Building a Global Agricultural Research System

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# Acronyms and Abbreviations

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<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>CGIAR</td>
<td>Consultative Group on International Agricultural Research</td>
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<td>CORAF</td>
<td>Conférence des Responsables de Recherche Agronomique de l’Afrique de l’Ouest et du Centre</td>
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<td>ESDAR</td>
<td>Agricultural Research and Extension Group (in the Environmentally and Socially Sustainable Development vice presidency of the World Bank)</td>
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<td>IARC</td>
<td>International Agricultural Research Center</td>
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<td>NADS</td>
<td>National Agricultural Development System</td>
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<td>NARDS</td>
<td>National Agricultural Research and Development System</td>
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<td>NARS</td>
<td>National Agricultural Research System</td>
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<td>NARSS/S</td>
<td>National Agricultural Research System of the South</td>
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<td>NARSS/N</td>
<td>National Agricultural Research System of the North</td>
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<td>NARI</td>
<td>National Agricultural Research Institute</td>
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<td>OECD</td>
<td>Organization for Economic Cooperation and Development</td>
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Introduction

The world’s basic objectives of poverty reduction, food security and sustainable natural resource management cannot be met unless rural well being in general, and a prosperous private agriculture for small and medium size holders in particular, are nurtured and improved. Central to improving the productivity and profitability of agriculture are improved technologies, appropriate policies, and supportive institutions. At the core of technological improvement is agricultural research.

Ismail Serageldin
September 28, 1996

The emergence and nurturing of a global agricultural research system requires development of a collective ownership of visions, strategies, and objectives. ESDAR offered a vision of such a system, and outlined its own role in facilitating the emergence of the system. At the same time, ESDAR recognizes that various groups of participants and stakeholders in the system must decide how they will participate, and then develop multiple and novel ways of doing so. This will be true both in making the investments needed for agricultural research, and in the process of providing and using technological innovations to promote and enhance food security, poverty alleviation and the sustainability of the natural resource base. A renewed commitment, new partnerships, and open and continuing discussions of contentious policy and technical issues will be essential in the process.

The building of an efficient global agricultural research system calls for new partnerships between all components of the system, but especially between farmers and researchers. This in turn necessitates a fundamental rethinking of the institutional arrangements of the entire agricultural services subsector. The involvement and active participation of multiple stakeholders outside research, and with different interests, makes it very difficult to visualize and clarify the different interfaces in decision making and interaction. Giving substance to these interfaces, however, will help to open a platform for dialogue and intervention.

It was in this context that ESDAR hosted a two-day seminar in Washington, D.C., on September 27-28, 1996, to promote further dialogue aimed at recognizing and bringing
out issues of importance for further discussion and action. In attendance were key representatives of stakeholder groups who have significant roles to play in the emergence of a global system.

The seminar was structured around three topics:

- A Renewed Call for Agricultural Research
- Agricultural Research and Farmers
- Towards a Global Agricultural Research System

The topics were chosen to elicit issues on which there might be varying and oppositional opinions, to promote dialogue on those issues, and to seek a future direction in resolving such issues.
The discussions during the three sessions of the seminar centered around policy issues, technical issues, instruments of implementation, and some strategic operations activities.

Policy Issues

Four major policy goals were addressed.

- An agricultural research policy focusing on the global challenges and needs for balanced social and economic development, and based on sustainable resource management (including capacity building as an education policy issue);
- Global oversight of agricultural development which addresses what needs to be done, what can be done by agricultural research and how to organize effective technology production and transfer;
- A global agricultural research structure as the platform for interaction and exchange, both horizontally and vertically; and
- Funding policies which effectively support global agricultural research.

Common Objectives

In order to give substance to the policy issues, common objectives can be elucidated to provide a basis by which to address them. For example,

- to achieve a global research policy, common visions, common strategies and the will to cooperate in partnership are necessary; developing a common vision and strategy thus provides a framework for developing policy;
- to achieve global oversight, a commonly agreed agricultural sector knowledge system that is shared among all participants is needed;
- to achieve the goal of a global agricultural research system will require formal or informal bodies for coordination and decision-making and for providing transparency and linkage to other bodies; and
- to achieve the necessary support funding policies will require a clear demonstration of proven economies of scale and scope in agricultural research, as well as its efficiency and effectiveness in positive impacts at the farmer level.
Such common objectives have already been achieved in some instances through regional fora interactions. These interactions have now led to the formation of an apex body, the Global Forum, which seeks to rationalize objectives from regional organizations into a coherent global position.

**Instruments of Implementation**

The methodologies underlying achievement of the common objectives will be specific for each of the policy goals and must be selected according to the partners involved at each step. They include:

- priority programs (regional plans of action, global plan of action; program development mechanisms, education and training programs);
- multiple research partners operating in a variety of collaborative modes, specifically NARS in the broadest sense, International Agricultural Research Centers (IARCs), Advanced Research Institutes (ARIs), networks, etc.;
- executive bodies in service functions at all levels;
- endowments, research foundations, national and regional research funds, incentive funding, thematic funding, etc.

**Specific Activities**

Activities can take many forms and again must be specific for the partners involved and the comparative advantage of each. They include:

- strengthening and capacity-building of all partners in the NARS;
- technology development in priority areas, information dissemination, monitoring and managing the research continuum, increasing the knowledge system;
- promoting partnership; linking data and information; evaluation; inventory of technology developers and programs;
- developing innovative funding mechanisms; adapting legal frameworks; generating resources; assuring accountability.
Conclusions of the Seminar

There is general agreement that strong globalization forces are at play. These include a true scientific revolution in biology which has led to a major involvement of private firms, notably powerful multinational companies, in the development of biotechnologies. There is also a growing global awareness that natural resources need to be better managed if the degradation of soils, water quality and biodiversity is to be halted or reversed. In addition, major breakthroughs in information technology provide increasing opportunities for much greater research collaboration between institutions, even if they are located on different continents. Those who are not party to the effects of these forces risk being left behind and missing the tremendous opportunities that these changes represent.

In the face of these powerful forces, and given the general retrenchment of governments and public institutions from many areas of traditional involvement in agricultural research, any attempt to orchestrate or govern these forces at a global level may be counter-productive and possibly fail. Competition among the numerous and varied actors involved should determine which role each is best placed to fulfill and which partnerships will endure.

While attempts to govern globalization forces have been ruled out, it is equally apparent that a totally "laissez-faire" approach is inappropriate. It is fraught with the well-known limitations associated with market failures. Public goods and services will not be adequately provided, meaning that poverty alleviation and natural resource management will receive inadequate attention. In addition, weaker agricultural research institutions, including entire national agricultural research systems in many developing countries, will risk being excluded. Finally, such a hands-off approach is totally inconsistent with the humanitarian goals of many donor agencies, including the World Bank. The provision of significant financial support to CGIAR centers and to NARS/S by the World Bank and other donors, in the market analogy, tantamount to expressing a demand for research, or equivalently to funding the supply of research. The decision to fund certain actors and organizations depends on a vision of their respective roles. It is inappropriate to wait for the market to define
those roles. Thus a vision is required of how on-going trends and initiatives are shaping the emergence of a global agricultural research system, as well as how it should evolve in order to effectively and efficiently contribute to poverty alleviation, food security and environmental protection. Such a system vision provides opportunities for strategic interventions where, clearly, neither a hands-off approach nor a top-down global approach to governing such a system is appropriate.

The institutional model of the CGIAR provides a useful reference with which to work. The consultative process leads to a high degree of consensus, which guides funding decisions and provides global coherence to a system made up of 16 independent centers and more than 50 donors. Each center has a unique identity, specific objectives and particular constraints. A broadly shared vision of the role of international agricultural research provides the basis for the consensus.

Similar features have emerged in recent years, and even months, for the global agricultural research system. They include the critical role of agricultural research for a more equitable and sustainable development, as well as the need for agricultural research to pursue a broad agenda in order to fulfill that role. The consensus also recognizes that NARSs must be the cornerstones of the global effort. The need to find effective ways to engage civil societies, particularly through NGOs, and the private sector in that effort have been explicitly emphasized and have been further reinforced through the current seminar discussions. In addition, the broadening of the partnerships with the CGIAR centers and the catalytic role which they can play has been stressed.

The need for NARS to organize themselves at the regional and subregional levels has been widely recognized and the recent achievements in doing so have received broad legitimacy. Similarly, the role of farmers and farmer organizations as critical partners in the global research effort has received increasing attention and is considered essential to its success, a point which was stressed repeatedly in this seminar. Thus, it is reasonable to assert that a consensus has emerged on key aspects of a desirable global agricultural research system. Concerted action is now needed to bring about the necessary changes.

The establishment of a Global Forum, which may alternatively be seen as the general assembly of a new Global Partnership, or of a Global Alliance, has been reinforced at this seminar and seems indispensable. This Forum would be expected to forge, very explicitly, the necessary global consensus. In that process, codes of conduct on the desirable behavior of each actor and on their relationships need to be elaborated and legitimized. Such codes might cover:

- the desirable features of the many partnerships needed to establish a workable system for agricultural research at the national level;
- the relationships between NARSs/S and CGIAR;
- the disciplines to be respected by OECD country research institutions in their relationships with NARSs/S; and
- best practices in the relationships between public research institutions and the private sector.

In addition, the Global Forum would be well placed to receive reports on agricultural research impact and on necessary reactions of various research actors to improve impact. Finally, a Global Forum would contribute to a consensus on research priorities and on the funding mechanisms capable of enhancing the desirable partnerships and of providing financial support of higher priority research activities.

