries--were established only a little time after the first agricultural experimental stations were founded in Buchelbronn in Alsace, France, in 1834, and in Rothamsted, England, in 1843. For example, the oldest research station in Nigeria was established in Moor Plantation near Ibadan in 1899, about 56 years after that of Rothamsted and only 22 years after the first experiment station was established in Connecticut in the United States (in 1877). The scientific method—the application of which to research institutionalized agricultural research and the application of statistical methods to field experimentation pioneered by R.A. Fisher—did not come into widespread use until the early 1900s. Therefore, it is obvious that the cultural and socioeconomic environment and the absence of or very slow evolution of a scientific culture more likely contributed as much to the weak status of national agricultural research systems as the colonial policies and
emphasis on cash crops, which are often emphasized. A more serious
dispasionate assessment of the situation may help us to fully comprehend
the reason for the disappointing performance of NARS in SSA and more
effectively redress the situation.

African countries should devote more effort to ensuring political
stability, consistency in their policies and allocation of resources on a
continuous basis to agricultural research and development at levels
commensurate with their declared priority of achieving self-reliance and
food security to satisfy the demands of rapid population growth and
urbanization. IARCs and donors can only assist in this process but the
burden is still mainly that of individual countries in Africa.

Finally, it is rather disturbing that over two decades after
independence, more of the data base and expertise on African agriculture
and natural resources needed for agricultural development is concentrated
in Europe than in SSA. Measures must be taken to redress this imbalance by
ensuring that African researchers and specialists involved in agricultural
research have available in Africa, an adequate library, documentation, and
necessary data required in their work.

There are several institutions, laboratories, and museums in
Europe that have conducted research on Africa since the colonial era and
are repositories of publications and information and specimens of Africa's
plants and animals. Among, these institutions, those that need to continue
collaborating with NARS are listed in the Appendix.
APPENDIX: RESEARCH INSTITUTES AND AGENCIES IN THE UNITED KINGDOM AND FRANCE THAT CAN USEFULLY CONTINUE TO COLLABORATE WITH SUB-SAHARAN NARS*

A INSTITUTES AND AGENCIES IN THE UNITED KINGDOM

1) The Antilocust Research Center
2) The Tropical Products Institute
3) The Tropical Stored Products Center
4) The Tropical Pesticides Research Unit or Headquarters
5) The Rothamsted Agricultural Experiment Station
6) Research Institutes and Units of various universities, e.g. National Institute of Plan Breeding at Cambridge, Insecticides Research Unit at the Imperial College of Science and Technology, etc.

Various other institutions and agencies that may be involved in research and development include Commonwealth Mycological Institute, Kew; The Royal Botanic Gardens, Kew; The Land Resources Division of the Directorate of Overseas Surveys; National Institute of Agricultural Engineering; Commonwealth Institute of Entomology; Commonwealth Institute of Biological Control, etc.

B INSTITUTES AND AGENCIES IN FRANCE

(a) L'Office de la Recherche Scientifique et Technique d'outre-Mer (ORSTOM), (b) l'Institut d'Elevage et de Médecine Vétérinaire des Pays Tropicaux (IEMVT), (c) the Centre Technique Forestier Tropical (CTFT) which cover research in agronomy, animal husbandry and forestry, respectively. There are also individual commodity research institutes that may be involved in contract research work or in collaborative research ventures. These include:

- i) Institut pour les Huiles et les Oléagineux (IRHO)
- ii) Institut Français de Recherche Fruittiers (IFAC)
- iii) Institut de Recherches du Coton et Fibres Textiles (IRCT)
- iv) Institut de Recherches sur le Caoutchouc Afrique (IRCA)
- v) Institut Français de Café et Cacao (IFCC)
- vi) Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières

*For details on collaborative research projects, see Arnon (1968), Okigbo (1987)
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THE SPECIAL PROGRAM FOR AFRICAN AGRICULTURAL RESEARCH (SPAAR)

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The growing realization of the need for better agricultural technology in Africa is leading to a number of initiatives by the international agricultural research and donor community. These initiatives are aimed at institutional development of national systems and improving the capacity of national programs to make better use of the outputs of new technology, and trained staff of the international centers, develop better coordination among donors, and build regional networks and programs for a range of commodities.

The issues pertaining to technology assume particular significance in view of the high population growth rate in African countries and the emerging pressure on land; the variety of agricultural conditions in many parts of Africa; the fragility of the soil; and of course the fact that national agricultural research in Africa has failed to meet national needs for improved technology by which to increase yields, for disease-resistant and drought-resistant crops, and for appropriate methods of using marginal lands. Furthermore, the work that we do and the money we spend on international agricultural research will not bear fruits unless we also take measures to strengthen the work in national agricultural research institutes.

As far as we can see, traditional agriculture will not be able to cater to the agricultural needs of Africa in the future, and therefore new technology and production methods will indeed be needed. Of course, new technology alone will not improve production, but it is one important factor. Other factors that are equally important are production incentives for the farmers, a good agricultural policy, trade, infrastructure, availability of fertilizer, seeds, mechanization, and so on. There is considerable donor support for national agricultural research in Africa, and substantial sums of money are going into the national programs through the bilateral donors, the World Bank, and other multilateral organizations and the international centers. But there is a lack of cooperation and coordination. "Donor coordination" is a phrase that comes up at every meeting. Everyone agrees that donor coordination is an absolute must. Everyone wants to coordinate, but it seems that no one wants to be coordinated.

How can this be done in the international agricultural research system? As a group, we discuss our goals and common objectives, we define strategies by which to reach those objectives, and then we contribute
individually to those objectives. In fact, we combine the cooperation that we get through collective discussions with the advantages of individual distribution. The way in which the CG system is working is probably a model in which cooperation rather than coordination works pretty effectively. Everyone has heard the horror stories about 200 or more donor missions having visited a country, so that the researchers in the country have no time to do research. Perhaps we could speed up with the badly needed research work if we had fewer missions to the countries concerned. Donors are going on mission alone, because they have technical and also political reasons for working in a particular country. But I am sure that one of the reasons why they do behave in this individual fashion is just a lack of knowledge about what other donors are doing. How may donors know about the programs of others? What overlaps and contradictions exist? The first step to remedy this situation should be to collect information and make it widely available. Obviously the countries themselves should coordinate the activities, but this is not always possible and the resources to do that are often not very great.

Therefore, the World Bank at a meeting of major donors in Tokyo in June 1985 proposed to find a way that would enable donors to operate together in supporting national agricultural research in Africa. Nearly all donors agreed that this action was necessary and so the Special Program for African Agricultural Research (SPAAR) was born. This led to the formation of a steering committee and the development of a work program.

The World Bank's generous offer to house the secretariat of SPAAR at its headquarters in Washington, D.C., and to meet the operating expenses was accepted by all donors. The SPAAR program is a long-term one, but it appears to be off to a good start. Its main working program at present consists of the activity we are discussing in this meeting along with about nine activities that I briefly outline below.

Establishment of a SPAAR information system

As I have already mentioned, information is the basis for cooperative action, that is, information on what is available in agricultural research systems. Over the years quite a lot of research has been done by many agencies and universities in national programs and by donors who have operated bilateral and multilateral programs. Some of the results have been published, but some are hidden in files and drawers, never to appear again. It is possible to use normal computer systems to gather and provide information about research projects—for example, information about the agro-ecological zones, research targets, research fields and disciplines, the amount and type of assistance provided, and other important items. In each donor country there is a so-called focal point that is responsible for the gathering of research project information, which then will be transferred to the SPAAR secretariat where we now have a centralized computer information system to which all donors and of course also all African decisionmakers and research organizations will have access. This data base helps improve research planning, provides a basis for research cooperation, and saves money by avoiding duplication.
of work. All African countries are invited to take part in this joint activity of exchanging research information.

Provision of small grants for African researchers

In many cases it is just a small component that is missing and preventing a research institution or a researcher from getting back on stream and out of the isolation. There is a lack of books, journals, and facilities for up-to-date information. Sometimes there is no means of transport to reach the field and the farmers, and also no means to take part in a meeting with colleagues of other African countries. Often the equipment a researcher badly needs for his work is missing. It is remarkable, when one looks around, to find just how many small things are missing. Here one could help with a relatively small amount. The donors in SPAAR therefore agreed to make money available for small grants to promising African scientists for their research activities. The money is given through the International Foundation for Science (IFS) in Stockholm, which already has long years of experience in this field. The amount for this year was about US$2 million.

Setting guidelines for strengthening national research system

To assist African governments in strengthening their national agricultural research capacities, a SPAAR working group for strengthening national research systems was set up. A revised draft was presented to African agricultural research directors attending the Nairobi and Cotonou regional meetings organized by the World Bank last year. The finished document has been widely distributed to African countries and the donor community.

