Sustainable Development and Agricultural Biotechnology

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ABSTRACT

Agenda 21, the work programme adopted by the 1992 United Nations Conference on Environment and Development (popularly known as the "Earth Summit") suggested that biotechnology "promises to make a significant contribution in enabling the development of, for example, better healthcare, enhanced food security through sustainable agricultural practices, improved supplies of potable water, more efficient industrial development processes for transforming raw materials, support for sustainable methods of afforestation and reforestation, and detoxification of hazardous wastes."

Today, poverty, disease and food insecurity still afflict most of humanity and the promise of biotechnology still has not materialized, particularly in developing countries. Part of the problem lies in the fact that development in biotechnology is driven by the private sector whereas biotechnology in developing countries has been promoted through government programmes. Existing biotechnology is mainly designed to address market needs in industrialized countries. It is imperative that developing countries adopt the right policies in accordance with their national priorities, taking into account the benefits and risks of biotechnology.

Biotechnology offers powerful tools for the sustainable development of agriculture, fisheries and forestry. When appropriately integrated with other technologies for the production of food, agricultural products and services, biotechnology can be of significant assistance in meeting the needs of the burgeoning global population.

INTRODUCTION

Some argue that the concept of biotechnology is not new and that we have old biotechnologies such as wine or cheese making. Although this is technically true, many of the problems in the biotechnology of today are entirely new. We now have concerns and problems that we did not have in the past. Yet biotechnology also offers solutions to these "new" problems and therefore in a sense is a new field of scientific activity.

I have been asked to talk about agricultural biotechnology; However I am not going to tell you about agriculture or even about biotechnology. What I am going to talk to you today is about "problems", or perhaps it is more appropriate to say "new problems" that the world is facing now. Problems that could be addressed through agricultural biotechnology application.

It was nearly three years ago that world leaders came together at the UN in New York and adopted the so called "Millennium Development Goals". The eight goals are:

- Eradicating extreme poverty and hunger
- Achieving universal primary education
- Promoting gender equality and empowering women

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- Reducing child mortality
- Improving maternal health
- Combating HIV/AIDS, malaria and other diseases
- Ensuring environmental sustainability
- Global Partnership for Development

These goals and targets were reaffirmed at the 2002 World Summit on Sustainable Development (WSSD) in Johannesburg, South Africa and the UN Secretary-General Kofi Annan proposed that the global community consider looking at sustainable development within the five key thematic areas of Water, Energy, Health, Agriculture and Biodiversity (WEHAB).

Agriculture plays a crucial role in all the above goals. There are some 1.2 billion people who live in poverty (earn less than $ 1 a day), and 70% of them are living in rural areas. Poverty is not just "income poverty", but a scourge with many faces: poor education, poor health, HIV infection, malaria, unsustainable resource management, child mortality etc. Low income leads to low consumption, and low consumption leads to low health, low saving, low education, and eventually low opportunity to give one the chance to use his/her potentials. It is true to say that higher income can help in alleviating poverty, but only if it goes hand to hand with proper governance. But generating the income in the first place is the challenge. Therefore is there any prospect that biotechnology can contribute to alleviating these problems?

CONSTRAINTS TO SUSTAINABLE DEVELOPMENT

Over the past 30 years, agricultural productivity growth resulting from successful research and development meant food production in developing countries tripled, outstripping population growth. Over the same period, the proportion of undernourished people dropped from 35 to 17 percent, real prices of the main cereal crops declined dramatically, and poverty decreased. However, to what extent could existing technologies increase our agricultural productivity?

In my view, there are four major limitations in agriculture where biotechnology could overcome and make contributions.