The terms of reference of the Global Forum, its organization and its protocols will be most critical. It is clear that NARSs representatives should be selected on the basis of the regional organization process which has been taking place in recent years. The CGIAR could be represented in a number of ways. The form of representation of OECD research institutions is less clear and might depend on the breadth of the agricultural research focus of the Forum. Its terms of reference should cover the establishment of recommended codes of conduct, the assessment of research impact, and the identification of gaps in the global research efforts.
Thus, it will need to commission and launch independent assessment and studies.

In addition, it is expected that a Global Forum would facilitate the launching of new funding mechanisms, or at least ensure a greater degree of coherence among funding agencies' decisions, in support of the partnerships to be strengthened or newly created. In some instances, global programs geared to specific objectives may be effective means to mobilize the necessary resources and promote the appropriate partnerships.

In summary, the expectations of a Global Forum reflect very well the major policy goals which have been discussed and debated at this seminar. The Global Forum presents a further opportunity to develop the common objectives, the mechanisms of implementation, and even some of the specific activities which are needed to realize a truly cohesive global agricultural research system focused on the need to alleviate poverty, and protect our natural resources, and assure a safe and secure food supply for the world's growing population.
Since the ESDAR Seminar in 1996, significant events have occurred to further the establishment of the Global Forum on Agricultural Research. The inaugural meeting of the Global Forum occurred at the CGIAR’s International Center’s Week in Washington, D.C. in October of 1996. The primary objective of the Forum is to develop and enhance partnerships among stakeholders in the emerging global agricultural research system. Toward that goal, the result of the first meeting was a Global Forum Declaration and Plan of Action. The group of participants also decided to establish a Global Forum Steering Committee with the mandate to translate the Plan of Action into a program of activities. In implementing the Plan of Action, the Steering Committee is tasked with:

- promoting a global framework for agricultural research;
- fostering research partnership and collaboration;
- contributing to the strengthening of the NARS and regional/subregional fora; and
- encouraging the identification of collaborative projects through suitable mechanisms including regional/subregional fora.

The Steering Committee took up this challenging mandate at its first meeting in Cairo on the occasion of the Mid-Term Meeting of the CGIAR. Besides reaffirming its membership, which includes representatives of all the regional fora, advanced research institutes, NGOs, farmers’ organizations, IARCs, private sector and donors, the Committee also agreed on an initial set of activities and projects. These activities are directed towards key elements of the Plan of Action and include:

- enhancement of exchange of information;
- establishing a platform for discussion of globally pertinent agricultural research issues, including the establishment of an electronic forum;
- monitoring research partnerships and analyzing successful partnerships;
- supporting NARS, subregional and regional fora to strengthen institutions and build capacity; and
- continuing to work towards identifying collaborative projects.

The Global Forum Steering Committee emphasized the importance of establishing and maintaining a secretariat which will serve as the primary mechanism for implementing its work.
program and providing continuity to the Committee and its activities. ESDAR was chosen to provide that function and is very pleased to be able to do so. The goals of ESDAR in promoting and facilitating the emergence of a global agricultural research system are entirely compatible and supportive of the mandate of the Global Forum on Agricultural Research. The partnership will be beneficial to both.
APPENDIX I

A Renewed Call for Agricultural Research

A. BACKGROUND PAPER

Agricultural Research:
Toward a New Set of Roles

The commonly accepted image of agricultural research has changed over the past decade. The crisis of agricultural research institutions, all too easily blamed on the difficulty of sustaining public financing but due mainly to a reassessment of traditional institutional frontiers, is indeed fostering rapid changes.

In response to the increasing "globalization" of scientific research and to the growing diversification of development support services in every country, agricultural research needs to redefine its true "identity." The agricultural research establishment has traditionally been equated to a series of scientific skills or, in the best of cases, to the complex formed by the grouping together of these skills within a given institution. Today, the development of communication facilities, the need to attain a critical mass in each scientific discipline, the scarcity of top-quality human resources, and the high cost of equipment are fostering a redistribution of personnel that in a great many cases are too fragmented to be truly productive.

This trend toward redistribution of roles clearly evident in the scientifically advanced countries, is undoubtedly even more justified in the scientifically less well-endowed countries. Moreover, a more flexible management of these scientific skills would not pose major problems. Redeploying the available human resources is perfectly feasible using new financing mechanisms. This approach to research management is both effective and easy to implement. It remains a limited approach, however, in that ultimately it does not lead to the reorganization of the agricultural research system, a system that requires lasting structures and relationships.

This contradiction between the need for mobility of human skills and the necessary durability of institutions lies at the heart of the problem of rebuilding and managing agricultural research in the next few years. The distinction, while it may appear artificial in some respects, is an invaluable tool in seeking to redefine the identity of the agricultural research
institutions and the specific roles they are called to play within emerging “national agricultural research systems” (NARSs).

Before discussing the basic principles that are to guide us in reorganizing agricultural research, we need to assess the new demands made by society on agriculture and hence on agricultural research.

This paper will focus on three issues crucial to the design of a new policy:

- the new concerns expressed by local, national and international communities with respect to the development of agriculture, and the demands addressed by them to agricultural research;
- the tailoring of the research establishment to the specific characteristics of agriculture in a given country, and the construction of better interfaces between research and farmers;
- the management of dispersed scientific skills and their mobilization through the promotion of new, stronger, more diversified partnerships.

1. AN AGRICULTURAL RESEARCH RESPONSIBLE TO NEW NEEDS

The characteristics of any agriculture reflect the economic, ecological and social conditions of a territory and of the society that inhabits it. In time, as these conditions evolve, agriculture changes with them. This response is in part passive (reacting to changes in the environment) and in part voluntary (policy changes).

Support for agricultural research reflects the authorities desire to foster the evolution of agriculture in the direction they deem appropriate. The ultimate function of agricultural research is to identify feasible new techniques and practices—innovative solutions—and propose them to the farmers and thereby help promote the innovation process. This task of identifying and elaborating innovative practices is guided by an agenda which usually remains implicit but is sometimes spelled out. In the latter case the agenda reflects society's concerns with respect to the future of agriculture and seeks to define the researchers' mandate in clear and precise terms.

The economic concern that hitherto dominated agricultural development thinking today shares the stage with two other major concerns, one ecological and the other social. Each of these three concerns is reflected in objectives expressed at both the micro level, i.e. the production unit, and the macro level, i.e. national communities.

1.1 The economic concern: food supply

For researchers, this concern is reflected concretely in the search for new techniques and practices that can boost the yields of the main crops and livestock products. This is consistent:

- At the micro level, with the farmer's desire to raise production volume, notably through increased yields, a necessary condition for rising income at the farmer's level.
- At the macro level, with the community's desire to raise national production, i.e. to ensure food security, and/or to reduce the cost of food and/or promote export development.

1.2 The ecological concern: conservation of the environment

For researchers, this concern leads to the search for new techniques and practices that can ensure renewal of the natural resources utilized in agricultural production. These permit:

- At the micro level, the rational management of natural resources, particularly the production factors, soil fertility and water quality.
- At the macro level, the compatibility, as part of land-use and development policy, between agricultural production and natural resources conservation.

1.3 The social concern: combating social exclusion and poverty

For researchers, this concern leads to the search for new techniques and practices that can foster greater labor absorption and wider distribution of income:

- At the micro level, by the creation of new economic activities through which labor can be incorporated into the farming operation.
At the macro level, by the alleviation of unemployment and social exclusion, i.e. by creating economic activities both within and, above all, outside farming.

Thus, it is necessary to promote the transition from an agricultural research system whose agenda reflected a single, simple and clear objective (the pursuit of higher yields) to one whose agenda is tailored to three sets of objectives that moreover reflect concerns expressed at both the micro and macro ends of the scale, i.e. by the farmer and by national communities. This transition from a single- to a three-point basic agenda would be a complex process if these objectives were substantially incompatible; such a transition would even be impracticable if the objectives were mutually contradictory. In the agricultural modernization process that prevailed over the last few decades and provided the basis for the agricultural research agenda, the ecological and social concerns were not often taken into account as objectives but at best only as constraints. Some indeed assert that while the innovative practices recommended by research have for the most part generated increases in yields and more generally in production, they have also, in some situations, triggered large-scale social exclusion of agricultural workers and degradation of natural resources.

The new awareness of the world community concerning such issues as environmental conservation and alleviation of the problem of social exclusion entails a greater urgency and a new vision for agricultural development. Researchers are beginning to pay attention to these concerns and this is changing the face of agricultural research. More systematic focus on these concerns could well spark a radical revolution in the global agricultural research system.

2. ADJUSTING TO THE SPECIFICITIES OF AGRICULTURAL SITUATIONS

In focusing our thinking on the interface between the production of knowledge and the specifics of agricultural situations we are led from the outset to reflect on the nature of those specifics and the "laws" that govern the transformation of agricultural situations. This thinking focuses on the one hand on the farm and its evolutionary path and on the other on the farmer and his or her technical development path.

In the final analysis, agricultural research must strive to develop solutions able to fit into a farmer's technical program and dovetail into a plausible path of development of his or her farm. For research to be able to perform this task of developing solutions efficiently, it needs to take account of the diversity of existing types both of farms and of farmers.

2.1 The core components of a given agricultural situation: the farmer and the farm

It is ultimately the farmer, on the farm, that makes decisions regarding agricultural production and natural resources management. These decisions determine the amount of labor incorporated and the type of income distribution which ensues. It is also the farmer who decides whether or not these results will be altered by incorporating new practices into the production system.

Indeed, smallholder, family farms are widespread even if other forms of farming undoubtedly exist: more community-based traditional undertaking, as well as state-run or corporate farms. But these are or remain marginal, even if in some cases they have to be dealt with for what they are.