Assessment of promising technologies

Another ongoing SPAAR project is the assessment of information on promising technologies. Considerable research work on various aspects of African agriculture has already been undertaken, but the research results have largely been underutilized for a variety of reasons.

French, Senagelese, and British scientists have gathered data on promising technologies in Senegal and Sudan. Both teams have worked in clearly defined agro-ecological zones. Initial efforts have uncovered a surprising wealth of information and research results. It is believed that some of the technologies may be applicable, but they were mostly never used at the farm level-- either they were never tested or the results were not published. The final reports will be presented at the next SPAAR meeting in October 1987.

Networking

Many countries in Africa are too small to have full-fledged national programs on all the commodities relevant to them. That is where
networking is becoming extremely important. Research networking is not new. The international nurseries set up by IRRI for rice and by CIMMYT for wheat germplasm testing in different ecological zones are well known. The SPAAR working group on networking has produced a list of 42 networks in Sub-Saharan Africa on commodities such as maize, sorghum, millet, cowpeas, oilcrops, etc. Despite the very rapid increase in the number of research networks in Africa, collaborative research is not as well developed as in Asia or South America. The main reason is that there are fewer well-trained research managers and scientists in Africa to manage the networks. SPAAR for the moment has identified 14 networks that should be developed and financially supported. Besides these five SPAAR activities, we have set up three working groups—on forestry research, agricultural research priorities, and education and training.

Last, but I hope not the least, I would like to mention a SPAAR activity that really boils down to customary practice and that will be a cornerstone and could prove whether SPAAR is an action-oriented forum for donors who are willing and able to cooperate to support national research systems. Coordination has to be action orientated; otherwise the coordination is going to be roundtable stuff only.

In the last meeting of SPAAR, we decided to have countries where, in a concerted action of donors and local scientists and government representatives, a strategy for the improvement of existing national research could be worked out and carried out and tested. At present, these countries are Cameroon, Mali, Sudan, and Tanzania. They were chosen because they already received significant support for agricultural research from several donors, and these single activities have to be coordinated. We are starting with these few countries, because there is not much experience in coordinated action. We have already set up a working group on Tanzania, which met the day before yesterday and discussed plans for strengthening national agricultural research capability in Tanzania.

In this meeting, details were also given of the negotiations currently under way between the government of Tanzania and the World Bank on a project for restructuring Tanzanian agricultural and livestock research. The working group agreed that SPAAR, in close collaboration with Tanzanian research organizations, would contribute to various fields such as the development of a plan of agricultural research, a so-called master plan in the preparation of a state-of-knowledge report on research training, particularly with respect to using and strengthening national in-country training capability. Furthermore, joint research projects could be carried out to develop stronger links between Tanzanian scientists and institutes and scientists and institutes of the international centers and the donor countries. This is an offer to the Tanzanian government by a group of donors in SPAAR, which could be realized if requested by the Tanzanian side.

I would also like to mention that all these SPAAR activities are geared to the development of national research in Africa. It is not necessary to point out that these activities could not be planned without
African representatives. In recent meetings we personally invited representatives from Nigeria, Tanzania, Ghana, Cameroon, Mali, Togo, Senegal, and SACCAR-region. I would be happy to see 5-6 African researchers sent to the SPAAR meeting officially in the future. At this meeting you will probably decide who to nominate. The official representatives from Africa could rotate after three years, but during this time they should also work with us outside the SPAAR meetings, in the working groups that I have mentioned.

I have said earlier that some African countries are too small to have a full-fledged national research infrastructure. This and the fact that research work could be done to some extent on a regional basis reminds me of what Dr. Köhler said this morning, and I think we should seriously ask why there is no regional grouping like SACCAR in West Africa. I believe that donors in SPAAR would also support such a regional institution if such a request was made by the African side.

Joint activities in strengthening agricultural research in Africa is a challenge for all of us.
SUMMARY OF PLENARY DISCUSSION

The discussion following the presentation of papers on the status of agricultural research in Sub-Saharan Africa and instruments for strengthening it was lively and free-ranging. It centered around five major and frequently interrelated issues:

- Finance
- Research relevance and dissemination of results
- Linkages between national research services and regional and international agricultural research initiatives
- Institutional arrangements
- Government pricing and marketing policies

The problems of providing sustained financing of national research services at adequate levels were widely recognized. Salaries typically take the lion's share of recurrent costs but the problems were judged to be most acute in respect of funds for such items as purchased inputs and transportation needed to conduct field trials. The foreign exchange component of such costs tends to be high and consequently make it difficult for governments to provide the foreign currency needed. Donor financing of these elements of research budgets was recognized as a valuable feature of the start-up phase of many projects. However, such funding rarely continues until project completion, and since many host governments fail to assume funding needs, projects are often abandoned before meaningful results have been obtained.

Participants agreed that funding sources other than regular budget allocations or short-term donor-funded projects do exist and they called upon the working group designated to address financial issues to explore these other possibilities. The creation and operation of national Science and Technology Funds was cited as one means of collecting and administering financial resources for agricultural research. Delegates cautioned, however, that funding of any kind would be difficult to obtain and sustain unless the decisionmakers concerned perceived the research in question to be relevant and likely to produce tangible economic and financial results.

The relevance of research and dissemination of results were recognized as central issues in the agricultural and economic development of the region. At least two audiences must be considered in this respect. First, economic planners and financial decisionmakers will have to be convinced of the relevance of research objectives or they may not be willing to initiate funding for research projects. Furthermore, they will
have to remain convinced of this relevance during execution of projects, which can take several, and sometimes many, years. These considerations also apply to external donors but, it was observed, there are instances in which donors have their own agendas for funding research projects, and these agendas do not always accord precisely with the research objectives of host governments.

Second, and most important, the audience of farmers must be taken into account. These are the potential consumers of research results and stand to benefit if the results are relevant to their agricultural, social, and economic circumstances. Otherwise, resources devoted to research would, to a greater or lesser extent, be wasted and the credibility of research would be eroded among both farmers and funders.

Delegates agreed that an efficient mechanism for disseminating research results is an essential complement to the accurate diagnosis of research problems, their prioritization, and subsequent resolution. The importance of farming systems research for small farmers was cited as an example of belated recognition of research problems requiring accurate diagnosis. Discussants viewed agricultural research as a service and not an end in itself and pointed out that this fact must constantly be borne in mind by all concerned.

Attention was also drawn to the need for expanded research on post-harvest, storage, and processing issues. These areas have all been neglected by national and international agricultural research systems. They are becoming increasingly important now, and this trend should be reflected in future research priorities.

While recognizing the important part played by international agricultural research centers, delegates urged that the linkages between these centers and national systems be strengthened further. Nevertheless, they felt that Africans, especially uninformed decisionmakers, tend to underestimate the capabilities of national staff and institutions. This failing could best be corrected by improving output and the management of research--areas in which delegates agreed there was indeed room for improvement.

These observations led the discussants to examine the underlying causes of low research output and related questions. Poor conditions of service and chronic lack of resources were thought to be prime reasons for this state of affairs in many African countries. The relevant discussion groups were asked to explore possible solutions further, which, it was agreed, might include creating recognized research services outside the regular civil service structure, interacting more closely and seeking greater compatibility with the university community, and initiating structural reforms in national agricultural research institutions.

A major concern of the discussants was that attention be given to the policy climate in countries in respect of market opportunities, producer pricing, and subsidy policies. Participants agreed that these
factors need to be taken into account in the formulation of agricultural research strategies and programs. Such linkages underscore the importance of close interaction between finance and planning agencies with those concerned with agricultural research and development, a point that should be clearly made in the World Bank's strategy paper.
POLICY IMPLICATIONS OF STRENGTHENING NATIONAL AGRICULTURAL RESEARCH SYSTEMS: THEMES AND CONCLUSIONS OF THE WORKING GROUPS
INTRODUCTION

The second day of the Feldafing Meeting was devoted to working sessions in which participants deliberated the key issues and policy implications of strengthening national agricultural research systems. Whereas the first day was taken up with briefing delegates on this subject and presenting the proposals developed for strengthening agricultural research in Sub-Saharan Africa, the discussions of the second day generated much of the substantive output of the meeting. That is, the specific recommendations of the assembled delegates as to whether these proposals should be accepted, modified, or rejected. Their recommendations were seen to be an important input to the final and definitive version of the research strategy, to be issued after the meeting.

The chairmen of the working sessions were chosen from among the African delegates. Their function was to help the participants articulate their views on the topics covered by the session that they chaired and to present a summary of these views to all participants. Chairmen were assisted in this task by a discussant and a secretary. Discussants were senior members of international organizations, chosen for their wide-ranging experience of the issues to be discussed. On the basis of the first day's presentations and their own knowledge and experience, they introduced the topics that they considered to have priority. Subsequently they provided additional practical guidance to the chairmen and delegates as the discussions proceeded. They also assisted chairmen in summarizing the delegates' recommendations for presentation at the following day's plenary session. Secretaries, who were professional staff of the host institutions, assisted chairmen and discussants by taking notes during the working sessions and in drafting recommendations.

