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Consultative Group on International Agricultural Research
Science Forum
Strengthening Research-For-Development Capacities

STRENGTHENING RESEARCH FOR DEVELOPING CAPACITIES:

NATIONAL, REGIONAL AND GLOBAL SCIENCE CAPACITY

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Agricultural production and the rural sector are central pillars in the development process of developing countries. Recent studies by the World Bank and by IICA in Latin America indicate that the relative importance of agriculture and the rural sector to the overall economy is much larger than what official statistics may indicate.

These new estimates suggest that, in Latin America, the contributions of agriculture to GDP are close to 30% (as compared to official figures of 10%), and rural population measured following the methodology used in the OECD countries is close to 40% (compared to official figures of around 10%). Similar changes in the figures are likely to apply to other regions of the world.

The relative importance of the rural sector has to be seen in the context of a scarcity of land and fresh water in the world in general and in many developing countries. In this context of a growing scarcity in the natural resources base needed increments of production will depend on science and technology. Thus the development of research and science management capacities will be crucial for the development of the developing world.

Science and technology is, in modern life, the main driving force of agricultural modernization and rural development. As globalization of Science increases and becomes more pervasive new opportunities, but also new risks, need to be addressed through new institutions and policies

Draft Note

My presentation will attempt to highlight what I see as some major underlying trends and identify some of the policy and institutional implications they may have for developing countries.

My comments are mainly derived from my work in Latin America but most of them, I think, have a wider relevance

The presentation is organized in three chapters in addition to the introduction. The first chapter includes 10 observations on the major trends in agricultural science and technology. The second chapter attempts to delineate a number of institutional and policy matters that need to be considered in developing countries to improve the contributions of research and knowledge management to development. Finally chapter IV presents some concluding comments.

Major Trends

Science and technology has played a major role in production and productivity increases. In the last 30 or 40 years more than 2/3 of production increases can be attributed to technical change (IFPRI).

Agricultural production is becoming a technologically “intensive” sector. Many new productions are highly dependent on complex technologies that were developed through very sophisticated research. Examples of this are genetically modified soybeans in Argentina, flowers in Colombia and Costa Rica, salmon in Chile and prawns in Central America, highly sophisticated farm equipment and satellite information used for precision agriculture are additional examples.

Biotechnology, in particular, has established itself as a new way of creating agricultural technology. Even though it will not replace conventional research it will gradually become the scientific basis for major research processes. In order to take full advantage of these new opportunities will require major institutional changes.

The growing complexity of the processes that determine how knowledge is created, disseminated and controlled require the articulated participation of social actors: research organization, input producers, farmers, farm consultants etc.).As a consequence technical change depends not only on research but also on appropriate strategies for knowledge mobilization and management.

Globalization of science started many years ago specially in the public sector. The CGIAR is a product and an example of a voluntary and extended effort to globalize agricultural knowledge and technology generated within the public sector to the benefit of developing countries.

More recently the private sector that produces inputs for agricultural production like seeds and fertilizers has become a major player in the globalization process. The transnational nature of

Draft Note

these firms is the consequence of the large economies of scale generated by the growing complexity of science and the large investments required.

The growing importance of big investments in the development of hard science that leads to technologies that are protected by IP legislation creates a new and complex framework for developing countries. In this respect a major concern is to insure their effective access to these technologies. In addition its introduction to production processes is becoming highly demanding in management capacities at the farm levels.

For these reasons developing countries and more so if in addition they are small economies, will have great difficulties to develop the infrastructure, the human capacities and to do the necessary investments to develop the technology they need to modernize and be competitive in world markets. They will have to rely in the intelligent and deliberate utilization of international spillovers. The CGIAR and other international programs have played, in the past, an important role in this aspect

The main challenge for developing countries is to develop appropriate institutional and policy frameworks that promote efficient knowledge management processes that organize and deliver available knowledge and technologies to all those involved in the production process.