The farm and its evolutionary path

In the great majority of cases farming production, natural resources management, labor incorporation and income distribution are done or determined on the farm. A farm can be analyzed as a system, corresponding to an elementary unit of a cultivated ecosystem. We designate such a system by the term agrosystem.

Sound management of a farm consists in reconciling two objectives: goods production, and renewal of the factors of production.

The management of a farm is concerned with both the production of goods and the regeneration of
production factors. The two functions, production and renewal, are equally important. The "profession" of farmer lies as much in the farmer’s ability to manage a stock of capital, for example biological capital, over the long-term as in his or her capacity to extract an income from this capital year after year. Two of our initial concerns (food supply and environmental conservation) are hence echoed in the strategy of every farmer, who naturally seeks to reconcile the twin goals of the farm’s profitability and its sustainability.

At the farm level, it is important to understand and elucidate the livestock and crop production mechanisms and the natural resources conservation and renewal mechanisms involved. These constitute the very core of a farming activity. The goods production mechanisms are generally well known or are, at least, taken into consideration more fully than the natural resources replenishment mechanisms. It is by analyzing these mechanisms that we can come to understand the dynamics and constraints of the process of boosting farm’s production potential. It is therefore in light of these production and renewal mechanisms, more than of purely descriptive factors, that farm typologies will be constructed.

Because of their special importance, research needs to take soil fertility conservation mechanisms into account clearly in seeking to develop innovative solutions. Every proposed new practice must be assessed by reference not only to its direct impact on production but also to the changes it induces in the dynamics of soil fertility. Regeneration of fertility, whether at a lowered, unchanged or increased level, can be brought about by biological practices used in situ, by the organization of on-farm or of inter-farm fertility transfers, and finally by external contributions, essentially in the form of chemical fertilizers.

In the example of the temperate region plains, the individual stages in agricultural history correspond closely to the implementation of new fertility regeneration practices: burning of new forest growth, tilling of fallow land, farming/herding combinations, introduction of leguminous fodder, and finally the use of chemical fertilizers. The development of new biological practices, which could result, for example, in accelerated atmospheric nitrogen fixation by plants, could be a key factor in the historical trend toward higher-density farming.

In other ecosystems, agricultural history has followed other paths. Delta farmers depend on flood and alluvium management; the succession of delta-farming practices traces the agricultural history of the regions concerned. Other sequences have unfolded in other places, for instance in dry areas where only pastoralism is possible, in areas where irrigation is feasible or in mountain areas. In every ecosystem where agriculture is present, the evolution of production mechanisms has only been made possible by the evolution of the mechanisms which ensure the conservation and renewal of soil fertility.

There are however many cases in which goods production and natural resources renewal are conflicting:

Under certain conditions a farmer will have no interest in, or will be incapable of, pursuing the two objectives: production and renewal simultaneously. This is true for example when the farm’s sustainability is jeopardized by external conditions (especially precarious land tenure); the farmer will then prefer realizing an immediate income over renewing a capital the use of which he or she might well lose.

It is also the case that when capacity is inadequate to achieve the necessary minimum production, the farmer cannot afford the necessary inputs or they are unobtainable; the farmer is then constrained to favor the production of goods over replenishment of his or her capital.

Research at the service of sound farm management takes account of both objectives: goods production and resources replenishment:

Improving goods production mechanisms implies first of all action targeted to a plant or animal’s genetic potential. The farmer will be able to realize this potential to a greater or lesser degree by upgrading the farm environment, more or less, through external inputs and protecting the crops against pests.
Improving natural resources conservation and renewal mechanisms calls first of all for action addressed to the productive potential of the environment. Once the environment has become more productive, the farmer will be able to reduce the amount of external inputs used.

Advances in goods production and natural resources renewal must go hand in hand. Research must therefore strive to propose solutions that can at the same time raise the productive potential of the plants or animals concerned and that of the environment.

An innovative practice must hence be rated by reference to its impact on both processes: agricultural production and resource conservation. Care must be taken to ensure that a solution designed to boost production does not disrupt the natural resources renewal mechanisms. For example, in altering the utilization of new grass or forest growth or harvest by-products or changing herding methods, a new technique can interrupt the soil fertility restoration cycle. Similarly, by triggering salt build-up in irrigation water, a given technique can make water quality regeneration impossible.

Before seeking to disseminate a new technology, researchers must assess its limits of validity and the conditions of its sustainable use.

The producer and the technical development path

Ultimately, it is the farmer who decides whether or not to adopt new technologies. The decision is based on specific short-, medium- and long-term needs, interests and capabilities, especially financial capabilities. The farmer assesses the impact of the new technology on the system’s production and conservation mechanisms, and finally weighs the risks inherent in any change and decides whether it is a reasonable one under the circumstances.

By changing the amounts of labor or capital used, a farmer seeks to upgrade the farm’s environment (regrading of certain fields, water control through irrigation or drainage works, fertility enhancement through soil tilling, and so on) and/or to boost its production (purchase of chemical or mechanical inputs).

Any measure affecting the rebalance among factors, such as an increase in the ratio of labor to capital or in the ratio of biological factors to chemical and mechanical factors, modifies the technical system.

Special attention needs to be given to the trend of the labor/capital ratio. Where underemployment is endemic and, as a logical consequence, when the use of labor becomes profitable once the caloric income from labor is at least equal to its caloric cost, research must focus on techniques with high labor/capital ratios. In practice, there are limits on the development of this ratio: beyond a given threshold, specific to each individual situation, a farmer will judge that investing labor in farm improvements or goods production does not offer an adequate return and will abstain from devoting additional effort to it. Labor investment is then not considered to be remunerative, while capital investment may continue to be so. The result is to establish a new balance between capital and labor, and with it a new technical system.

A new technology has to be seen as an opportunity seized by the producer to progress further along the chosen development path. To be adopted, it has to become a component of his or her strategy.

2.2 Building “research/farmers’ reality” interfaces

Recognition of the diversity of both farms and farmers, and a readiness to take this diversity into account in research work, has major implications for the development of agricultural research systems. They range from fully taking into account the diversity of types of agrosystems and of farmers, to redefining the agricultural research system.

Factoring in the diversity of farm and farmer types

In seeking to devise new technologies, research must be conducted in close contact with the specifics of a given agricultural situation or, better, in the real environment, i.e. in compliance with the “laws” that govern the functioning of farms, and within the farmers’ decision parameters. Unfortu-
nately, there are innumerable types of both farm- ers and farms, and it is of course out of the ques- tion to ask research to perform “à la carte” tasks tailored to each individual farm or farmer. The development of farm and farmer typologies is hence a key factor in the organization of agricultural research. The classification criteria must be geared to the research tasks to be undertaken. They also need to be few in number, with the object of identifying a few broad types and not an unmanageable multitude of categories. 

Establishing farm typologies can involve geographic factors, mainly those related to climate and relief, economic factors, mainly market access, or technological factors, notably water control. But the essential feature of the process is the construction of farm types characterized by the two sets of mechanisms identified in the previous section: agricultural production and resource conservation. Because the purpose is to define a type, simplified models of these mechanisms, capturing their characteristics deemed as essential, must somehow be elaborated. Because of the numerous interrelationships involved the word “agrosystem” is suggested to designate such a modelized farm type. By way of example, the typology adopted by CORAF for Western and Central Africa identified nine broad farm types, i.e. nine major agrosystems, seven of them based on climatic factors, one on an economic factor (urban fringe agrosystem) and one on a technological factor (irrigated agrosystem). This initial simplicity must not, however, disguise the great diversity of existing agrosystems. Each of the major categories can be infinitely subdivided by increasing the number of classification criteria. The need to establish such subcategories depends on the type of research to be undertaken. For the purposes of restructuring a necessarily durable research system, however, we will need to stick to a relatively small number of broad categories.

Establishing farmer typologies can involve economic, social and cultural factors that help to characterize farmers’ strategies. Here again, we are speaking of broad typologies developed for the purpose of identifying major behavior patterns in connection with the question of new technologies. For researchers, the producer groups or networks that can be developed from these analyses constitute partner groups with which it will be fruitful to conduct experiments and, in due course, action to disseminate research results.

Redefining the agricultural research system

The boundaries of national agricultural research institutions are today being redefined, often both as part of and as a consequence of, decentralization and privatization processes. These processes can result from deliberate central government policy or from a rebalancing of forces between central, regional and local authorities or between the public and the private sectors. Their origin can often be traced to impoverishment of the state and to financial crises in public institutions. A schematic representation of the actual agricultural situation, in terms of agrosystem and farmer categories, can furnish a valuable frame of reference to guide these decentralization and privatization processes when they affect research institutions.

A decentralization process will be effective if, beyond the administrative approach based on existing political entities, it produces agronomically homogenous groupings. Research institutions can thus build stable interface arrangements to interact with groups of farmers facing similar problems. These arrangements can be diverse, depending on local circumstances. They should however most often include facilities for the conduct of experiments on farmers’ fields. Such linkages are indeed the “raison d’être” of agricultural research institutions.

Privatization can be used to identify economic participants having similar economic interests. Such groups should be interested partners for agricultural research institutions; and building these partnerships could be a part of, or be facilitated by, the process of privatization.

For agricultural research institutions the partnerships with farmers groups facing similar circumstances and with economic participants having similar interests are more critical than ever. Thus these research institutions must
assign to the corresponding arrangements a central place in their organization.