The six working sessions were organized as follows. Each discussant presented a brief opening statement to the assembled delegates meeting in plenary session. The meeting then broke up into separate, concurrent working sessions, each having its own chairman, discussant, and secretary. Discussants recapitulated or expanded on their opening presentations as necessary. Each concurrent session had two sittings of about two hours and a different set of delegates. This arrangement allowed each delegate to contribute to two of the six working sessions. Delegates were asked to state their choice of sessions on arrival at Feldafing. Simultaneous French-English translation was provided during all working sessions. When discussion ended, the chairman, discussant, and secretary met to draft the recommendations of the session. Finally, chairmen reported conclusions and recommendations of their sessions in a brief address to the plenary session of delegates the following morning.
The six themes chosen for discussion in the working group format were as follows:

- Role of agricultural research in national development strategy
- Technical and research programming issues
- Financial issues
- Education and training issues
- Organization and management issues
- Regional collaboration, networking, and international agricultural research centers.

Although the group concerned with the role of agricultural research in national development strategy attracted the largest number of participants, none functioned with less than six in either of the two sessions. A summary of the major themes discussed and the conclusions drawn by the respective working groups is presented in subsequent pages. Some discussants prepared scripts of their material, which are reproduced in these Proceedings. Other statements are based on notes taken during oral presentations.
I want to make only one point of a preliminary nature. Although this point is probably recognized by most of us, by making it we will be clear in our thinking and in our communication. The point I want to make consists of three parts. First, the output of agricultural research is new knowledge. Second, on the biological and physical side, that knowledge is ultimately reflected in new production technology which raises the productivity of the traditional resources of land and labor. Third, on the social sciences side, the new "technology" is reflected in improved economic policy, in new and improved institutional arrangements, and in improved resource efficiency—its own an important source of economic growth.

From these premises, I move on to the six principal points of my presentation. I would warn those of you who don't know me that I am usually referred to as a "provocateur." That is because I try to challenge people to think differently about things that are generally well ingrained in their thinking patterns. Today, I will stick to that tradition, because I will ask you to think differently about things that are probably well-ingrained in your thinking patterns.

The six points I want to emphasize as we consider the role of agricultural research in national development strategies are as follows:

1. The fundamental role of agricultural research as part of a development strategy is to raise the productivity of land and labor—the two most important resources in most developing countries. Notice that I did not say that the role was to increase agricultural output, although that will be a logical consequence of raising productivity. To promote economic growth and development, however, our goal must be to raise resource productivity. In low-income countries, the bulk of the nation's resources lie in agriculture. Moreover, the productivity of these resources tends to be very low. Raising that productivity can be a very powerful source of economic growth. That is what new production technology
does, and that is why investing in the capacity for agricultural research and in the support of such research is such a high-payoff investment.

2. **Agricultural production technology**—an output of agricultural research—**is a powerful and important source of new income streams in an economy.** It is of the utmost importance that we think about it in this way. Unfortunately, all too often we tend to think about it from a production perspective. That is, we tend to think only of increasing agricultural output. This, unfortunately, lulls us into traps such as taking food self-sufficiency as a research goal, or into the counterproductive discussion of whether food crops or export crops should receive the highest priority in research programs.

When thinking about agricultural research as a source of economic growth—and that is the way we should think about it—we should be looking for those investments that will give society the highest rate of return. In assessing those rates of return, we should look not just at the producer side. After all, the ultimate beneficiary of new production technology and improved resource efficiency is the consumer. Only a modest share of the benefits ultimately redound to producers. The benefits to the consumer are reflected either in lower prices for food, in expanded export earnings that can be used to promote a higher rate of economic growth, or in reduced imports that release foreign exchange for this same purpose.

A corollary that is equally, if not more important is that by creating declines in the real price of food, new production technology is a source of economic growth whose benefits are distributed progressively to the low-income groups in society. A decline in the real price of food constitutes an increase in the real income of consumers. Since low-income consumers spend a relatively larger share of their income on food than do upper-income groups, the lower-income groups benefit more in a relative sense.

Thus we see that we have to consider the whole of society in thinking about agricultural research, not just the producer side. The benefits of agricultural research are pervasive in the society. And that is why the social rates of return to such investments are so high. If we consider only the producer side, we miss most of what is important.

This issue is also important from the perspective of food security. It is commonplace today to think about food security from the production or supply side alone. Thus, governments focus on food self-sufficiency, on carrying stocks, and on other means of assuring adequate supplies. What they fail to recognize in doing this is that malnutrition and famine are primarily a consequence of inadequate means and poverty, either at the level of the individual family or at the level of the nation as a whole. Moreover, carrying stocks is expensive, as every finance minister knows, and they are also difficult to manage. On the self-sufficiency side, India is a perfect example of a country that technically became self-sufficient in food and carried up to 25 million tons of grains in stocks, yet one in which malnutrition was rampant.
Professor Sen, a famous Indian economist, emphasized this connection between poverty and hunger some years ago in an important little book. The World Bank in its food security policy paper, entitled Poverty and Hunger, makes the same point, while discussing in some detail the policy implications of this important relationship. From our standpoint, the issue once again is the importance of viewing new production technology as a source of income streams, not of production per se. To be more specific, raising productivity in export commodities may be a more effective means of dealing with the food security problem than raising the productivity of food crops. Please note, if you will, that I said it may be. This, like so many other issues in this area, is an empirical issue that requires empirical analysis, not an ideological issue that can be answered in an a priori sense.

4. Agricultural research contributes to economic growth and development by improving trade performance. Despite the presence of extensive barriers to trade in agricultural commodities and the recent intensive and wasteful use of export subsidies on the part of the EEC and the United States to dump their surpluses abroad, most countries in Africa need to increase their export earnings as a means of servicing their foreign debt and paying for the imports needed for more general economic development.

In addressing this issue, I would like to make three quick but important points. First, comparative advantage in today’s world is based on human capital, not on the natural endowment of land and climate. Investments in new production technology and in the education and training of the rural population are the keys to remaining competitive in international markets. In the final analysis, there is no other way.

Second, the only defense any country has to the persistent decline in their external terms of trade is to raise productivity in their export sector. If productivity is raised, there will be no minimizing effects from the decline in price, since costs will be reduced to offset it. In fact, if productivity growth can be sustained at rates higher than the decline in external prices, the country can actually increase its real exchange earnings at the same time that the price for its export commodity declines.

Finally, we must recognize that in many, if not most African countries, the barriers to agricultural trade are for the most part self-imposed, not imposed from abroad. These barriers are made up of hugely overvalued currencies, large export taxes, and direct barriers to exports so as to keep domestic food prices low. Until we reduce this gross discrimination against agriculture, the chances of moving external barriers to trade are slim. (The shibboleth in most developing countries is that it is the middlemen who exploit farmers. It’s time we shine the spotlight where it belongs—on what governments do to exploit farmers with their urban-biased economic policies.)
5. **Agricultural research can contribute to economic development by reducing environmental damage and improving sustainability.** Sustaining our resource base is critical to longer-term productivity and growth, and can also have a high rate of return. The agenda here is long and much neglected: soil conservation, water harvesting, watershed management, agroforestry, alley cropping, and so on. These issues need to receive priority attention, and should be integral parts of the more general research agenda.

6. **Finally, I want to stress the importance of economic and other social science research.** Such research has a number of roles to play in furthering economic growth and development. First, science and technology policy and economic policy are highly complementary. No matter how successful the new production technology, it will not be adopted if the incentives for producers are not right. Hence, economic and other social science research that leads to improved economic policy causes the investments in agricultural research to have a higher payoff to society.

Second, new and improved institutional arrangements are needed as economic development proceeds. This includes credit systems that are truly financial intermediaries instead of channels for government subsidies, new marketing arrangements, improved risk markets to transfer the risks inherent in agriculture to those more willing to bear it, and so on. These new institutional arrangements are in effect the "technology" for the biological and physical sciences. They are every bit as important as the production technology itself.

Third, economic and other social science research is also needed to keep the new production technology on an efficient growth path. In this sense it has a fundamental role to play in establishing research priorities. Finally, economic and other social science research is important in understanding the adoption of the new production technology by the farmers. This provides important feedback to researchers, as well as guidelines for the farmers.

Thus we see the high complementarity between biological and physical research, on the one hand, and economic and other social science research, on the other. One simply cannot have sustained agricultural development without knowledge generated by the full range of disciplines.

**Concluding Comments**

There are many things I have not covered in these remarks, which I hope we can get into in the working groups. Among these are such things as nutrition, education as a complement to research, the optimum size and extent of research systems, and so on.