Public Sector institutions and organizations have a major role to play in:

- Defining the appropriate normative instruments and legal frameworks that facilitate the access to new international technologies.
- Organizing and funding the necessary institutional processes and organizational mechanisms to adapt and disseminate the available technologies and knowledge.
- Providing the necessary funding and research facilities for the creation of knowledge and technologies in areas of special interest to the specific country and that are not available and are not being produced internationally

These actions need to be organized around a well developed strategy at national, regional and global levels for which appropriate institutions and policies need to be developed.

Institutions and Policies

National Level: Building National Innovation Systems

There exists, in all countries, an informal national innovation system based on the natural relationships and cooperation among the various institutional actors. However, in general, this coordination is weak and ineffective. Countries need to develop appropriate strategies and policies, including funding, to improve their effective collaboration in order to bring together all available resources for innovation. Mexico and Colombia are examples of countries in Latin America which have taken concrete steps to articulate their agricultural innovation systems.

Draft Note

In many countries, NARI's are the main research organization and little efforts have been made to link and coordinate their activities with other institutions in the science community. Consequently, neither the institutional architecture nor the funding mechanisms utilized have favored inter-agency coordination or a sense of belonging to a wider, more complex scientific community. These shortcomings do not have a great impact on the level of innovation when the rest of the scientific community is weak in agricultural issues. However, in a number of developing countries, the recent development of universities and other research organizations has been vigorous, and they are now part of a wide range of increasingly important institutions and activities. To coordinate these public efforts and optimize possible synergies is of the greatest importance.

Further, the new technological paradigm relies on biology, communication and computer sciences, fields in which collaboration from university and research institutions devoted to non-agricultural research becomes extremely important. This evolution calls for inter-agency coordination and cooperation mechanisms which are more complex and need to be explicitly coordinated through public policy, including funding mechanisms. In addition, an overt policy on the promotion and integration of private sector actors should be designed. It should be noted that in most developing countries the investments made by the private sector are still very small in absolute terms and as a proportion of public sector investments. For example private investment in research in Mexico and Argentina is around 30% of total investment while in the USA is 65% and in Japan 18%.¹

In terms of these objectives, it would seem appropriate to create an institutional mechanism responsible for designing and implementing an innovation policy that sets objectives and national strategic priorities, guides public funding towards these priorities and fosters the development and functioning of the set of social actors involved in the innovation process. To a certain extent, this function has been fulfilled by government agencies such as Ministries of Agriculture or Secretaries of Science and Technology. Recent experiences suggest that this role should be entrusted to a collegial body with a considerable degree of autonomy that enables it to analyze problems with a long-term perspective². Besides state representatives, this body should include representatives of all social strata involved in the innovation process. This agency should also create coordination mechanisms among all research institutions and develop a long-term policy for the development of the human resources needed for the innovation system.

Research funding. Agricultural Research Funding is not receiving the necessary attention in developing countries. In most developing countries the level of investment is around 0,5% of agricultural GDP. Compared to levels of 2% in most OECD countries and 3% in Australia and New Zealand. In most cases, public funding for NARI's come from appropriations in the national budget³.

¹ Red Latinoamericana de Indicadores en Ciencia y Tecnología (RICYT)

² The institutional structure that has been used is that of a Science and Technology Council.

³ In Latin America two countries, Argentina and Uruguay, funding come at least as part from an export or import tax.

Draft Note

However, international experience suggests that it is highly beneficial for the NARIs' to have an independent funding regime. This provides certainty about the amount of funding that will be received and about its free availability during the budget year. Both elements are essential for appropriate planning and encourage careful use of resources.

Another form for obtaining supplementary funding, that is independent of annual national budget allocations, is the application of rates to the first sale of specific products, method widely used in Australia. In Latin America, Colombia uses a similar method through the so-called "Fondos Parafiscales" on a number of products. In both cases, resources can only be used to support research and exports promotion and are managed by the private sector with appropriate overseeing by the public sector.