3. MANAGING SCIENTIFIC SKILLS IN THE CONTEXT OF A NATIONAL AGRICULTURAL RESEARCH SYSTEM

To be able to generate scientific knowledge, an agricultural research institution needs to be able to recruit research staff. Some of this research staff must be fully invested in building and energizing the interface mechanisms just discussed above. These researchers will generally have come from the social sciences and be used to analyzing complex systems. They represent research institutions in the commodity- or subsector-based partnerships with economic actors or agrosystem-based partnerships with producers’ organizations. The majority of the research staff will, however, be skilled in a single discipline. Whatever projects they are involved in, these researchers will need to update their skills.

Human resource management is hence not an easy task, since all national agricultural research institutions must gain an understanding of the specifics of given agricultural situations and create a mechanism through which to interface with them. The bulk of the human resources required to perform the research work comprises traditionally discipline- or faculty-based scientific skills. This poses the risk that agricultural research institutions will find themselves torn between their linkages with agriculture and their linkages with science, each of these requiring a different professional mindset.

3.1 Sustainable human resources management

The processes of generating research findings and, more generally, scientific knowledge, and of human resources training, are organized on the basis of discipline-specific rationales. The model used to accomplish this—a model that has dominated since the Middle Ages and still dominates today in most countries—is the university model, which links research with higher education and defines specialized research skills in accordance with a discipline-based rationale. The necessity to realign discipline boundaries in step with advances in research does not, any more than the need to set up inter-discipline bridges, cast doubt on the original rationale of the university model. Separation of the research and higher education functions, justified by the fact that the first three or four years of higher education comprise merely a disguised prolongation of secondary education, ceases to be significant once the students embark on research work. In poor countries, the institutional separation of research and higher education creates overlap and waste; it prevents both research and educational institutions from managing their human resources efficiently.

The formal establishment of a national system can provide an opportunity for universities and the national research institute to rediscover their respective identities and their complementarities. Schematically, it must be the responsibility of the “university” pole to build and manage scientific knowledge and the related human resources and that of the “agricultural research” pole to build and manage the interfaces with agriculture.

This approach does not necessarily imply staff transfers and changes in formal conditions of service, which always pose difficulties. Each institution can little by little find its proper place in the national system, as indeed can each research worker, provided that adequate governance and financing mechanisms, supporting energizing and “structuring” research programs, are put in place. Under discipline-driven structurizing programs, for example, durable partnerships between scientific and university personnel can be set up using appropriate incentive mechanisms. These programs can encompass broad scientific areas—biology, chemistry, geography, economics, mathematics/data processing, and the associated technological tools, biotechnology/genetic engineering, remote sensing/GIS, IST. They will generally cover more sharply defined scientific areas. Linkages can be established between postgraduate education and these programs as well as information exchange networks and evaluation procedures. The scientific linkage of the researchers to such programs, and the pro-
grams' durability, which depends *inter alia* on the establishment of an institutionalized national system, should permit a new approach to programs of training, information and evaluation of the human resources involved in discipline-driven research projects.

However, for mechanisms of this kind to impose a new set of rules, the "national system" rationale must first succeed in winning out over the traditional institutional rationale, and lead to a new national division of scientific labor. We have seen earlier the critical role that a national agricultural research institute must play in this new system.

3.2 Increased mobility of researchers and of research activities

Stability in human resource management (a prerequisite of continuity in research) and the necessity for discipline-based refresher training of researchers (a prerequisite of scientific production) in no way signify the setting up of a system that encourages researchers to withdraw comfortably into academic environments. Thus, together with the assurances given with respect to further training, if not to conditions of services, the research institutions must be provided with incentives and energizing mechanisms enabling them to mobilize research staff, of whatever origin, toward priority activities and to build new partnerships.

More important for agricultural research than the management of scientific staff is that it be able to build and energize the research systems and possess mechanisms and resources that enable it to mobilize scientific skills at the national, or even the regional and international, levels. These mechanisms and resources, too, must be durable, since research activities require a minimum of continuity.

3.3 Agricultural research between the national agricultural research system (NARS) and the national agricultural development system (NADS)

The typical image of a national agricultural research institute (NARI), inward-looking and addressing its own exclusive objectives, is a thing of the past. Agricultural research needs to be open to new partnerships. Upstream, it must dovetail with the emerging and already integrating "parent" scientific systems, national systems, regional cooperation and the global system. Downstream, it must dovetail with the actors in the areas of both production and natural resources management. Here also, new partnerships are emerging, based on economic subsectors or agrosystem families. This dual openness is leading agricultural research to reposition itself and even to redefine itself.

Instead of seeking to delineate a new standard institutional profile, it is preferable to study cooperative arrangements between agricultural research and its upstream and downstream partners. The setting up on the one hand of a national agricultural research system (NARS) and on the other of a national agricultural development system (NADS), both provided with a respect-worthy governance structure, incentive instruments and partner-based programs, should create a new environment within which agricultural research can progressively evolve and find a new stance and a new function. While this evolution can be suggested in terms of general principles, the new agricultural research profiles will emerge case by case in response to the combined impact of specific partnerships.

National systems are emerging in Latin America, Asia, the Mediterranean area and Sub-Saharan Africa, and cooperation between their component institutions is developing rapidly. This development varies in tempo and sometimes also in direction. The reflection concerning the emergence of a global agricultural research system must take due account of this diversity. It will thus provide an opportunity to interpret that diversity and, on that basis, to build a new coherence.

B. SUMMARY OF MAJOR DISCUSSION POINTS

The opening presentation stressed the new challenges for research in addressing: food security, poverty reduction, and natural resources management; the holistic evolution of the farm unit as the basis of agricultural sys-
tems; and the need for new mechanisms to bring researchers together to solve problems. Wide ranging discussions led to general consensus on the need for research to balance:

- reductions in funding for research, but increased need for research to provide input to meeting global challenges of hunger, poverty, and the environment;
- opportunities for farmers to share research costs and the private sector to play a larger role, but a remaining need to support public goods research;
- technology development for more favored areas for world market needs, but technology for less favored areas important for equity concerns;
- technological innovation as an important input, but public policy and rural investment decisions that also have major roles in addressing global issues;
- national agricultural research systems (NARS) that must become national agricultural research and development systems (NARDS) to ensure their relevance and impact;
- farmers and the farm unit with its defining social and community characteristics must be the basis of systemic research efforts.
A. BACKGROUND PAPER

AGRICULTURAL RESEARCH
AND THE FARMERS

Research is not an isolated phenomenon. Operating in partnership with the farming sector, research plays a part in the development of agrosystems by offering solutions designed to make them more productive, more sustainable, and more profitable. Agrosystems evolve through the incorporation of new techniques and technologies, of which some are the result of a dialogue carried on, either directly or through mediators, between the farmers and those engaged in agricultural research.

1 - Policies in support of technological innovation
or
How to organize a meeting between the supply of technical solutions and the demand for them?

Over the past few years, the approach to technological innovation has undergone a radical change. Policies relative to the introduction of technology-based solutions, intended originally to support the supply of those solutions and later to support the corresponding demand, are now tending more and more to promote interaction between the sources of supply and those of demand.

1.1 Limitations of a policy supporting the supply of technological innovations

For many years, technological innovation was regarded as the outcome of a policy focusing on supply. Within this context, it was the task of the researchers to design and develop technical solutions, that of the extension workers to transfer them to the farmers, and that of the farmers to incorporate them into their production systems. However, this approach to agricultural development based on the adoption of a “technological package,” while proving effective in certain contexts, is in fact subject to many limitations.

The most serious of these limitations is naturally the contradiction between the “ready to wear” nature of this kind of supply, and the extreme diversity of productive activities, reflecting the infinite variety of natural environments and of those who farm them. There is
little chance of a meeting between a stand-ardized and centralized supply and a diversi-fied and decentralized demand. An analysis of the evolution of agrosystems, particularly of those existing in tropical countries, reveals that in general the introduction of new technologies and techniques responds to processes that are much more complex and much more interactive than might be assumed from this linear, top-down approach.

Another limitation of this supply-driven ap-proach is the failure to acknowledge the crea-tivity of the farmers themselves and of the representative nature of their organizations. Over the past 20 years in Latin America and in Asia, and more recently in Africa, the most striking development that has taken place in the agricultural sector is very probably the affirmation of farmers as partners, and often even as leaders in the processes of agricultural develop-ment and technical innovation. This trend is mani-fested by the emergence of represent-ative farmer organizations capable of engaging in a genuine dialogue with the technical institutions.

Thus, at a time when governments are pull-ing out of the productive sector, certain func-tions traditionally performed by the public authori-ties can be transferred to the farmer or-ganizations. A case in point is the agricultural extension service, which is going to have to work out an arrangement with the farmer organizations, or even become a privately oper-ated activity. Such a development is not without risk: if the farmers or the private sector do not take over, the technical advisory func-tion is likely to fall apart, leaving the farmers without support and the researchers without partners.

1.2 Affirmation of a policy supporting the demand for technological innovation

Thus many experts in technological innovation processes have come around to putting farmer demand first. For instance, projects geared to farmer demand (a demand that sometimes has first to be kindled by the promoters) have multi-plied. Through such projects it has generally been possible to tailor the proposed technologies more closely to the farmers’ ownership capacities, and, above all, to ensure explicit involvement by the farmers in the processes of modernizing their agrosystems.

But this approach is subject to other limita-tions. The most serious is undoubtedly the uneven capacity of the different categories of farmer to express their demands or, at least, to assert their own special interests. In situations where the rural environment is highly diversi-fied, if not seriously polarized, where certain categories of farmer own the bulk of the pro-duction facilities and are highly organized, while others remain widely scattered, and where those privileged classes can afford to finance technical advisory services and sometimes even agricultural research, there is consider-able danger that the needed research and technical advice will simply focus on the prob-lems of that privileged minority and leave the majority of farmers without any targeted support.