There is one point I would like to emphasize in closing, however. I often hear ministers of state and other policymakers say that developing countries cannot afford to invest in agricultural research. I would urge those who think along those lines to recall that all the evidence we
have--and it is considerable--indicates that the rate of return to investments in agricultural research is quite high, ranging from 35 to 70, and well over 100% per year in perpetuity. With rates of return that high, the point is, no country can afford not to make such investments. To do otherwise is to sacrifice important sources of economic growth.

I hope that in some small way I have helped you to think differently about agricultural research and its role in economic development.

**Chairman's Report**

Participants felt that the reality of the African continent should form the basis for discussing the complex issue of the Role of Agricultural Research in National Development Strategy. Its complexity was reflected in the differences of opinion expressed within the group, the findings of which are summarized below.

- Delegates stated that Africa is a very diverse continent with considerable agroecological variation, which prohibits generalizations.
- The present research systems are fragmented and in general represent what the countries inherited from colonial powers after independence.
- It was concluded that many research results are dispersed and have not been collated within or between the countries of the continent.
- Discussion arose concerning the suitability of the technology developed and the poor adoption rate by farmers. The problems in these areas have been due in part to a lack of knowledge about what farmers need. Some delegates also noted that agricultural research planners and managers fail to consider women, even though they constitute a significant proportion of the farming population in Africa. In this regard the absence of women participants from the meeting was noted and regretted.
- The role of agricultural price policy in stimulating production was discussed at length, but no consensus was reached on this issue. However, some delegates expressed support for initial subsidization to encourage the uptake of inputs that form components of new technologies.
- The group agreed that most African economies are very susceptible to price fluctuations on the world market as they rely on only a few export crops. It was felt that this influence could be reduced by diversifying production.
No consensus was reached on whether developing countries should rely on food self-sufficiency or on food security. The group felt that research could play a role in alleviating this problem, but further analysis of this complex issue was needed. The role that export crops could offer by opening new avenues of income was questioned, since developing countries have no control over world market prices.

The negative influence of food aid on changes in food habits and on local food production was pointed out, along with the need to develop food-processing technologies for local crops.

The consensus was that further research efforts are necessary to develop new technologies, but that a balance must be found in addressing short- and long-term problems.

To develop appropriate technologies, planners must have a better understanding of farmers' goals and constraints. Research is a service that has to consider the needs of the clients.

Furthermore, the weaknesses within research institutes need to be clearly identified and remedied. Delegates felt that socioeconomic problems were neglected by most research institutes. It is equally important for research institutes to be capable of analyzing market opportunities so that they can guide decisionmakers.

Delegates agreed that research organizations (including universities) in most African countries fail to maintain a constant and systematic dialogue among themselves, nor is there, in general, a strong linkage to the policy level. Delegates also noted that it is critical for researchers and planners, as well as researchers and extensionists, to interact constantly.

Better integration and cooperation between the various research institutes and universities within countries is important if they are to make better use of scarce resources. Equally important is cooperation and division of labor at a regional level within Sub Saharan Africa.

Emphasis should be placed on producing and retaining well-trained scientists since they form the capital on which to base all further steps in agricultural research. Attention must therefore be given to strengthening the universities in African countries.

All participants stressed the potentially important role of private sector research.
TECHNICAL AND RESEARCH PROGRAMMING ISSUES

Chairman: Rabesa Antoine Zafera, Ministre de la Recherche Scientifique et Technologique pour le Developpment, Madagascar

Discussant: C. Bonte-Friedheim, Assistant Director General, Agriculture Department, Food and Agriculture Organization, Rome, Italy

Secretary: A. Viereck, German Council for Tropical and Subtropical Agricultural Research, Bonn, Federal Republic of Germany

The discussant proposed that a matrix approach be used to link issues of significance to economic development with research priorities and targets (Appendix).

Participants were reminded that the critical factors to consider in setting research targets and choosing the approaches to meet them are agro-climatic conditions, key commodities — i.e. the choices to be made between subsistence, cash and foreign exchange earning crops, and the farming systems in which they are produced — social structure, and the different types of experimental approach. The quality of individual researchers is another critical factor and, within research systems, responsibilities must be clearly defined with emphasis on objective and systematic monitoring of progress and evaluation of results.

The discussant urged participants to consider the importance of operational structures and procedures in research programming. They need to be addressed not only in the context of national institutions and responsibilities, but also in relation to regional and international bodies if maximum complementarity and cost effectiveness are to be achieved. In the smaller countries in particular, issues of critical mass of research personnel loom large in the face of multiple demands for research attention and priorities. Rational priority setting is therefore essential in research programming.

Participants were also asked to give more thought to the relative merits of single-discipline vs. the multidisciplinary approaches to programming research activities in the context of commodity, system, and factor research. Although the tendency has been to approach applied and adaptive research from a multidisciplinary standpoint, certain problems are probably more readily solved by a single disciplinary approach. In view of the importance of communications between researchers and with research consumers, more attention should be given to information systems for data handling and exchange. These are but one of the many areas requiring financing and demonstrate the importance of financial sources to research programs. Programs must be carefully phased if finance is to be sustained
over periods of three to four years at a minimum, and frequently much longer.

Donor preference for funding particular programs is important but should not be permitted to override national priorities. Nor should researchers' preferences for particular topics, although important in obtaining high quality results, be permitted to override national priorities.

Chairman's Report

The group met twice and in the first session used the matrix provided by the discussant to examine important research priorities and targets. Useful input came from participants who have experienced very different ecological conditions, farming systems, and institutional arrangements. For example, in some countries there are a number of independent institutions, whereas in others research centers are fully controlled by government, and in still others university research is linked to national research programs. Furthermore, comments pertaining to the varying size of countries and numbers of agro-ecological zones provided an additional perspective to the discussions. Despite some differences, the group agreed on a number of points:

- Research programs should be allotted a specific period of time in which to complete their activities: 3-4 years for short-term, 7 years for mid-term, and up to 12 years for long-term activities.

- The national plan is a prerequisite for formulating research policy and setting priorities. Therefore the national plan should be the end result of inputs from various levels and various sectors of the government.

- Priority setting must be linked to the macroeconomic framework as well as the financial policies and resources of the government.

- Research institutions should be relatively free to determine their own programs as long as they are in line with the national program for research.

- Basic research is required in Africa for the normal development of science and technology.

- The mandates of national institutions and research programs should be reviewed from time to time, preferably every five years, but not more often since policy might therefore become unstable. The review of the institutions should be addressed to the highest office of government directly responsible for research. In certain cases, programs should be reviewed as a national exercise; in others, a joint national and international approach addressed to the institutions' management would be more appropriate.
Delegates emphasized that a good information system is essential to improve ongoing research or initiate planned research.

Information systems must be coordinated if duplication is to be avoided. Subregional coordination was considered to be a priority. The example of SADCC 3/ was quoted repeatedly as one that should be studied for its possible application or adaptation in other regions.

Delegates cited examples of agreements with industry involving specific research. It was suggested that when industries are the end users of research findings, they should provide a tax-deductable percentage of their earnings to a research fund to help pay for the work carried out in their interest.

It was felt that donors should seek to strengthen national institutions by providing them with research contracts rather than relying on external institutions. Revenue from other activities, such as seed production, could also be considered. However, such ventures should not be permitted to distract institutes from their primary purpose, which is to perform research tasks.

The consensus was that research institutions should actively seek to acquire whatever resources are available, provided that funding sources do not attempt to interfere in the setting of national research priorities.

The second session covered a wide range of topics covering both the foregoing issues and others of common interest. The principal points made were as follows:

- It was proposed that means should be sought to protect agricultural research from the harmful effects of frequent political change.

- Closest possible integration and cooperation with universities was emphasized and it was felt that in many countries the universities could take over much of the agricultural research on a contract basis.

- The need to stabilize funding of research was reemphasized.

- Some of the discussion concerned the need for small countries with similar ecological zones to promote close cooperation with each other in order to establish joint programs.

3/ Southern Africa Development Conference.
Delegates emphasized that in general the multidisciplinary approach to research needs to be given priority. It might perhaps require more manpower than the monodisciplinary approach, but overall it will provide the target group with more relevant results and hence better service.

Following a long discussion of food versus export crops, it was recommended that agricultural research should seek to improve monetary incomes in rural areas either by promoting the introduction of cash crops or fostering other cash-earning activities by promoting increased productivity of food crops, and thus expanding income-earning opportunities.

Delegates also discussed the influence of donor preferences, which was thought to be especially strong in countries that either lack the economic basis for independent research or are too weak to withstand pressure from some donors. It was noted that unfortunately tied aid covers agricultural research as well as inputs. Therefore, when donors supply funds to help implement government policy and programs in the agricultural sector, they should be asked to do so without interfering unduly in the ordering of national priorities.