Most of public research funding is of an institutional nature. In other words, funds are allocated to each institution at the beginning of the budget year. More recently, project financing through a competitive selection process based on quality and, in some cases, on the relative relevance of competing projects is becoming more important.

This competitive funding system has proved a powerful instrument to: a) guide research in terms of predefined priorities. It is thus possible to coordinate users' needs and demands with research activities, b) strengthen the clear definition of objectives and the projects research methodology, therefore helping achieve desired results, and c) facilitate the development of mechanisms of research monitoring and evaluation⁴.

Experience suggests that research funding through the so-called Competitive Funds is extremely useful. However, this form of financing should be complementary to institutional funding. A good public funding structure should integrate three alternative sources. One of them should be aimed at the basic maintenance of the institution, including programs of human resources and physical infrastructure development (science basic). Another source should be based on competitive mechanisms to finance research activities originating in disciplinary interests and basic science interests. In this case, evaluation should be based on quality criteria. Last, a third source should be aimed at funding research activities associated with the national, regional and products strategic priorities which have been set through institutional mechanisms external to the research institutions themselves. In this case, evaluation should include quality and relevance criteria.

Regional networks and institutional mechanisms

The globalization of science and the increasing complexity and costs of agricultural research make it increasingly important for countries to become coordinated with international science

⁴See also e.g. a) Echeverría (1998). With competitive Funding will improve the performance of Agricultural Research. Doc 98-16, ISNAR, The Hague.

b) Echeverría, R; E. Trigo y D. Dyerlee (1996). Cambio institucional y alternativas de financiación de la investigación agropecuaria en América Latina. BID, Washington, DC.

Draft Note

and fully exploit technological “spillovers”. The first step in this process is to promote and make use of the opportunities offered by the institutional mechanisms arising from regional integration processes. The various important science programs developed within the European Union are examples that illustrate the possibilities and benefits of integrating research activities. Latin America has a number of regional organizations with specific mandates for research and technology promotion. CATIE in Central America, CARDI in the Caribbean, the PROCIs in each sub-region of Latin America and IICA at a regional level are important technological integration mechanisms. More recently, the creation of the Regional Agricultural Technology Fund (FONTAGRO) by IDB and a number of countries of the region is an important, promising initiative^{5,6}. Africa and to some extent Asia have similar institutional mechanisms.

These types of regional institutional arrangements can play an important role in a number of areas. Some of these areas are:

- Develop joint research efforts and share research results in order to share research costs.
- Share knowledge and human capacities seeking for synergies and critical mass
- Develop personal relationships and cross-cultural linkages as a way of increasing political understanding and willingness to share and collaborate.

Globalization of Science and Using International Spillovers

The second step is to develop the institutional mechanisms needed to fully exploit the opportunities offered by international technological innovation. In this sphere, countries need to develop the institutional culture and the necessary formal mechanisms to integrate into the world. This implies not only keeping up to date with international scientific advances but also having the capacity to adapt them to local conditions, to produce the prototypes and products derived from existing technologies, and to develop a trade and policy framework for these to be available at the production level.

An explicit strategy aimed at a better, more effective integration into the world in the field of science and technological innovation includes, at least, two elements: a) participation in multilateral science and technology institutions, and b) coordination and cooperation with developed countries’ research institutions. c) promoting private local research by transnational corporations that operate in developing countries and collaborative activities.

⁵ This Project has received formal support from a large number of countries. The initiative raises the creation of a permanent Fund of 200 million dollars, which is expected to produce 15 million dollars per year—which would be allocated to funding of research of interest for groups of two or more countries. Research could be developed by the countries themselves, in collaboration with advanced countries’ international research institutions or centers.

⁶ There is also FORAGRO which plays an important role as a Regional Fora and coordination mechanism.