As the approach to technological innovation shifts toward a demand-driven policy, it is therefore important to ensure that the demand of the different farmer categories can be ex-pressed and that appropriate and diversified responses are effectively sought and offered by the public authorities.

Another danger of the demand-driven ap-proach is that expressed needs are often stereo-typed, referring to various modes or to symbols of modernity without any real reference to the often very profound crisis affecting a given agrosystem. In such cases, it is likely that the analysis phase will be completely short-circuited and catch-all solutions proposed right from the start. Research then becomes nothing more than a distributor of solutions rather than a provider of critical analyses of diverse situ-a tions. This shift in the approach to policy in the area of technological innovations thus runs the risk of focusing on the instrumental side of agricultural research and isolating those whose task it is to deepen the understanding of the true realities of the agricultural sector.

In addition to the farmers, its principal cus-tomers, agricultural research is also the partner
of private industrial enterprises working up- 
stream or downstream of agricultural produc-
tion. Such enterprises sometimes maintain their
own research unit. Most frequently, however,
they bring their specific problems to the public
research institutions, sign contracts with them,
and provide the financing, generally at mar-
ginal cost, of the work they wish to have
performed.

1.3 Search for interaction between supply
and demand in the area of technological
innovation

Where the introduction of new technical solutions
is concerned, experience has shown that, rather
than simply promoting demand, or, worse, sim-
ply promoting supply, it is more productive to
promote interaction between demand and supply,
between farmers and researchers. This interaction
takes place at two levels with overlapping impli-
cations, namely that at which the realities of farm-
ing, of the crises faced by the farmers, and of their
potential for development are properly under-
stood, and that at which new techniques, designed
to fit into plausible development paths, are pro-
posed. A new technology cannot be isolated from
the context into which it is to be incorporated, and
that context, for the specific purpose of this study,
is essentially that of the farm itself.

(a) Framework for the design and discussion
of technology-based solutions

Every farm is an individual entity. The fact of this
diversity has to be explicitly acknowledged by
agricultural research, but since a single research
system cannot handle the huge number of individ-
ual cases, it needs to determine the principal types
of farming operation and allocate the farms to the
corresponding categories. It must establish the
typology of the principal agrosystems so that it
can work in relation to situations that are more or
less similar, seek responses suited to problems
specific to each category, and ensure that no major
category of farm or farmer is overlooked.

Once the different types, which correspond par-
tially to different regional situations, have
been identified, a true dialogue between re-
searchers, technical advisers, and the farmer
organizations can be established. For this
type of dialogue to be fruitful, account must
be taken of the constraints affecting the different
types of agrosystem and the concerns of
the different categories of farmer. Where the
introduction of new techniques is concerned,
the quality of the interaction between supply
and demand depends to a large extent on the
specific nature of the questions asked and re-
 sponses given.

(b) Research and development in the area
of technology-based solutions

Once the main farm categories have been identi-
fied and the development path of each category
has been observed or visualized, it becomes pos-
sible to work on innovative techniques that are
capable of promoting the sustainability, produc-
tivity, and profitability of the farms. A true policy
of innovation requires a systematic effort by the
research institutions to internalize the realities of
farming and the demands of the farmers. Re-
searchers need to make an effort to translate their
findings into proposals for new techniques incor-
porating the most recent advances of which the
farmers will be capable of claiming immediate
ownership.

To accomplish this, the researchers need to
work toward the establishment in the real envi-
ronment, i.e. within the framework of farms or
pastoral units, of experiments that they can
monitor along with the farmers. Such experi-
mental networks should, if possible, be
constructed in liaison with the farmer organiza-
tions, with are gradually acquiring the technical
capabilities they need to enable them to dia-
logue with the researchers and help dissemi-
nate the latter’s findings.

2 - Developments in the sharing
of responsibilities among the principal
stakeholders in the process of
 technological innovation

The transition from a linear to an interactive ap-
proach to technological innovation is dependent
on convergent evolutionary processes at the levels
of research, the agricultural advisory services, and the farmer organizations. And, beyond the individual development of each of the partners, the need to construct functions and tools common to them all has become an element in the formulation of new policies for introducing technology-based solutions.

2.1 Evolution of research

Being aware of the need for research to take account of the variety of farm categories and to design innovative techniques in partnership with the farmers, the research institutions are finding themselves obliged not only to rethink some of their traditional functions, but also to take on certain new ones.

In this new perspective, four functions may be viewed as having strategic importance:

(a) **Function: “Regional diagnostic surveys and establishment of farm typologies”**

As we have seen, the establishment of farm typologies by eco-region and the analysis of development paths for each type are basic to the construction of the framework within which a dialogue with the farmers can be established and new technological solutions tested out. The approach by agrosystem and the approach by individual subsector overlap the most often because agrosystems are often organized around a dominant subsector of production (cotton agrosystems, rice or irrigated vegetable systems, pastoral systems, for example). The same subsector on which the farmer hinges the organization of his own agrosystem also forms the basis for a chain linking the actors in the different stages of production, processing, and marketing of the product concerned.

Thus it is important for research to acquire the tools necessary to the accomplishment of this task, and, first of all, to set up multidisciplinary teams in the different eco-regions, whose members are trained in agrosystem analysis and farm typology creation. Those teams will be responsible for identifying the principal farm categories, analyzing development dynamics and constraints, and carrying out, and subsequently updating, regional diagnostic surveys.

(b) **Function: “Development of new technology-based solutions”**

Linked to the above function, this one is known by several different names (development research, action research, participatory research), and consists of the organization of real-environment experimental networks by type of technical innovation. The places where technical references are prepared may also become support points for a policy to promote exchanges and communication among farmers.

It is important to mobilize the researchers in the various disciplines to monitor the reference networks, and, through this monitoring process, to encourage them to enter into a sustainable dialogue with the farmers.

(c) **Function: “Mobilization of national, regional and international scientific skills”**

The purpose of the first two functions is to strengthen the interface between scientific research and the real world of production. The construction of a field facility is undoubtedly the primary mission of a national agricultural research system. It will need to assign the necessary human resources to that facility, even though this could mean abandoning certain fundamental disciplines that can be developed elsewhere and without any particular links to the world of agriculture. The universities, other national research institutions, the international centers, and the specialized research institutions in the countries of the North are all equipped with scientific expertise of this kind.

Within the framework of sustainable alliances with the national, regional or international scientific partners, national agricultural research will be able to mobilize new scientific forces capable of helping it to pursue its research program. Those partners, being far removed from agriculture at the local level, will often be interested in participating within the context of the field facilities operated by the national agricultural research sys-
tem. This is in particular the attitude of many teachers and students at national universities who want to obtain hands-on experience of the real world of agriculture. It is therefore incumbent on a country’s national agricultural research institute to define and implement an external relations policy that will come fully into its own with the construction of a “national agricultural research system,” in which the national institute is responsible for building and maintaining the field facilities and the university is in charge of bringing in and managing the expertise in the various basic disciplines.

(d) Function: “Exchange and communication of scientific and technical information”

Research essentially generates information, and in the present case that information is of a scientific and technical nature. Part of the research function is to disseminate such information to the final users. With the strengthening of the first three of the above functions, all of which involve the building up of research and development partnerships, this information function will take on strategic importance. But within this prospect of strengthened partnerships there is more. The bilateral nature of information must be understood. The idea of “dissemination” needs to be replaced by that of “exchange and communication.” Within this approach, each partner is both generator and consumer of information. The farmers are the repositories of knowledge about traditional practices and decentralized technical innovations, and this knowledge can be useful not only to the researchers but also, and above all, to other farmers working in related situations.

Hence the appearance of a new “exchange and communication” function. It is a bilateral function, based on the new tools of observation, investigation, accumulation, processing and dissemination of information and on the new products available in the area of communication.

2.2 Evolution of technical advisory services

The traditional modes of agricultural extension have had their day. In the countries of the North, in Asia, Latin America, and now Africa, extension has faced, or is now facing, the need to take into account the emergence of farmer organizations, the formulation of decentralized demands for technology, and the diversification of the supply of technical advisory services, a phenomenon that is mainly rooted in the rapidly growing numbers of private initiatives. All over the world, technical advisory assistance is adapting to the interaction between supply and demand in the area of technological innovation.

At the local level, farmers are no longer interested in having to deal with a know-it-all technician whose qualifications are often lower than their own and who can be quickly outstripped by technological advances. They generally prefer to work with a technician or “mediator” who can mobilize information networks and have first-hand access to specialized know-how.

(a) Evolution and diversification of the supply of technical advisory services

Within this approach, rather than seeking to disseminate standardized technical solutions, the public agricultural advisory institute attempts to identify the necessary sources of technical information and expertise and to make these accessible to the users. Agricultural advisers are then able to play to the full the role of mediator between the sources of information and the farmers, between the supply of innovative technologies and the demand for them. But the most important development is that agricultural advisory assistance is no longer a monopolistic public function, and may now assume a variety of legal forms, that of a public agency, a professional organization, a non-governmental organization, or a private company. What happens most frequently is that these different forms develop simultaneously and exist side by side.

From one standpoint, technical assistance is still viewed as a “public commodity” and as such is still financed out of the public-sector budget, or even provided by public-sector institutions. From another standpoint, it is becoming a commercial service that seeks to sell itself to the farmers.
A matrix constructed by region, which crosses technical assistants with specialized messages, is a useful tool to provide consumers with information concerning the variety of services available from public and private sources.