- Utilization of marginal resources such as dryland and saline water
- Increasing the genetic potential of agricultural crops
- Improving the nutritional value of food crops
- Improving pest control measures

Natural resource constraint is one major factor in limiting agricultural intensification and growth. Arable land per person in developing countries has shrunk from 0.32 hectares in 1961/63 to 0.21 hectares in 1997/99 and is expected to drop to 0.16 hectares by 2030. At the same time, several processes are contributing to declining quality of land resources. Soil erosion is responsible for about 40 percent of land degradation worldwide, while 20-30 percent of irrigated land in developing countries has been damaged by water-logging and salinity. Extreme poverty and hunger push people onto marginal lands and more fragile ecosystems characterized by drought stress and low soil fertility. Biotechnology can be used to develop new plants adaptable to these marginal areas.

PROSPECTS OF BIOTECHNOLOGY

There is a good prospect to increase the yield potential of agricultural crops using biotechnology. In developing countries, the potential of biotechnology to increase the quantity of food production may be more

significant. A joint report by the World Bank and Consultative Group on Agricultural Research[†] indicates that bioengineered crops, on an average, could improve crop yield by 25% in developing countries. Other studies[‡] suggest positive gains as well.

Biotechnology can improve the nutritional value of agricultural crops. Blindness caused by shortage of Vitamin A and directly related to malnutrition takes an annual toll of 250,000 to 500,000 of poor children[§]. In the Asia and Pacific region malnourishment is currently a serious problem. About one-fifth of the population living in the region, or 525 million people, are malnourished[**]. The recent development of a rice variety rich in vitamin A demonstrates the potential of biotechnology in improving the nutritional value of our food.

Biotechnology also has made significant progress in pest control. There is a strong global market demand for crop pest control measures. The total global export of herbicides in 1999 was US $ 3.86 billion; insecticides, US $ 2.56 billion, and fungicides, US $ 2.93 billions[††]. Therefore transgenic crops resistant to pests have been of particular interest to investors in the agricultural biotechnology industry. The traits most frequently used in genetic modification experiments in 1997 were herbicide resistance (54%), insect resistance (31%), viral resistance (14%), product quality (less than 1%) and insect along with herbicide resistance (less than 1%). Major crops which have been the focus of genetic modification include soybean, corn, cotton and canola. Transgenic varieties of these crops are widely grown world wide. Of the total global cultivation area covered by soybean, 46% were under transgenic soybean cultivars in 2001. The figures for cotton, canola, and maize stood at 20%, 11% and 7%, respectively[‡‡]. According to the latest briefing from the International Service for the Acquisition of Agri-biotech Applications (ISAAA), the estimated global area of transgenic crops in 2002 was 58.7 million hectares (145 million acres) grown by about 5.5 to 6.0 million farmers in 16 countries (up from 5 million farmers and 13 countries in 2001).

The characteristics and the historic manner by which biotechnology has developed demand the adoption of a necessary policy framework if the technology is to become widely available for use in sustainable human development in developing countries. There are three important features in biotechnology. Firstly, it is heavily driven and developed by private investment; secondly, it is a knowledge-based industry, [§§] and thirdly, it has risks associated with it that may extend to unknown boundaries. Developing appropriate policies to explore the potentials of the technology has to take into the account the above features. The existence of an appropriate national infrastructure and relevant institutions within the country, the ability to produce changes to comply with the establishment of the necessary environment for technology development and the transfer and acceptance of the technology are important considerations that governments need to take into account.

To realize the immense economical and developmental impact of biotechnology, it is appropriate that capacity at technical as well as at intuitional levels be developed. This requires skilled personnel at the laboratory and policy making levels, as well as the creation of institutions for a long-term effect on the creation of new knowledge, the transfer of the already existing technology, and the transformation of that technology to address local needs. One such institution could be the development of an intellectual property protection system. Such a system would consider enforcing intellectual property laws and endeavor to create a public culture that values knowledge and inventors. These are essential for developing a knowledge based industry.

