

Agricultural Biotechnology: What is in it for Developing Countries? - The Role of International Research and Development Centers

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Agricultural biotechnology can be used as a tool to enhance productivity thus enhancing farmer competitiveness. The role of international agricultural research organizations (IAROs) in this regard is envisioned as follows: (1) the IAROs must provide information and various technologies, including biotechnologies, to farmers to solve a particular problem. (2) IAROs should provide opportunities to improve national capacity in science, technology management and policy studies such as on managing intellectual property, biosafety, bioprospecting and related issues. (3) IAROs are in the best position to support and/or manage networks or partnerships on various topics such as training on technical aspects, harmonization of policies and guidelines affecting the conduct of biotechnology. (4) Collections of about 600,000 accessions of crops, forage and agroforestry species are now held by CGIAR centers in trust for the benefit of the international community. These continue to be a source of materials for varietal improvement of national programs. Long-term continuing support for genetic resources conservation must be assured. (5) Results of research studies undertaken by IAROs must be shared with the NARS to encourage institution of proper interventions.

Modern biotechnology, specifically applied to agriculture, has produced useful tools for improving productivity in the farm. However, using these tools requires relatively large investments, which are often intimidating to developing countries. Fairly well-equipped laboratories and highly trained researchers are needed for the practice of modern biotechnology. In addition, problems that have emerged are of such complexity that teamwork is a necessary element in the success of the research activities. All these require substantial investments of resources, often with no guarantee of a quick return.

The role of agricultural biotechnology in poverty elimination has been the subject of many debates. There is clear evidence that modern biotechnology provides the tools that may overcome many of the technical road blocks that limit the application of conventional biological techniques in agricultural research, especially in the area of varietal improvement. Since the discovery of recombinant DNA technology by Cohen and Boyer in 1973 and many other advances in molecular biology, researchers have used and improved on these techniques. The great strides achieved in biological research attest to the precision and rapidity of these techniques. However, it is still a fact that modern biotechnology research is an expensive undertaking. As such, most of the research activities have been supported by rich countries and big corporations.

Be that as it may, the goal of any research activity in agricultural biotechnology research is still a product or a process that can be used by the farmers in the field. Notwithstanding the sophisticated laboratories and the high level of training required of researchers, the end products are similar to those generated by the conventional means such as a seed, planting material, diagnostic kit or process. These product forms hide the tremendous amount of investment and testing to get to the point of application in the farmers' fields.

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The array of new tools and new experimental techniques are a result of greater understanding of biological processes at the molecular level. Thus, the researcher acquires precise tools that significantly reduce uncertainties in the experiment and accelerate the pace at which new data is generated, thus reducing the time to get to a useful product. Hence, many feel that the gains in precision and time are worth the investment.

Modern biotechnology when applied to agriculture is expected to provide better products, which will help alleviate hunger and want in a timely fashion. It is the precision and rapidity of approach which agricultural biotechnology offers that makes it a powerful tool to address the problems of productivity and sustainability. At some point in the research and development process, these products are brought to the farmers' fields for testing. The farmers try it out under field conditions and provide valuable feedback to the researchers.

Biotechnology in the Context of Poverty Alleviation

National programs aimed at poverty elimination need, among others, highly trained people who can help assess the potentials of new processes and technologies. Each country must have the internal capacity to identify and absorb emerging technologies that they consider most useful for their development programs.

In many countries, agriculture is often thought of as a low-tech activity that need not be or cannot be competitive. However, recent developments show that agriculture deals increasingly with many tradeable items that must compete and contend with the vagaries of the global market. Also, there is a growing realization that agriculture is a knowledge intensive activity and must be managed as such if it were to be competitive.

In developing countries, poverty elimination provides the context within which biotechnology can be developed. But it is clear that we are on the crossroads. Modern biotechnology is a very powerful tool for agricultural research, a production enhancing innovation. This tool is precise, rapid, and of wide application. It can be used to improve life forms and understand how they behave or react to the environment. Genetic material can be moved across unrelated species. The genome of organisms can be decoded, mapped, and related to phenotype.

Modern biotechnology is made more potent as a tool when combined with information technology. Thus, the field of bioinformatics is rapidly developing as an interphase between biotechnology and information technology. We do not know what other synergies can be derived between biotechnology and other emerging technologies in the near future. But such synergies are sure to happen.

The Challenge--- Rough Road Ahead

Even as we gather momentum to apply this production-enhancing innovation, we face many hurdles that we have to overcome.

There is a perception that the world already produces enough food for all and that food insecurity is not a result of global shortage of supply but of a distribution and marketing problem. On the basis of this observation, many argue that we do not need productivity-enhancing technologies anymore.

New products, new life forms created by the application of the tools of modern biotechnology are perceived to have yet unknown effects on the environment and human health. The genetically modified organisms are now subject to very rigid biosafety tests before they are released to the environment.

Furthermore, the massive investments in modern biotechnology have caused the application of intellectual property rights protection on most of the discoveries, which are in the possession of the private sector. Thus, limited access to vital scientific information owned by the private sector is now a subject of intense discussion. For example, the increasing barriers towards the accessibility of genetic resources, which were once considered the common heritage of mankind, has affected public perception, especially farmers' perception about the usefulness of biotechnology. Corporations have to recover costs if they are to sustain their research and development activities. New technologies and products generated by these corporations are protected and released only under certain conditions. Thus, the resource-poor farmer has difficulty in gaining access to improved varieties of various crops, some of which are transgenic which have been released for commercial applications.