(b) **Expression of an effective demand for technical advisory services**

The farmers are anxious to play a driving role in the definition of technical advisory services, either by paying for the service, or, if the service is provided free of charge, by participating at the level of the guiding authorities [instances de pilotage] of the public or parapublic institutions providing advisory assistance to the agricultural sector. In countries where the farmers have little or no purchasing power, an “effective demand” for advisory services has to be created through various mechanisms. It is important that the “customer” be able to choose his provider and to change to another one if his first choice proves unsatisfactory. Thus systems have been devised in which “vouchers” or “hourly credits” are distributed to individual farmers or farmer organizations, to be used for this purpose.

2.3 **Evolution of farmer organizations**

Any discussion about agriculture must start out by focusing on the farm as the primary framework for the processes of production and natural resource management, and on the farmer as the party who decides what forms those processes should take. In order to properly develop these two tasks of production and natural resource management, farmers and stockraisers everywhere have always banded together in organizations.

In former times, the various types of organization would be found within the area where those tasks of production and natural resource management were being performed, i.e. essentially at the local level. As markets have expanded, farmer organizations have expanded also. Moreover, as agriculture has developed, the farmer organizations have taken on new tasks upstream and downstream of actual production. And now, in a world where new developments are constantly taking place on the political, economic and social scenes, the farmers, as a professional group, are also seeking to defend their professional interests against other groups and to obtain favorable trade-offs from the public authorities.

Thus the building of a farmer organization progresses from the local level to the national level, and then to the level of the large regional economic units where part of the authority is now located, and finally, although so far only on a tentative scale, the farmers will have to acquire the means to intervene on an international scale.

Technological innovation is one of the key factors in the competitiveness, profitability, and sustainability of agricultural and pastoral activities. All over the world, farmers and their organizations are now realizing how much hangs on this fact. Alongside their trade union and economic functions, the farmer organizations are developing a technical function that involves applied research and technical advice and may take various forms.

Farmer organizations have thus become more and more “professional” in recent times both as a means of strengthening their technical capacities, for example through the incorporation of specialized technical advisory functions for their members, and of improving their capacity to approach external technical bodies, both public and private, for research or for advice. This trend has thus led to the appearance of a technical function, and sometimes even a scientific function, within the farmer organizations themselves, something that is altering the overall operation of the support system for technological innovation.

In the end, it is the overall operation of the support system that must be allowed to evolve at the same time as the various forms of partnership. It is up to the farmer organizations to become the driving forces in this process of evolution.

3 - **Towards a new partnership among stakeholders in the technological innovation process**

Collaboration among the stakeholders in the technological innovation process may take different
forms, depending on the different degrees of cooperation: cross participation at the guiding authority level, negotiation of operational contracts, creation of common functions or tools, and, in the long run, establishment of a true “national support system for technological innovation.”

3.1 Farmer participation in the authorities guiding the public research and advisory institutions

To ensure that user demand is taken into account at the time of formulation of public policies on research and technical advisory assistance, the first step is undoubtedly to ensure that representatives of the farmers and of the private industries participate in the authorities by which the public institutions are guided. Besides the regulatory agencies, certain more specialized entities should be looked at as potential fora where the farmers can put over their viewpoints more easily.

Thus committees could be set up on the basis of individual subsectors and/or regions, if possible corresponding to eco-regions, or, even better, to families of agrosystems. In either case, i.e. whether the groups so formed are agrosystem-based or subsector-based, the partners in the innovation process will be able to engage in a professional dialogue with the public institutions. This will amount to a gradual learning process, since in many regions the sectors of research, production and advisory assistance know nothing about each other, and it will take time for the three sides to come to understand each other and to adjust their outlooks accordingly.

3.2 Contractual arrangements for the performance of common tasks

A working partnership needs to be confirmed through a contract stating the responsibilities and duties incumbent upon each of the parties. Thus it is no longer sufficient for the public agencies to simply supply catch-all solutions to unknown farmers — they must instead engage in a dialogue aimed at bringing about the sector’s modernization. The contract will henceforth be the rule for establishing the interactive nature of a given technological innovation and the commitment of contracting partners. Such contracts may be concluded between the research organization, the technical advisory service, and one or more farmer organizations.

Contracts of this kind already exist between research and the private sector. In general these are very specifically targeted.

3.3 Pooling of functions and/or tools

Some of the functions we have indicated as needing to be strengthened by the research or technical advisory bodies or by the farmer organizations in fact belong to several partners and would gain from being pooled. Such functions include the organization of development research and of means of exchanging and communicating technical information. Jointly managed units could be set up with staff and financing provided by the different institutions. These common units could either operate independently or else be managed by one of the partners on behalf of all parties concerned.

For certain commercial crops, particularly those produced by a small number of powerful farmers, specialized units can be established, for example affiliates set up jointly by the research and advisory institutions and the professional organizations or economic interest groups. Such bodies already exist, for example, for certain tropical perennial crops.

3.4 Setting up of a “national support system for technological innovation”

Convergent developments at the level of all of the stakeholders in the innovation process, participation by the farmers in the guiding bodies of the public institutions, and the creation of common tools are all factors that are gradually altering the appearance of each of those stakeholders and of the environment in which the innovation process is taking place. This evolution is naturally leading to the establishment of a “national support system for technological innovation,” or, to use terms currently in vogue in certain countries, a “national agricultural development system” or “knowledge system.”
Like all systems, a system of this kind has its own particular anatomy and physiology. Its anatomy comprises specialized organs, the public research and advisory institutions, the professional farmer organizations, companies providing services, private enterprises, non-governmental organizations. Those partners all participate in the innovation processes, either separately or acting in concert, if they are encouraged to do so through incentives or specifically targeted offers of funding. The system's physiology is characterized by particular modalities of governance, reflecting the level of the partnership between public and private actors, and the operation of exchange and communication mechanisms among the partners, action programming, cooperation incentives, financing, and evaluation.

Where financing is concerned, in addition to the funding granted to each of the institutions in accordance with their individual logic, the system can only truly exist if a "national support system for technological innovation," or a "national agricultural development fund" or more specifically targeted or regional funds are established.

Institutionalization of this "national support system for technological innovation" reflects the sustainable nature of the contracts by which a sustainable bond is forged between the stakeholders in innovation and agricultural development as they affirm a reciprocal commitment to participate in modernization of the agricultural sector. To be fully significant and effective, such institutionalization must be accompanied by the development of each of the actors, by the pooling of functions and tools belonging to several different partners, and by the allocation of specifically targeted resources. But it is above all the creation of new entities that will influence a common policy that bears witness to the desire of each party to change its own logic and reflects the reality of a new order of accountability in agricultural development.

B. SUMMARY OF MAJOR DISCUSSION POINTS

The second session focused on interactions of technology services and institutions with farmers. Past programs have often been ineffective because of attempting a top-down approach to technology innovation and to "managing farmers". The complexities of agricultural systems makes this ineffective, but enlisting farmers as full decision-making partners draws on their knowledge and facilitates utilization of new technical and management innovations. Conclusions included:

- research programs must find ways of involving farmers in research priority setting, planning, conduct, and evaluation;
- extension systems will evolve to become commercial partners with farmers and are likely to become multi-institutional advisory services;
- NGOs, foundations, the private sector and other intermediaries will be important voices for farmer concerns and for dialog with research systems;
- farmer organizations, in particular, will be important partners in the governance of agricultural research systems.
APPENDIX III

Towards a Global Agricultural Research System

A. BACKGROUND PAPER

THE CRITICAL ROLE OF PARTNERSHIPS IN THE EMERGENCE OF A GLOBAL AGRICULTURAL RESEARCH SYSTEM

Relationships between scientific partners are multiplying. As in other sectors, agricultural research is gradually taking on the characteristics of a "global system," a movement that is partly the result of factors beyond the control of research officials and partly the fruit of deliberate policies. The building of national, regional, and international scientific partnerships is leading to the emergence of this global agricultural research system which will provide a common framework for action by a whole range of players in the science field.

Building scientific partnerships is the key feature in the establishment of the global agricultural research system.

While the form taken by such partnerships depends on the "contents" and "processes" involved, it also depends on the financial arrangements that enable the partners to collaborate. In addition, ensuring the overall coherence of innumerable decentralized initiatives requires the creation of facilitation entities open to the partners involved. These entities will contribute to consensus building, a key component of the governance of the global system.

1. CONTENTS AND PROCESSES FOR THE BUILDING OF SCIENTIFIC PARTNERSHIPS; PRODUCTS OF SUCH PARTNERSHIPS

1.1 Contents of scientific partnerships

The construction of new or stronger research partnerships, must build on existing collaborations and respond to the evolving concerns of societies.

(a) Inventory and classification of agricultural research entities and activities

Information on the research being performed by potential partners is the first requirement in build-
ing a structure to facilitate collaboration. The initial basis for partner relationships is what each partner is or does. Participants in the agricultural research field need to inventory and classify their research entities and activities, on an ongoing basis. Selection of the data they should monitor in the form of descriptors and indicators is crucial, as are the nomenclatures to be used in organizing these data. Definition of generally accepted norms is an essential prerequisite if aggregation and comparison of data are to be possible.

The question of nomenclatures, designed to reflect the structuring of the research field, is essential to the sustainability and scope of the observation exercise. Several approaches to the structuring of the agricultural research field and to laying the foundations for instances of scientific cooperation can be considered: a "commodity" approach, an "agro-systems" approach, and a "disciplinary" approach. In each of these cases, the construction of typologies is the key to structuring the corresponding field and classifying the observations collected.

It is worthwhile commenting at this point on the establishment of typologies. While the typologies of commodities and of disciplines pose few conceptual problems, the typology of agro-systems on the other hand is more difficult to set up.

**Commodity (or subsector) typology:** A list of products, organized by family, can be established with no difficulty at the international level. It might be established within the context of the NARS/CG support group process and proposed to the Global Forum. Countries and regions could call for such a list to include products important for their national research programs or their regional cooperation programs, and could organize data collection in terms of that choice.