Many countries do not have the foreign exchange to obtain the equipment and spare parts they need to conduct research programs. It was felt that donors could provide a valuable service by providing funds to cover these necessary expenses.

Despite the short time allotted to addressing the subject, the group carried on a lively exchange of views and ideas. Participants felt that more benefits could be derived from such discussions if they were given more time.
## APPENDIX

### RESEARCH PRIORITIES AND TARGETS

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FINANCIAL ISSUES

Chairman: Robert Kitariko Kikomo, Minister of Agriculture and Forestry, Uganda

Discussant: H. Wyss, Director, Technical Department, Africa Region, World Bank, Washington, D.C., U.S.A.

Secretary: U. von Poschinger-Camphausen, German Council for Tropical and Subtropical Agricultural Research, Bonn, Federal Republic of Germany

The discussant outlined an agenda of issues for consideration, beginning with the need to establish clear criteria for the allocation of funds. The criteria should be objective and apparent to all concerned. Moreover, it must be possible to readily decide on the adjustments to be made as a result of changes in overall levels of available funding. Different criteria may need to be applied for different funding sources, whether in the private or public sector.

Another critical point raised concerned the need to achieve funding stability during the time it takes to execute research programs, and at the levels required. The measures used should be in line with agreed criteria and should achieve an appropriate balance between capital and recurrent costs. The discussant urged that an effort be made to anticipate as closely as possible the operating and maintenance costs to be generated by investment in capital goods such as equipment and physical infrastructure. It is also important to balance out personnel costs and funds needed for other recurrent expenses such as the operation and maintenance of equipment, the purchase of materials (including scientific journals), and transportation.

Third, key issues in the financial management of research include the degree of autonomy permitted between the local spending authority and centralized control. Whether results are obtained in seasonal trials often depends on recognizing the seasonality of research activities and the adequate and timely release of funds.

Fourth, if the financial support from donors is to be managed effectively, attention must be given not only to the issues raised earlier, but also to ensuring that the proposed allocation of funds is clearly understood. Efforts to promote standardization in equipment provided and to obtain a clear agreement on acceptable procurement and reporting requirements are also important in this regard.

Fifth, planners and research managers need to put more thought into expanding resources and finding more imaginative ways of funding.
research in Africa. Some possibilities to consider are cesses on production, taxes on export commodities, and other avenues of cost recovery from the beneficiaries of research. Such approaches could relieve the cost burden on government general revenues and budgets. They would also force researchers to focus on the needs of research consumers and hence ensure that their programs would be relevant to producers and would promote agricultural development.

At the same time, researchers should be permitted to benefit financially from the results of their work. For example, they should be given appropriate incentives, whether in the form of improved conditions of service, performance bonuses, or tangible recognition of the cash value of genetic improvements produced by researchers in plants and livestock. Most African countries have depended on increased agricultural productivity as their engine of economic growth, but have failed to return sufficient funds to agricultural research to support the efforts needed to sustain and enhance priority programs. Work is needed to develop and test mechanisms designed to guard against this state of affairs. This work cannot take place unless funds are earmarked for research activities designed to help achieve national economic development goals.

Chairman's Report

Several points of view emerged in the working group concerning financial issues. It was agreed that the political will of a nation to promote agricultural research needs to be repeatedly expressed at the highest level of the government in order to find the support to establish a national master plan of consistent and manageable priorities for action and then to secure long-term financial support. However, authorities must guard against the temptation to address too many issues and thus spread resources too thinly to be effective. Furthermore, financial planners and decisionmakers should make every effort to see that promising preliminary research results can still be followed up when initial funding allocations have come to an end. Continuous funding is also vital for the training of research workers.

The working group identified several potential sources of funding for agricultural research that are already partly in use. These include core support from the national budget, contributions from export earnings, and levies (e.g., on marketing of agricultural products, import-licensing, inputs, and on financial institutions). But, bearing in mind the need for sustained levels of funding, mechanisms must be devised to counteract possible instability, such as the oscillation in export crop earnings. Also, a substantial portion of counterpart funds recovered from food aid should go toward agricultural research. The group recommended that complex areas of research be packaged into programs that could be supported by several donors according to their best capability. This would enable donors to obtain the most efficient use of their resources.

Finally, the working group called upon authorities to investigate organizational problems with a view to finding flexible mechanisms for
funding, establishing scientific linkages internally and externally, and guaranteeing accountability in financial and scientific terms. This may be best achieved via semiautonomous research institutions.
EDUCATION AND TRAINING ISSUES

Chairman: Dzingai Mutumbuka, Minister of Education, Zimbabwe

Discussant: B. Abbai, Principal Economist, Technical Department, Africa Region, World Bank, Washington, D.C., U.S.A.

Secretary: D.C. Pickering, Technical Department, Africa Region, World Bank, Washington, D.C., U.S.A.

The discussant examined education and training issues against the backdrop of the summary on Manpower Requirements provided in pages 12-14 of the Eastern and Southern Africa Agricultural Research Review:

"The strength of an agricultural research system is determined in large part by the training, motivation and innovativeness of its staff. A decline in producing future researchers jeopardizes the continent’s long term ability to take advantage of worldwide advances in science and technology. Regarding training, solid post-graduate programs exist only in a few African countries, and their capacity does not provide replacements for attrition at today’s modest staff levels. On motivation, Drs. Hirst and Green, in their paper on tree crops, address this topic by saying: "(We need)...policies that provide the stable career prospects, the intellectual incentives and the financial rewards necessary to encourage the best staff to dedicate their careers to the improvement of agriculture." In contrast, the present situation is characterized by:

- **Insufficient training**: Many research staff have no advanced degree and little training in research methods (at least 10% of scientists ought to have a Ph.D.). Furthermore, the planning and analysis of experiments leaves much to be desired, and the significance of the findings may be questioned.

- **Lack of "knowledge services"**: Few libraries, newsletters, and external contacts are available to inform researchers and students of developments in agricultural science in their countries and abroad, and to facilitate the dissemination of their own results.

- **A high attrition rate**: The attrition rate is probably in excess of 7% a year (which is twice the rate regarded as acceptable in developed countries), and jeopardizes the continuity of research as many research efforts are aborted.
A lack of entrepreneurship. The ability to articulate hypotheses, develop a relevant research program, and mobilize resources to carry it forward is hampered by the increased bureaucratization of research.

One of the first national priorities should be to upgrade the skills of existing researchers. However, this must be linked with efforts to strengthen the national capacity for research management and leadership, which is equally essential, and with steps to reduce the reliance of the region on expatriate specialists. Meanwhile authorities can continue to consolidate research services and correct the imbalance between salaries and operating costs. Once this is achieved, the expansion of research systems can be resumed; the eventual goal would be to allocate 1.0% of agricultural GDP to research. At that level, Africa would need 4-5 times its present number of researchers.

Up to now, postgraduate technical training of researchers abroad has proved to be of little relevance to domestic problems, except for the training in the few overseas institutions that have developed tailor-made courses for Africa. Also, much of it has been wasted because many students never return. Some workshop participants suggested that, where foreign postgraduate training is inevitable, students should be directed to distinguished universities in other developing countries, with the proviso that thesis work be done on the problems of, and under the joint supervision of, university/research staff from their home country. Smaller countries of the region that are unable to sustain an agricultural university of adequate standards should be encouraged to seek agreements with neighboring countries for postgraduate, and, if necessary, undergraduate, training. Experts from IARCs should be encouraged to provide researchers from national systems with more training on scientific methodology, complemented by training in report writing, communications, and the use of information systems.

Improvement in the quality of local undergraduate training is also of crucial importance to research and agricultural development. Postgraduate programs that have already been initiated in large countries may need to be strengthened as well. However, universities have also been starved of funds, and many agricultural faculties have deteriorated rapidly, in parallel with the national agricultural research system. To correct this situation, painful adjustments may be needed: For instance, student admissions may have to be limited to match available funds, and measures taken to increase efficiency and recover more costs from students. Because teaching is divorced from research and extension, the profession is less relevant. Workshop participants felt that more university staff should participate in research, and that research staff should teach courses at universities. Research organizations might also set aside
resources to support research projects proposed by university staff. Such initiatives could make it possible to exploit recent scientific breakthroughs more rapidly, but they would depend on the active cooperation of university administrators, who would have to agree to reduce the teaching load on lecturers. A university outreach program to acquaint staff and students with farmers' constraints would also help.

Meaningful work and adequate training may improve morale, but this alone will not be sufficient to overcome the high rate of attrition of research staff. Many research personnel receive low civil service salaries and work under poor conditions. The Workshop participants urged that more countries follow the example of Malawi, for instance, which is considering special legislation that would bring the salary structure for senior agricultural researchers more in line with that of physicians in the public service. Performance bonuses should also be made available to reward breakthroughs and encourage work relevant to overall development objectives, while a certain flexibility in the salary structure should be permitted to reward research staff showing particular entrepreneurial talent. The general level of salaries for public sector researchers should correspond to that of university teaching staff. Finally, recruitment and promotion should be based on merit only, and in-service training should be regarded as a vital development factor.