The Changing Role of International Agricultural Research Centers- Toward Enhancing Competitiveness

While we cannot predict what shape and form the regime of trade liberalization and globalization will take, we must strive to make farming profitable and competitive. The massive influx of food products, especially from developed countries, has caused a lot of disequilibrium among farmers of developing countries who do not have the wherewithal to compete. These farmers do not have easy access to technology, finance, marketing, and the policy environment to engender efficiency in their productive operations. Thus, developing country farmers are often not competitive and are marginalized in the global market.

It is in the context of enhancing farmer competitiveness that agricultural biotechnology can be used as a tool to enhance productivity. International agricultural research organizations (IARO) cannot be expected to provide the silver bullet to rescue developing country farmers from the throes of poverty. This is a complex undertaking that cannot be assumed by the IAROs alone. Poverty elimination has to be a global undertaking, with many actors in the stage committed to a convergence of purpose. The IAROs can be one vital cog in the wheel of progress if they play their roles properly as discussed in the next paragraphs.

Honest Broker. As a general approach, IAROs must be organized to be able to deal with the different and complex situations existing in the national agricultural research system (NARS). IAROs are most effective if they can provide valuable advice to developing countries. They can offer a menu of options and leave it up to the nations

to decide. The international centers focus on the production of international public goods that are shared on a non-exclusive and on a non-competitive basis.

To be able to assist developing countries, the IARO must be an honest broker of information and technologies. They must make known to potential users all the options available to solve a particular problem. Agricultural biotechnology must be seen simply as one of the tools that can be used. Other approaches, even using traditional breeding techniques should also be offered. It is the duty of IAROs to make available as many options as can be handled.

Human Resource Development. The knowledge-intensive emerging technologies, of which modern biotechnology is one, need people who are trained to handle the new features of such tools. Thus, IAROs may provide some opportunities to improve national capacity in the science, technology management, and policy studies. The national research systems need assistance also in capacity building to enhance the capability to manage intellectual property, biosafety, bioprospecting, and related issues.

IAROs can enhance accessibility to new knowledge and expertise to the NARS, especially in the following areas:

- Development and dissemination of tools and protocols for biotechnology research.
- Training and information networking.
- Technology management and policy formulation especially in biosafety, genetic conservation and use, intellectual property rights.

The graduate studies scholarships and various research consortia being promoted by SEARCA are good examples of capacity building.

Networking. The magnitude of today's challenges that lend themselves to the application of biotechnology requires the combined efforts of research institutions. IAROs are organized to manage these partnerships well and reduce transaction costs, enhance flexibility, and augment resources and competencies. The role of IRRI in the Asian Rice Biotechnology Network is a good example of this effort. Networks can include advanced research institutions in molecular biology, particularly those in the developed countries. Furthermore, IAROs can provide technical and policy support to the NARS as they prepare to participate in international meetings that involve harmonization of policies and guidelines affecting the conduct of biotechnology.

A very important partner in this effort is the private sector. In the field of biotechnology, they have much to share and a network that includes private sector under mutually beneficial terms would be a great advantage to research.

Genetic Resources Conservation. Among the IAROs, the CGIAR centers have gathered enormous quantities of collections of crops, forage and agroforestry species. The collections numbering about 600,000 accessions are held in trust for the benefit of the international community. Many national programmes have obtained materials from these collections and used them for their varietal improvement programs. These

collections are available freely and free-of-charge to both public and private sector. However, these materials are shared on the condition that no intellectual property protection be obtained on the material *per se*. The collections and the work done at the centres to characterize, evaluate and enhance the material have been considered valuable contributions to research in food and agriculture. Therefore, it is important that long-term continuing support for genetic resources conservation must be assured.

Policy Research. International research centres undertake policy and socioeconomic research on the impact of biotechnology and information technology, especially among the poor countries. These studies are intended to understand how policy distortions, institutional deficiencies, and ill-defined public goods create barriers to the diffusion and adoption of new technologies. Policy studies may cover the following:

- legal and policy issues on food, agriculture and resource use, IPR, risk assessment;
- improved use of technological advances responsive to the goal of poverty elimination capitalizing on biotechnology, precision farming, geographical information systems, participatory breeding, and extension techniques.

The results of these studies must be shared with the NARS so that proper interventions can be instituted.

Concluding Statements

Thus, in this era of expanding knowledge and faced with the challenges to apply new tools towards the elimination of poverty, a strong partnership is needed among all sectors involved in research and development. The international agricultural research organizations have the comparative advantage to promote these partnerships. It has been suggested that these partnerships should be widened and diversified to include academic institutions, private foundations, corporations, small and medium enterprises, professional organizations, NGOs, peoples' organizations, farmers and others.

To ensure the effective delivery of new technologies to the resource-poor farmers, international agricultural research organizations and other research institutions, public or private, must now work together and explore new modes of institutional governance and institutional arrangements that should be transparent, flexible, mutually beneficial and efficient.