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- Multilateral institutions. There are various multilateral institutions that contribute to agricultural technological innovation. FAO and of course the system of 15 International Centers funded by the CGIAR⁷ are the major ones.
- Developed countries' research institutions. They are the main global source of knowledge. Investments in countries like United States and United Kingdom, France, etc. in science and technology are around 2 to 3% of the GDP and are over 10,000 million dollars per year. Traditionally, developing countries have had access to research results through scientific literature and the knowledge gained by postgraduate students. Although important and necessary, these mechanisms are currently insufficient. First, an increasing share of the research conducted by universities is funded by the private sector under confidentiality clauses that restrict the publication of results, particularly in the implementation phases. Second, the growing needs, especially in terms of laboratories and highly complex equipment, make it highly beneficial to participate in collaboration programs that provide the opportunity to share available laboratories in developed countries. An example of this strategy is the action taken by EMBRAPA Brazil, who places scientists with their own resources in developed countries' laboratories.
- Private research is increasingly important in agriculture being responsible of more than 1/3 of expenditures worldwide. However, only 6% of that investment is done in developing countries⁸. Additionally a growing proportion of embodied technological change is generated by large transnational corporations. Their active participation and the access to that technology requires appropriate legal framework that protect intellectual property rights and that generate the necessary economic environment for technological investments and private research.

Some concluding comments

Innovation is a major force in development. However the access to new technologies is becoming more difficult for developing countries and if these trends continue international income inequalities will worsen. The XXI century is facing a new technological revolution even more profound than those experienced in the past. New scientific methods, new social actors, and the need for complex institutions and policies have dramatically changed the way innovation takes place.

Developing countries need to take a new look to their strategies in regards to agricultural innovation. In the first place it is necessary to develop and appropriately fund an effective agricultural research infrastructure.

⁷ The 15 International Centers located in different countries of the world form a network of applied research focused on small producers' problems. It had a predominant role in the technological developments on which the green revolution was based. Today, total CGIAR funding is around 400 million dollars per year.

⁸ The CGIAR at 31. An Independent Meta Evaluation. World Bank May 2003

Draft Note

However, in the context of globalization and the growing complexity of science it is also necessary to develop, as a complement to its research infrastructure, other complex institutional mechanisms and policy frameworks that contribute to:

- The development of a local private sector involved in research activities and technological development for agriculture and the rural sector
- The wide utilization of technologies and knowledge available in the world both in the public sector and the private sector. In the latter case appropriate legal frameworks and economic environment will be necessary.
- The creation of knowledge management capacities that will lead to a better utilization of available technology at the global level in the production conditions of each country.

Globalization and the new context for agricultural innovation also has major implication for the CGIAR

- The Centers had a huge success in the 70s and 80s. They developed technologies that were widely adopted and resulted in major increases in production and productivity. This research was concentrated on crop improvement and the technology generated responded quite neatly to the Public Goods definition.
- At present the Centers have a wide research agenda. A recent external evaluation carried out by the Operations Evaluation Department (OED) of the World Bank suggests that “ Its current mix of activities reflects neither its comparative advantage nor its core competence”
- A second consideration is that the Centers with their excellent human resources are a relatively small investment in relation to world needs and in comparison to other sources of knowledge in the developed world.
- In this context, it would seem, that a new strategic direction is needed in order to go back and to concentrate in the major roles and activities that were successful a few decades ago but defined within the new context of innovation.
- Some major lines of work that seem to be important are: a) conservation of genetic resources, biotechnology (molecular markers), c) integration, dissemination and management of knowledge available world wide for its use in the developing world.
- The 5 Systems Priorities recently defined by the Science Council is an important step in this direction. In addition the recently adopted Challenge Programs is a useful mechanism that contributes to focalizing the research effort and facilitates long term funding.
- However adjusting the CGIAR activities to the new innovation context may require additional changes in the organization of the present research infrastructure, the relationships with the private sector and the intensity and characteristics of the relationship with research institutions in the developing world.