Chairman's Report

Both working sessions concentrated on three overall issues:

1. There is an overriding need to change the attitudes of rural youth, most of whom do not wish to enter the agricultural sector. These attitudes must be changed. That means agriculture must become an attractive occupation to young people and must offer the best minds a good opportunity to work in developing and disseminating new agricultural technology for the betterment of economic development in their countries. African governments must design policies that will bring about this change in attitude through policy interventions that recognize the all-important role of agriculture in promoting economic development.

2. More specifically, governments need to define national objectives for agricultural development, for education and training objectives in agriculture in general, and for agricultural research in particular.

3. Training for agricultural research must be the product of policies agreed between all responsible agencies in government at the highest level, such that no individual agency—whether agriculture, science and technology, or
education--can promulgate policies without appropriate mechanisms for checks and balances to ensure that the national interest is best served.

Both sessions of the group discussions recognized the importance of the issues outlined by the discussant. A summary of their observations on the individual items follows:

**Education and Training Issues**

1. **Strengthening of Faculties (Departments) of Agriculture in African Universities for Undergraduate Education:** Each government should first attempt to provide its own resources for such strengthening. They should call for regular curriculum reviews to meet changing needs; see that undergraduates receive field training; establish minimum national standards for staff:student ratios; provide adequate facilities, relevant training, and accreditation reviewed at regular intervals, upon which government funding would be based. Donors have an important role in providing the foreign exchange needed to improve library facilities, accessibility to technical journals, laboratory and other essential equipment, and training opportunities for teaching staff, preferably within Africa, but also elsewhere as appropriate.

2. **Postgraduate training:** Advanced training should take place within the country or elsewhere in Africa, if at all possible, to guard against disorientation, possible domestic problems, and the desire to emigrate. Where local capability is limited, African institutions should seek the services of appropriate, qualified visiting professors and academic supervisors. Donors can help by agreeing to strengthen postgraduate training and promoting the return of émigré African academics to their home countries for postgraduate training on a temporary, or preferably a permanent, basis. African governments should enunciate clear policies to this effect and discourage postgraduate students from going abroad unless the training sought cannot be provided by any other means. Although discussants supported the idea of creating centers of excellence in existing universities, they did not favor creating new regional universities in Africa.

Joint action for postgraduate work, both M.Sc. and Ph.D., should seek to strengthen partnership (twinning) arrangements between developing and developed country institutions, as appropriate, where mutual benefits can be gained. Stronger linkages should be sought between national research institutes and universities with International
Agricultural Research Centers (IARC) that can provide research and supervision opportunities in mutually agreed fields. The IARC should make more effort to provide these opportunities for African postgraduate students rather than those from developed countries.

Upgrading of Technicians, Scientists and Research Managers

1. **Upgrading of technicians:** This should preferably be done in-country; if necessary, trainers could be brought in from appropriate IARC or other institutions.

2. **Midcareer updating of research scientists:** This should be encouraged by African institutions in appropriate techniques and disciplines, either within Africa in recognized centers of excellence such as IARC; in national or regional centers; or overseas, especially for those outside the university community. Donors should be encouraged to fund such training within Africa or elsewhere, as mutually agreed.

3. **Training of research managers:** This training is also most important and should be given similar encouragement by national governments and by donor agencies.

Transfer of Technology

Top priority should be given to this area. Training should be offered in both technical and communication skills. Particular emphasis should be placed on client needs, especially in regard to the role of women in extension services for agricultural production and home economics. Planners should also focus on school leavers and adult education in rural development, utilizing donor assistance to provide mass media, such as publications and radio, by which to facilitate staff training and extension work, in accordance with planned programs in this regard.

Adequacy of Supply and Stability of Funding

The success of research programs in general and the training of staff in particular depend on an adequate amount and continuous supply of funds. This in turn depends on clearly articulated programs having national government commitment, thereby facilitating local funding and giving donor agencies confidence that their assistance will be supported by counterpart financing in the medium and long term. In both cases, funding is more likely to be provided and sustained if steps are taken to ensure that performance is regularly and effectively monitored and that results are evaluated against stated goals. A 15-year time frame is probably needed, and should be clearly divided into 3- to
5-year tranches, each having its own objectives and stated goals.

Conditions of Service and Incentives for the Creativity of Research Workers

Most discussants considered these to be inadequate and to need improvement. One solution would be to provide government and university staff with the same terms and conditions of service, thereby recognizing the status of researchers and facilitating the interchange of staff between both groups of agencies for research and teaching purposes, to the benefit of both. In addition, means should be sought to reward researchers financially, or in other status-enhancing ways, for producing research results, such as improved varieties of crops or improved technologies that have an impact on development. Thus, they would be encouraged to continue their efforts in their chosen fields, and would be more willing to remain in service, despite competing attractions from outside national research or university institutions.

The foregoing presents the highlights of the two groups' detailed discussions on the Education and Training Issues.
The discussant drew attention in particular to four sets of issues, each of which is composed of a number of subsets.

The first set concerns institutional structures and organizational forms. These need to be viewed in terms of the size appropriate to current and anticipated circumstances, which in turn might depend on the maturity of the research system. Furthermore, structural issues must be examined at the national level, as well as in the zonal institutes and local experimental stations.

The second set of issues pertains to mechanisms that would encourage research organizations to interact with other agencies. Among the more important ones cited are the extension service and other agricultural and rural development agencies. Effective linkage mechanisms are vital for education and training institutions, and especially the university community, if research organization is to be effective. Mechanisms are also needed to promote interaction with bilateral, regional, and international development agencies actually or potentially involved with agricultural research in the country. Linkages with the international agricultural research centers (IARC) are of special importance in this group. Finally, and this would depend on individual country circumstance, mechanisms need to be developed for promoting interaction with relevant segments of private sector research and development activities.

Among the most important management issues in developing national agricultural research systems are those related to personnel policies and procedures. Components that are frequently interdependent include qualifications, performance evaluations, and promotion criteria. Terms of service were recognized as a problem in many national research systems. Key factors in this area include salaries, allowances, housing provision, hardship allowances for outstation postings, and interchangeability with university personnel in the case of government research departments. An overriding goal of those concerned with formulating personnel policies and procedures for agricultural research workers should be to foster maximum creativity and commitment to the aims and objectives of research plans and programs.
Another important set of issues deserving attention has to do with the role of expatriates in national agricultural research systems in Africa. It is important to establish, on the basis of country policies and circumstances, priorities for the use of expatriates and the precise roles that are either acceptable or unacceptable to both host and donor agencies. Working relationships, terms of reference, monitoring and evaluation of performance are all important, as also is the question of long-term residential contracts versus short-term multiple visits. The central concern, however, is that the activities of expatriates should have lasting benefits in view of their high cost relative to that of local research workers.

Chairman's Report

Thanks were expressed to the World Bank for its unconventional invitation to African policymakers to discuss their problems together in the context of formulating the Bank's strategy in this important area.

The Working Group agreed that it is of utmost importance to organize and manage national research systems in such a way that they can become significantly stronger and more effective in producing useful results to farmers. Most systems in Africa are still far behind the level they should have reached at this stage of development. The credibility of the national systems needs to be established.

Discussants supported the general thrust of the draft strategy paper with respect to this topic, and noted some points that they felt deserved somewhat more emphasis, without substantial changes in basic orientation. These are outlined in the following paragraphs.

The professional and scientific environment can and must be improved in order to foster better research, particularly by bringing together all the active participants within a framework of stronger coordination at the national level--this includes the various ministries involved, extension services and farmer organizations, the private sector, and universities with research institutes.

The research system must be coordinated under a general policy framework provided by the central government, but should be given considerable autonomy in managing research and implementing its research programs.

In particular, far better incentives with respect to both salary and physical conditions must be provided for research workers. Key staff can only be retained and new talents successfully recruited if, among other things, their salaries are brought in line with those of the university community. Such action would facilitate more interchange of senior staff, when appropriate.

The collection and management of data and information can and must be given higher priority in research planning and management.
National research administrators are involved but seldom manage these data and information systems, in part, because in many cases most of the useful information is more readily available outside Africa. It is felt that donors could be helpful in correcting this state of affairs.

External factors can be either positive or negative in fostering stronger national systems. They are positive when they seek to supplement and stimulate national capacity, which can be particularly important for smaller countries. However, donors can weaken these systems by sponsoring uncoordinated research initiatives that are not rooted in priority-focused national research programs, including networking initiatives. Donors can also weaken national systems by providing expatriate technical assistance that replaces rather than strengthens national scientific and institutional capacity. With regard to the latter point, more flexible use of long-term and short-term technical expertise may be helpful.