The UN General Assembly Economic and Social Council recently outlines the following proposals for biotechnology development and technology acquisition. Any national biotechnology development strategy

[†] See press release by Consultative Group on International Agricultural Research at: http://www.worldbank.org/html/cgiar/press/biopress.html
[‡] FAO (1999).CCP:GR99/3-RI99/3
[§] FAO (2001). Press release 01/94
[**] FAO (2000).APRC/00/5
[††] FAOSTAT (2002)
[‡‡] See press release by ISAAA on 10th Jan. 2002 at: http://www.isaaa.org/press%20release/Global%20Area_Jan2002.htm
[§§] UNCTAD (2001). E/CN.16.2001/Misc.1 and Corr.1

should consider the following common features:

- Clear Government plans to develop a biotechnology industry with benchmarks (number of scientists trained, products developed and technologies acquired) on activities to be attained by each stage of development.
- Establishment of biotechnology-related programmes (research, development and marketing) in universities and national research institutions.
- Involvement of the private sector in planning the biotechnology development agenda through matching funds, sharing facilities and technologies.
- Establishment of international collaboration and partnerships for research and development, production and marketing, e.g., technical cooperation.
- Provision of public venture capital to fund small start-up firms and commercialization of research products.
- Policies and programmes that stimulate entrepreneurship in public institutions and investments. These include policies on commercialization and ownership of knowledge and allowing scientists to interact freely with industry.
- Incentives for public-private partnerships. These include government contracts, directives on publicly funded projects and international strategic partnerships.

With regards to using the potential of agricultural biotechnology, International Food Policy Research Institute (IFPRI)[***] has extensively reviewed policy options for developing countries and has provided policy choices at five levels. These levels are: Intellectual property rights, biosafety, trade, food safety and consumer choice and public research investments. Biotechnology and development is affected by policies adopted at each of the above levels. Depending on the policy adopted, biotechnology development and transfer could be promoted at one end or prevented at the other end of the scale. Therefore, unleashing the power of biotechnology in developing countries needs a well balanced and coordinated policy design at various levels.

RISK MANAGEMENT OF BIOTECHNOLOGY

Another area of concern is risk management. Engineering the genetic makeup of an organism, from an optimistic point of view, makes it possible to transfer any gene from any organism to any other. This creates a new "being" that may have not existed in nature. The Cartagena Protocol on Biosafety to the CBD attempts to address such concerns. The trade in commodities fosters trans- boundary movement of living modified organisms (LMOs) and this is regarded as an important factor that could rapidly spread LMOs through a large geographical area and environment. Therefore to minimize the associated risk with the release of LMOs into the environment, the Protocol seeks the adoption of measures by parties to minimize such risks. The Protocol even advocates adoption of a precautionary approach, in accordance with the Rio Declaration, in the event Parties are unable to conclude a risk assessment on scientific grounds.

It is now nearly 10 years since LMOs were released into the environment on a commercial scale. They may have an impact on the ecosystem through interaction with other species already present in the given environment. To fully understand this interaction and the likely consequences, continuous environmental monitoring and measurements are required. There is thus a need to have a permanent institution for assessing and managing environmental risk of LMOs in individual countries. This could involve designing laws and regulations, raising public awareness, education and training of technicians and policy makers.

In addition to environmental and social aspects of biotechnology application, the scientists themselves

[***] Paarlberg, R.L. (2000). Governing the GM crop revolution, policy choices for developing countries

[†††] World Conference on Science, Budapest, Hungary, 26th Jun – 1st July 1999

who are developing this technology need to observe a high ethical responsibility. The notion of "Science for Profit" has to recognize human ethical values. The Budapest World Conference on Science[†††] has recognized the need for developing a "Biotechnology Culture". To develop that culture, professionals working in this field require continuous education and training. This would enable them to link innovations to developmental applications in a responsible way and compatible with ethical values. The Declaration on Science and Uses of Scientific Knowledge recognizes that scientists have a social responsibility and that they need to commit themselves to high ethical principles. Cultural organizations need to work on these issues to make them acceptable with the values and beliefs of society. Such measures would collectively constitute as Biotechnology Culture.

CONCLUSION

Biotechnology has to be part of the global fight against poverty, hunger, disease and underdevelopment. It is not a question of whether it will deliver the promises but how the promise of biotechnology will be shared. It is in the interest of humanity, in developed and developing countries, that biotechnology applications are used as widely as possible.