**Disciplinary typology:** The same is true in the case of disciplinary support services. A typology could be established and validated by the same method. For instance, in its study *Afrique de l'ouest et du centre*, CORAF opted for support services in: chemistry (soil analysis, plant analysis, etc.); biology (identification of organisms and micro-organisms, tissue culture, biotechnologies, etc.); geography (cartography, remote sensing, etc.); economics (monitoring of agricultural policies, subsector analysis, etc.); mathematics (computation center, etc.); and scientific and technical information.

**Agro-systems typology:** In the majority of agricultural situations, it is ultimately the farmers, in the setting of their own farms, who decide how their output will be produced and how the natural resources will be managed. They are the decision-makers, even if in reaching their decision they have to take into account innumerable facts concerning their ecological, economic, social, institutional, etc. environment. Admittedly, this environment is frequently shaped by national policies or the effects of international trade, which thus have an indirect, but increasingly strong, influence on the way production and resource management practices evolve. But it remains that on the basis of all available data, the decision to innovate will be taken, or not, at the level of the individual farm or pastoral unit.

Accordingly agricultural research needs to propose innovations developed within the context of specific agro-systems. Since the number of agro-systems is potentially as great as the number of individual agricultural holdings itself, it is necessary to identify families of agro-systems and to classify them using a typological approach. An agro-system is characterized not so much by descriptive data, as by the nature of its mechanisms for the production of goods and the conservation and renewal of natural resources. Physical, economic, social and technological parameters influence the nature of these mechanisms greatly.

The situation is exemplified well in the study *Afrique de l'ouest et du centre*, in which CORAF distinguishes nine major types of agro-systems. Seven are identified using physical criteria (rainfall pattern), one using an economic criteria (proximity to a consumer market), and one using a technological criteria (irrigation control).
(b) Setting of priorities to govern cooperation

If current research activities are the chief material used to build collaborative arrangements, only the definition of common objectives can finalize partnerships and give them form. Even if founded on a rigorous study of real situations, formulation of the priorities that are to govern collaboration is a fundamentally political exercise. While the decision process involved is simple when the partnership is to consist of two parties, it becomes complex when there are various prospective partners, and especially so when the aim is to build a multi-member partnership with a broad geographic base associated with a national, regional, or—obviously—international system.

In institutional terms, this type of multi-member partnership probably requires the formation of a “Programming Committee” consisting of representatives of the partners. It will be responsible for determining what priorities are to govern the collaborative arrangement. To do so, it will need not only to assemble proposals for collaboration from the participants, but also to reach a consensus on a strategic vision of the evolution of agriculture in the geographic area concerned.

1.2 Procedures for building complex partnerships

Collaboration among research scientists can take different forms. It may consist of an exchange of information between partners engaged on related work, a case that as a rule is unlikely to lead to new, joint research projects. Or, on the other hand, the collaboration may consist in launching new, joint research activities, the danger here being that the parties will often omit to take existing research into account.

This frequent separation between the old and the new, and also a lack of coordination in the definition of new activities, produces great confusion. New initiatives, often exterior in origin, particularly in the case of countries where external aid represents a major part of the research effort, can disrupt activities already under way and create contradictions. In the process of building partnerships, merely taking existing research efforts into account can increase synergies and coherence.

We propose that the basic tool used in building scientific partnerships be a matrix that allows research and/or collaboration topics on the one hand and national, regional, and international players in the scientific arena on the other to intersect and interact.

(a) Building a national partnership for agricultural research

National agricultural research is often taken as being synonymous with the work of a national agricultural research institute, whereas actually many partners contribute to the national agricultural research effort. If this reality is to reveal itself clearly, the present situation needs to be progressively institutionalized, through the gradual creation of a “national agricultural research system.” Such a system would comprise not only the national agricultural research institute but also other research institutions (working, for example, on forestry, environmental problems, agro-processing, or any other agriculture-related topics), the universities, and private-sector research teams (affiliated with corporations, professional organizations, and NGOs).

Construction of a national matrix which lists research topics and national players in the science arena, while highlighting the activities of each partner, is the first step toward formal establishment of a national agricultural research system. This task of assembling information obtained from an inventory of activities and then feeding it into the matrix is being carried out on an experimental basis by research institutions in Senegal, and in related ways by institutions in several other countries. In the case of Senegal, information has been fed into the matrix by some twenty institutions, either wholly or partially scientific, public or private, specialized in agricultural subjects or not, Senegalese or not.

On the basis of a sound knowledge of activities already in progress and priorities already determined, the competent authorities and interested potential partners can then decide what new activities should be initiated and
what partnerships should be formed and/or strengthened.

(b) Building a regional partnership for scientific collaboration

The establishment of regional collaborative arrangements, rather than of specific regional research activities, which proceeds from a different logic, also needs to be preceded by an inventory of research projects undertaken by the countries of the region and the selection of collaboration priorities.

Construction of a regional matrix is the best method of conducting a topic-by-topic identification of the activities conducted in the region by the scientific institutions. This matrix should be constructed by aggregating national matrices.

The selection of the priorities that are to govern collaboration in a particular region allows positioning of the rows of the matrix in hierarchical order and identification of the topics which warrant the formation or strengthening of partnerships linking players in the scientific arena who are already involved in the region or wish to be. Where these priority topics are concerned, priority regional cooperation programs can be designed, supported, and put into effect.

(c) Building an international partnership for scientific collaboration

What goes for the national and regional levels goes also for the international level. Collaboration needs to be based on the activities undertaken by the partners involved and on a strategic vision focused on the selection and implementation of activities to be conducted through international collaboration.

Conceptually, it would be possible to construct an international matrix from regional matrices, with the addition of the matrices of institutions working directly in the international sphere (International Centers and Specialized Research Centers). Such a matrix could even serve as a monitoring tool for the research projects being conducted by all partners working in the global system; its elaboration and management could be one of the major objectives of a Global Forum on Agricultural Research. However, for the moment this is too ambitious a goal. The magnitude of the task leaves no doubt that, at least initially, international scientific partnerships need to be built up from the regional level.

To circumvent this difficulty, it is also possible to proceed row by row and feed data into the matrix only for those rows that correspond to the priorities selected by institutions concerned with international cooperation. It is here that the priority programs focused on “agro-systems,” “commodities,” and “disciplinary support services” come to the fore. This is the approach adopted by some CG centers that are engaged in “commodity” — and, more recently, “eco-regional” — partnerships or programs.

1.3 Establishment of Priority Programs

In its most elaborate form, a partnership becomes a “Priority Program” of cooperation founded on a contract between the parties involved. Such a program translates a cooperation priority into operational terms by defining a framework and a set of researchable issues. A Priority Program will incorporate not only activities already in progress but new activities as well. And rather than being distinguished by the activities it consists of, which generally have their own origins and momentum, we suggest that at the onset Priority Programs be focused on the establishment of mechanisms for communication between partners engaged in related activities and of incentive mechanisms likely to contribute to the launching of new actions under the Program.

What this means is that a Priority Program serves as a vehicle:

*For enriching activities already in progress, by introducing mechanisms of communication conducive to interchange of information and interchange of research scientists. Establishment of a communications network (e.g. electronic mail) and development of communications products (e.g. liaison bulletins) will enable Program partners to exchange information, while mechanisms for the support of*
long- or short-term secondments will allow interchanges of research scientists.

For launching new activities, by introducing incentive mechanisms designed to orient national, regional, and/or international cooperation efforts in the direction of the designated priorities. Once research and cooperation priorities have been identified and the content of a Priority Program has been determined, the launching of new activities and partnerships can be organized on the basis of competitive grants. Such formulas are powerful mechanisms for inducing further development and evolution of research systems.

A competitive environment, by its very nature, prompts the best partners to join forces, thereby enabling them to reinforce one another. Conversely, weak sectors find it hard to obtain support. Before long, given the effects of the interplay of these mechanisms, the scientific community as a whole shapes itself in terms of the comparative advantages different teams have. The fact that different research systems develop different specializations is less a result of authoritarian “governance” effected through deliberate planning than of peer recognition of the scientific quality of research teams and their comparative advantages.

It is advisable to seek a balance between this evolutionary approach stemming from scientific quality and the need for each research system to find a place in the global agricultural research system. The introduction of condition-alities or criteria into the competitive bidding process may provide a means of achieving this necessary balance and, for example, of preventing the exclusion of scientific teams from countries with more modest scientific endowments. In any event, this type of “controlled natural evolution” can be instituted topic by topic within the setting of Priority Programs, which should emphasize scientific competence by every means possible.

A Priority Program thus integrates this set of mechanisms in such a way as to link activities in progress and new actions, communication activities, and collaborative actions. It serves as a framework for the monitoring and evaluation of the performance of scientific institutions, and makes it possible to avoid the duplications and contradictions that often exist between projects. Mere definition of a policy framework and transparent procedures can preclude such contradictions between initiatives which by nature need to remain decentralized.

2. INSTITUTIONAL FORMS AND FINANCING OF SCIENTIFIC PARTNERSHIPS

Two possible approaches to the organization and promotion of scientific partnerships can be envisioned: geographic (national, regional, international); and topic-based or thematic (types of agro-systems, commodities, and disciplinary support services). Geographic frameworks are more political in nature, and thematic frameworks more scientific.