Among the most important things policymakers can do to strengthen national research systems is to give agricultural research higher priority and support the management of these systems with more funding and more stability in funding and to grant them higher respect and backing in carrying out the above tasks.
REGIONAL COLLABORATION, NETWORKING AND INTERNATIONAL AGRICULTURAL RESEARCH CENTERS

Chairman: Anastase Ntezilyayo, Ministre de l'Agriculture, Rwanda

Discussant: C. Farrar, Executive Secretary, Consultative Group for International Agricultural Research, Washington, D.C., U.S.A.

Secretary: S. Hocombe, FAO/World Bank Cooperative Programme, Rome, Italy

The Discussant divided the topic into two broad interrelated perspectives: the external contribution and the national contribution. In the case of the former, important issues include the role of regional research organizations, bilateral, and multilateral donors, and the special role of the international agricultural research centers (IARC) to facilitate the creation and free exchange of new scientific knowledge as well as the provision of technical assistance to support national research systems. This technical assistance could take a variety of forms, including the creation of germplasm and technologies for national testing; human resource development; the provision of specialist staff, equipment, and information sources; and direct funding. It is important that potential contributions be assessed in relation to perceived needs and take into account what national systems have to offer. The objective should be to achieve maximum complementarity between external and national contributions to the research effort.

Improving the impact and outreach of IARC and other relevant donor agencies is considered an important, necessary, and difficult task for those concerned with strengthening national research systems. As a first step, those directly involved must agree on a clear and objective definition of national strengths and weaknesses in order to obtain maximum complementarity between the groups of agencies that could be of greatest assistance in the fields in question.

More specifically, it is important to identify and establish the priority of the topics for which collaboration is being sought. Depending on local conditions, these might include focusing on particular commodities or production systems, human target groups, factor-based research such as soil or water management, agro-ecological zones or geographic regions, alone or in a variety of combinations.

Collaboration between national systems directly or via some form of networking arrangements is potentially important. But like other forms of collaboration, it can raise political issues that will be reflected in government attitudes and policy, for example, toward the free exchange of
information or germplasm or even complete technologies. Issues of national or individual proprietary rights can arise and need to be taken into account. Participants may wish to consider the roles of the different levels of agencies in networking. How far should each go in respect of network management, organization, and financing?

Differences of opinion can be expected concerning the appropriate balance between scientific and socioeconomic research, between emphasis on particular commodity or factor research, and how responsibility can best be shared between the international, regional, and national systems. What are the views of participants regarding IARC collaboration with national systems on cash and perennial crop research, especially in the context of existing and evolving farming systems, bearing in mind the need for realism as to the capabilities of each in particular fields? Obviously there are no single or simple answers to any of the questions raised but that does not mean that they should not be asked or considered.

Chairman's Report

The working group addressed the issues of regional collaboration, networking, coordination, international agricultural research, and manpower development in the course of its deliberations. The group's conclusions and recommendations are summarized below.

National Level

The Working Group stressed that instead of characterizing the participants in national research programs as donors and recipients, more attempts should be made to establish genuine partnership. It was emphasized that donor coordination of external support for national programs is essential, but is only feasible where there is an established national plan to develop the research system. Where no suitable plan exists, donors should give priority support to the elaboration of such a plan as a first, immediate step. Once a plan exists, the benefits from other support, from interactions with IARC and nongovernment organizations, as well as from participation in regional programs and networks are likely to be greatly increased. The establishment of donor coordination mechanisms at the country level would greatly enhance the momentum already being achieved by SPAAR.

Regional Cooperation

The Working Group recognized that well-coordinated regional research programs prevent the duplication of efforts, economize in the use of scarce research manpower and other resources, and ensure that programs are implemented in appropriate agro-climatic or social settings.

Participants stressed that scientists themselves, need to maintain regional contacts and plan programs. The Group called on politicians and administrators to give the necessary commitment and support to facilitate these technical activities. In this context, the Group noted
that the SADCC has contributed in large measure to the effective coordination of research in the Southern Africa Region.

If they are to be fully effective, regional structures must be adequate, have limited but sufficient staff, and other resources in place. Cooperation must be based on genuine partnership among the participants.

The Group noted that West Africa does not have a regional coordinating institution equivalent to SACCAR and stressed that good arrangements for regional coordination would improve the effectiveness of IARC in the regions concerned.

Networking

The Working Group also noted that collaborative research networks could help to resolve specific types of problems in areas of agro-ecological or other similarity. Such networks merit strong support, especially those that are involved with commodity-based research, including crop variety and input testing. It recommended that responsibility for planning and execution of networking plans should be allocated to scientists themselves. The Group also agreed that networks need to be based on collaboration and genuine partnership among the institutions and individuals involved.

Coordination

The Group called on donors to consent to coordination, and to avoid imposing their individual preference or prejudices to the detriment (or duplication) of national programs.

Regional and subregional coordination can be achieved through a harmonization of objectives and programs, always on the basis of a free and complete interchange of information.

It was noted that the mechanisms needed for scientific coordination differ from those required for joint research policy formulation: the former is the job of scientists themselves, whereas the latter requires action by political decisionmakers and administrators.

International Issues

The Group noted the widespread international support now being given to agricultural research in Sub-Saharan Africa. However, the support received could be even more effective if the following points were observed. IARC could make a more effective contribution on certain topics if some adjustments were made to their programs, for example, if possible overlaps were eliminated, such as at present exist in maize research. The system recently set up, under French influence, for research cooperation in Francophone West Africa could be expanded to advantage by asking Anglophone countries and other international organizations to participate. Increased support is also called for in areas such as the low-potential areas of the
Sahelian Zone, since they appear to be receiving inadequate attention at present. Adjustment of the volume of support to certain countries is needed in cases where it exceeds the local capacity to extend effective cooperation.

The research methods growing out of biotechnology can and should be used increasingly to solve African problems. The IARC can play an important role in bringing this about.

**Manpower Development**

The Working Group concluded that international support gives special opportunities to maximize the use and development of indigenous research capability, for instance, through the employment of local researchers in preference to expatriates whenever possible; and by making maximum use of local manpower in externally financed aspects of networks and regional programs.
CONCLUDING OBSERVATIONS AND PROPOSED FOLLOW-UP

The substantive conclusions of the meeting are presented in the reports of the Chairmen of the six Working Groups in the previous chapter. However, the closing plenary session gave individuals a final opportunity to address points of particular personal or professional interest. Most interventions supported or underscored the findings of Working Groups. The concluding comments are summarized below, but do not appear in the order in which they were made.

In expressing their gratitude to the sponsors of the meeting, several speakers commended the World Bank for providing them with the opportunity to comment on its draft strategy in the formative stage. Some felt that the Bank had neglected agricultural research in Africa in the past, but agreed its current focus was especially timely in view of the rising populations and deteriorating natural resource base in many countries.

A number of participants emphasized the importance of obtaining and sustaining national political commitment to agricultural research—"of moving from rhetoric to realization of goals." They reemphasized that national governments must have the primary responsibility not only for strengthening their own systems, but also for strengthening regional initiatives and facilitating the free movement of information, materials, and research personnel seeking specialized training or experience between African countries. In the latter instance especially, centers of excellence in training and research in the region should be encouraged to accept researchers and graduate students from other African countries as part of their mandate.

To avoid the problems that could arise in the search for effective collaboration, participants were urged to learn from the experience of existing regional organizations in Africa. For example, it is particularly important to establish flexible and apolitical linkages between scientific and teaching institutions. In this way, Africa could make up for failing to develop the continental science culture it needs for the future development of its technologies.

Although it was agreed that African countries must take the lead in planning and implementing their national agricultural research programs, the role of the donor community in supplementing African financial and intellectual inputs was clearly appreciated. This must continue for years to come, notwithstanding past problems encountered with some short-term technical assistance. At the same time, delegates felt that much better use could and should be made of technical assistance sources from other developing countries in Africa and elsewhere. How this initiative can be facilitated presents a challenge to the entire development community that should be accepted and pursued vigorously.
Attention was also drawn to the importance of women in African agriculture, and to their past and current neglect in the design of research and extension programs. It was recommended that the topic should be specifically addressed in the strategy paper and be more actively pursued by African governments and others concerned. The current very heavy male bias in the numbers of agricultural researchers, and by implication, their imperfect understanding of the problems facing women farmers is a problem that will not be easy to resolve. It is one important aspect of the overall difficulty of attracting top-quality students into agricultural science and the associated social sciences.