2.1 Geographic approaches

Ensuring coherence among partnerships created at different geographical levels is the responsibility of the relevant authorities at the corresponding levels. The governance of the national, regional, and international systems should also be linked among themselves, if possible in a vertical hierarchy, so as to create continuity between the local level and the international level, across a series of intermediate levels. This continuity is the essential feature to ensure that each actor has a voice or is represented in the governance of the global system. Accordingly, ensuring this continuity, which is in no way natural, is a requirement of a political nature.

(a) National institutions

The process of shaping a national agricultural research system which, in addition to the national agricultural research institutes, must incorporate universities, private, professional, and non-governmental research teams. We suggest that this process must involve the creation of entities and procedures for the handling of partnership com-
munications, financing, incentives, promotion, and evaluation. Moving from a national institute (NARI) model to a national system (NARS) may involve the establishment of a national commission or council consisting of representatives of the various partners in the NARS. This commission’s first task should be to arrange for an inventory of research projects and players (formation of a national agricultural data base and matrix), and then to formulate a strategic vision and determine national cooperation priorities. A national fund financed, at least in part, by the partners involved should enable the commission and its executive secretariat to assemble the resources to provide incentives for the construction of the necessary partnerships at the national level, in particular through the launching of some multi-member partner priority programs.

(b) Regional institutions

In order to build regional collaboration, a regional association consisting of officials of the countries concerned seems to be an effective mechanism. Participants should include the coordinators of all NARIs, who often are responsible also for the management of their country’s NARIs. The committee of Directors, through its executive secretariat, should assemble data on research in progress in the region (formation of a data base and regional matrix). Using a strategic vision as its guide, the association’s next task is to prioritize regional needs and launch priority regional collaborative programs.

The national research system representatives who make up the regional committee of Directors contribute by their commitment to its unquestionable legitimacy. The committee is therefore in a position to effectively coordinate the various scientific players active, or wishing to be active, in the region. A regional association should ensure the effective integration of the international players (International Centers, and specialized research institutions in the countries of the North) in the region’s collaboration programs. Furthermore, if its legitimacy is broadly recognized, the association and its executive secretariat will hold the necessary authority to impose a discipline on initiatives for the formation of partnerships. As already indicated, unchecked multiplication of networks and programs, often originating outside the region, is not only wasteful but also extremely prejudicial to the quality of national research efforts.

As has been heavily emphasized here with regard to national collaboration, it is important that regional collaboration focus on both activities in progress and the creation of new ones. Finally, so that sight is not lost of the complementary nature of the functions in play, the regional association should not be expected to institute regional research projects but rather regional scientific collaboration. It is at the national level that research activities should be launched, even where they fit into regional and international programs identified by the ad hoc bodies in place at those levels.

(c) Institutions of the Global System

As observed earlier in this paper, the bulk of agricultural research and building of scientific partnerships takes place at the national and regional levels. Nevertheless, in a system that is taking on global dimensions, it is important to set up bodies able to intervene on a global level. The various scientific players who are the stakeholders in this global system should be able to participate in its formation and, at the appropriate time, in its development. The potential players are so numerous and so scattered that the only feasible operating mode is that of indirect participation based on representational arrangements.

The global agricultural research system as currently envisaged (perhaps our concern should be restricted to inter-tropical agriculture) comprises three key components: the national research systems of Southern countries (NARSs/S), the national research systems of Northern countries (NARSs/N), and the international agricultural research centers (IARCs):

The IARCs have for the past 25 years been part of a network known as the Consultative Group on International Agricultural Research (CGIAR), which also comprises many...
other entities, among them a Committee of Center Directors. The International Centers component, already highly organized, can easily be incorporated into the Global System.

The NARSs/S are poised to create an organization that will enable them to interact collectively with the other collective players in the global system, and thus to put forward their views and defend their own interests. Because it is to be a bottom/up organization, the membership of its subregional (and subsequently continental) committees, associations and councils will consist of NARS/S officials. In their own turn, representatives of these bodies will constitute an International Forum, as well as a more formal International Committee of NARSs/S. Four major continental complexes have emerged (sub-Saharan Africa, Latin America, Asia/Pacific, and West Asia/North Africa), as have 17 subregional groupings (three in sub-Saharan Africa, five in Latin America, four in Asia/Pacific, and five in West Asia/North Africa). Each subregion forms a collaboration area.

These regional associations have a twofold task: to initiate and promote regional collaboration, and to serve as the international representatives of the players in their region's agricultural research. Two of the continental complexes, Africa and Latin America, are already very focused on subregional collaboration, while the other two are still chiefly preoccupied with continental concerns.

The present situation is a fluid one, in the sense that while the developments in progress are largely associated with the CGIAR, an internal dynamic — a manifestation of the coming together of regional forces and interests — is in the process of emerging.

The NARSs/N should also participate fully in the birth of the global agricultural research system. However, if this system is to take permanent shape, and if the process of consultation (and possibly also promotion) is to be institutionalized, they will need to organize themselves accordingly.

In the case of Europe, a process is under way which should lead to a greater coordination among European participants in agricultural (tropical) research and ensure a European participation in the birth of the global system. In this respect, a "European initiative" on agricultural research for development has been launched by the relevant ministries of certain European countries and the European Commission. To be fully effective, this "initiative" needs to be accompanied, if not supplanted, by creation of an entity with a mandate to represent research institutions themselves. The question as to precisely how the NARSs/N would participate in a Global Agricultural Research Forum, and beyond that in an International Committee, remains unresolved. A prerequisite for the creation of the Global Forum is that the three groups, or "colleges," listed and examined briefly here be formally organized. In this regard, it remains for the NARS/S college to finalize its organization process and for the NARS/N college to think how it too might organize itself.

2.2 Thematic approaches

Priority Programs focused on a particular research theme or topic or on a given geographic area provide the framework for the building of scientific partnerships and take advantage of the potential synergy between activities in progress and possible new actions and partnerships. Depending on the geographic scale of a Program, oversight arrangements will be national, regional, or international, but if it is thematic in nature, oversight will be exercised from the international level. Once oversight arrangements are in place, Programs can focus on operational activities, development of which should be the responsibility of the scientists involved.

Generally speaking, a Priority Program's governance can be undertaken by a Program Committee consisting of representatives of the main partners. If the legitimacy and credibility
of the Committee are to be assured, partner representatives’ qualifications in the thematic arena in question must be beyond dispute. The Committee may set up an executive secretariat to make preparations for and implementation of its decisions.

The partnership will be formalized by a contract between the parties concerned. In the case of a multi-member partner program, each partner subscribes to the approach that has been agreed upon and gives its undertaking to the group to play its due part in program communications and activities. Even if the contract in question is unwritten, it signifies a commitment by the various partners to a common cause.

2.3 Financing scientific partnerships

Though sometimes difficult to do so accurately, it is worthwhile distinguishing between funding for partners’ projects and funding for their collaborative activities. A partnership has its full value only if none of the partners needs partnership financing to fund its own operations.

Funding sources are well-known: the NARSs/N are supported by public budget allocations, and to a marginal degree, by private funds made available by countries of the North for scientific research; the IARCs are financed by the international community (i.e. the CGIAR), mainly out of official development assistance funds; and the NARSs/S are financed by public budget allocations plus international official funds made available as grants and, increasingly, as loans.

The fact that each of the three groups of institutions making up the global system relies on different sources, forms and channels of financing means that the competition for funding among them remains moderate. Nevertheless, vigilance is needed to ensure that the crisis situations affecting government finances in Southern countries, research budgets in OECD countries, and support for international cooperation do not lead to active competition among the three groups; if it were ever to become intense, the building of scientific partnerships would prove impossible.

The need for vigilance is made all the greater by the fact that successful building of scientific partnerships depends on the availability of ad hoc resources to cover the additional cost burden which national, regional, and international cooperation imposes on the budgets of players in the scientific arena. This applies particularly in the case of transaction costs associated with bringing partners together, communication, and secondments.

Given the importance of collaboration in the evolution of research systems, it is advisable to set up financing arrangements and make provision for ad hoc resources. The creation of national, regional, and even international incentive and competitive funds, whose intervention would depend on the outcome of calls for tenders, would be one way to promote partnerships built on a basis of scientific quality. Such funds could serve as one of the essential levers for improving the scientific level of institutions comprising the national systems.

Various experiments are currently under way. At the national level — in Senegal and Brazil, for instance — funds set up for the development of scientific partnerships will help shape the particular country’s national agricultural research system. At the regional level also, numerous initiatives are in evidence: several Latin American NARSs, for instance, have established a regional fund for the strengthening of scientific cooperation; and the regional associations in Africa are planning to set up Priority Programs and discussing the necessary financing with, inter alia, the EU Commission.

Building partnerships is crucial to building the global system. The more relationships that exist for the purpose of collaboration, and — more importantly — the higher their quality, then the more likely it is that the global system, and the geographic and thematic subsystems composing it, will materialize successfully. The institutional forms in which the entities entrusted with oversight of this building effort are cast, and the financing arrangements put in place to support the various processes involved, will also be of great importance. Care must be exercised as well to ensure that these
mechanisms place the proper value on partners' scientific quality and assist each one to make the most of its specific potential.

B. SUMMARY OF MAJOR DISCUSSION POINTS

Partnerships were the focus of the third workshop session, which explored the rationale for varied types and levels of partnerships. The linkages between NARSs, IARCs, and advanced research institutions are in some areas well established, but strengthening and facilitating these linkages to become global partnerships will provide substance to the emerging global agricultural research system. The participants concluded that:

- technology is becoming globalized, in a similar way to the globalization of markets;
- partnerships will form through multiple approaches depending on the market for technology innovation, but consideration must be given to "weaker" members of the research community;
- innovations in information technology and science (i.e., biotechnology) are driving forces towards building partnerships;
- regional associations will be an important mechanism for NARS participation and influence in a global system.
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