Delegates suggested that by improving the teaching of the basic sciences in primary and secondary schools, countries could draw more young people of both sexes into agricultural science. Regardless of whether or not this would actually happen, there was unequivocal support for moves to improve the terms of service of agricultural researchers. Such a move would not only attract better-quality entrants, but would also reduce the serious brain drain of promising and experienced researchers to more attractive jobs. In any event, action is needed at the national level to establish comparability, and hence freedom of movement of research staff between government research agencies, relevant parastatal organizations, and the university community.

The financing of research attracted many closing comments. Many argued that African countries need to explore further the unconventional sources of funding. Commodity financing of research was especially favored. Such possibilities as targeted taxation of urban consumers and developers were also mooted; in the latter case, a graduated levy on building construction was suggested but gained little support.

There were differences of opinion on the general priorities for research in Africa. Some argued that unless African countries give appropriate attention to the research problems of food crops, they will find themselves increasingly dependent on food aid. Others argued that, given increased export crop productivity as a result of research focus in that area, foreign exchange would be available to purchase food more cheaply than it could be produced at home. A plea was also made for research to promote diversification into production of promising but neglected commodities, with nontraditional export crops suggested as specific targets.

It was said that priority should be given to research on storage, food processing, and other aspects of post-harvest technology that would help increase the value added of major commodities. Many research systems have neglected this area, but it is becoming more and more important as population pressure on the production base intensifies, and production costs escalate. In this regard, participants were also reminded of the need to focus on ecological factors in the design of research strategies and programs.
In their closing remarks, representatives of the sponsoring institutions noted that participants had largely accepted the essence of the World Bank's draft strategy statement on strengthening African agricultural research. There was agreement that science-based agriculture is essential for future economic development and the well-being of the peoples of the continent. Participants unanimously supported the call for collaboration and coordination of action between national, regional, and international research agencies and the university community. But this cannot be achieved unless there is improved collaboration and coordination of action between African governments and the donor community; between finance ministries and economic and agricultural planners and educators; and between researchers, extension agents, and farmers, especially women. Only in this way can countries ensure that the research undertaken will be relevant. Delegates had agreed that the responsibility for strengthening agricultural research rests squarely with the governments of the countries concerned and that, if this mandate is accepted, governments must be prepared to make and maintain a clear political commitment to providing the support needed. Some suggested the need to maintain momentum by convening follow-up meetings to review and monitor progress in this regard.

The representative of the World Bank, in thanking the co-sponsors and participants for their many substantive contributions, gave the assurance that their views would be carefully considered and reflected as appropriate in the final version of the Bank's strategy paper, which was expected to be completed with the minimum of delay and, after approval, distributed widely to those concerned with African agricultural research and development in African countries and elsewhere. The Bank's hope is that the paper, and the process leading to its completion, will help to promote cost-effective, sustained, and relevant agricultural research in Africa. Participants had demonstrated clearly in the course of the meeting their belief that such research is essential if the countries of Africa are to increase and sustain agricultural productivity, hence achieve economic development, improve living standards, and contribute to the well-being of the people of the continent.
High-level Meeting

on

"African Agricultural Research and Technological Development"

24 - 27 September 1987

in

Feldafing

Federal Republic of Germany
Wednesday, September 23

Registration of delegates

18:00 Welcome cocktail

18:45 Dinner

Thursday, September 24

Opening Session

Chairman: Dr. Krüsken, Director, DSE/ZEL

8:45 Welcoming address
by Prof. Dr. Paul Kevenhürster, Director General, DSE

9:00 Address
by Dr. Volkmann Köhler, Parliamentary State Secretary, BMZ

9:15 The Origins and Aims of the Feldafing meeting
by Dr. H. Wyss, Technical Director, Africa Region,
World Bank

9:30 Statement on behalf of the Organization of African Unity
by Dr. Idris M. N. Nur, Head, Natural Resources
Division, OAU

9:50 Statement on behalf of the Economic Commission for Africa
by S. Nana-Sinkam, Chief, Agricultural Division, ECA

10:10 Statement on behalf of the United Nations
Development Program
by Trevor Gordon-Somers, Deputy Assistant Administrator
Regional Bureau for Africa, UNDP

10:30 Coffee

11:00 Statement on behalf of the Food and Agriculture Organization of the United Nations
by Dr. C. Bonte-Friedheim, Assistant Director General,
Agriculture Department, FAO

11:20 Strengthening Agricultural Research in Sub-Saharan Africa: A Proposed Strategy
introduced by Mr. D.C. Pickering, Senior Agricultural Adviser; Africa Region; World Bank

11:50 Questions on points of clarification

12:15 Administrative announcements
The Present Status of Agricultural Research in Sub-Saharan Africa

Chairman: Dr. W. Koinange, Permanent Secretary, Ministry of Research Science and Technology, Kenya.

12:30 Group picture
12:45 Lunch

14:00 Some National Issues from Western Africa
by Dr. M. Touré, Director General, ISRA, Senegal

14:30 Some National Issues from Eastern/Southern Africa
by Dr. L. Gahamanyi, Director, Rwanda Institute for Agricultural Sciences (ISAR), Rwanda

15:00 ISNAR Experience in Supporting National Agricultural Research Systems in Sub-Saharan Africa
by Dr. A. von der Osten, Director General, ISNAR

15:30 Coffee

Instruments for Strengthening Agricultural Research in Sub-Saharan Africa

16:00 Some Issues in Regional Cooperation in Agricultural Research
by Dr. M. Kyomo, Director, South African Center for Cooperation in Agricultural Research (SACCAR)

16:30 The Role of the International Agricultural Research Centers in Supporting National Research Efforts
by Dr. B. Okigbo, Deputy Director General, International Institute of Tropical Agriculture (IITA)

17:00 The SPAAR Initiative
by Mr. Thomas Schurig, Head, Agriculture, Agricultural Research and Rural Development Section, BMZ, and Acting Chairman of the Special Program for African Agricultural Research (SPAAR)

17:30 Plenary discussion

18:45 Departure for reception in Munich hosted by the Bavarian State Government in the "Residenz" (residence of the former kings of Bavaria)
Friday, September 25

Policy Implications in the Strengthening of National Agricultural Research Systems: Presentation of Working Group Themes by Discussants

Chairman: Dr. Taye Gulilat, Commissioner for Higher Education, Ethiopia

8:30 The Role of Agricultural Research in National Development Strategy (Dr. E. Schuh, World Bank)

8:45 Technical and Research Programming Issues (Dr. C. Bonte-Friedheim, FAO)

9:00 Financial Issues (Dr. H. Wyss, World Bank)

9:15 Education and Training Issues (Mr. B. Abbai, World Bank)

9:30 Organization and Management Issues (Dr. A. von der Osten, ISNAR)

9:45 Regional Collaboration, Networking and International Agricultural Research Centers (Mr. Curtis Farrar, Ex. Secretary, CGIAR)

10:00 Questions on points of clarification

10:30 Coffee

11:00 Concurrent Working Group sessions

13:30 Lunch

15:00 Concurrent Working Group sessions

16:30 Coffee

17:00 Continuation of afternoon sittings

18:30 Dinner

20:00 Concert: Bavarian Courtly Music

Saturday, September 26

Recommendations of the Seminar and Follow-up Actions

Chairman: Professor E.V. Emovon, Minister of Science and Technology, Nigeria

Conclusions of the Working Groups
8:30 Organization and Management Issues
by Omer Nour El Daiem, Minister of Agriculture, Sudan

8:50 The Role of Agricultural Research in National Development Strategy by Jackson Makwetta, Minister of Agriculture and Livestock Development, Tanzania

9:10 Technical and Research Programming Issues
by Robert Kitariko Kikomo, Minister of Agriculture and Forestry, Uganda

9:30 Financial Issues
by Adam Issaka Ibrahim, Under Secretary, Ministry of Agriculture, Ghana

9:50 Education and Training Issues
by Dzingai Mutumbuka, Minister of Education, Zimbabwe

10:10 Regional Collaboration, Networking and IARCs
by Anastase Ntezilyayo, Ministre de l'Agriculture, Elevage et Forêts, Rwanda

10:30 Coffee

11:00 Observations by Professor Bonza Mokonda, Commissaire d'Etat à l'Enseignement Supérieur et Universitaire à la Recherche Scientifique, Zaire

11:20 Discussion of reports of Working Sessions

12:15 Closing remarks
- World Bank/BMZ/DSE

13:00 Lunch
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High-level Meeting on

"AFRICAN AGRICULTURAL RESEARCH AND TECHNOLOGICAL DEVELOPMENT"

24 - 27 September 1987, Feldafing, Federal Republic of Germany

Réunion de dirigeants de haut niveau sur le thème

"RECHERCHE AGRICOLE ET DEVELOPPEMENT TECHNOLOGIQUE EN AFRIQUE"

24 - 27 septembre 1987 à Feldafing, République fédérale d'Allmagne
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International Service for National Agricultural Research (ISNAR) and Special Program for African Agricultural Research (SPAAR).

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