

Management of appropriate agricultural biotechnology for small producers: case study – Ecuador

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Today, agricultural biotechnology, together with its potential and risks, is a matter of concern for politicians, producers, scientists and the civil society. It is a heavily discussed issue in almost every country, where opinions of the different parties vary considerably and sometimes are quite different. Consequently, appropriate management, considering aspects related to research, biosafety, intellectual property rights and public perception regarding this technology, is of utmost importance. For this reason, the International REDBIO Foundation started and sponsored this study, choosing Ecuador as a country with a high potential for the application of biotechnology since it presents an important degree of diversity with problems typical of many Latin American countries, such as loss of biological diversity, poor institutional development and scarcity of financial resources.

The objective of the present document is to outline the framework and general concept of biotechnological management at three levels: international, local and institutional and to carry out an in-depth analysis of the particular case of Ecuador in order to propose steps to improve the application of appropriate biotechnologies for the small producers in the country.

In this regard, a study and regulation analysis on the issue has been carried out, complemented by 22 interviews with 32 experts from 19 institutions (Annex) in Ecuador, who play an important role in the innovation, regulation and

operation of agricultural biotechnology in the country. The main biotechnological applications are geared towards tissue culture, molecular markers and transgenic technologies. While tissue culture is already technically standardized in almost all the Latin American biotechnological laboratories, molecular markers and especially the application of transgenic technologies are limited to large laboratories in technologically advanced countries in the Region, such as Argentina, Brazil and Mexico (BID, 2001; ISNAR, 2000; Trigo et al. 2002).

In view of the high cost of creating first-generation transgenics, emphasis worldwide has been placed on the production (resistance to diseases and tolerance to herbicides) of the most economically important crops (wheat, cotton, rapeseed and soybean) with no direct benefits for the consumer, which has not helped create a favourable public opinion on biotechnology in general and on transgenic crops in particular. Nevertheless, efforts are being made with second-generation transgenics to improve the quality of products, for example by increasing the nutritional value of food, improving flavour or reducing those substances in food which traditionally produce allergies (FAO, 2001; FAO, 2002a; ISAAA, 2001; James, 2001).

Besides plant breeding, conservation of genetic resources is another issue of importance in the application of biotechnology. In this sense, the fundamental role of

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germplasm banks should be highlighted, in particular those operating within international agricultural research centres, such as the CIP, CIAT, CIMMYT, IRRI and others. Nevertheless, *ex situ* conservation in germplasm banks is only one aspect; another element of agrobiodiversity conservation of equal importance is *in situ* conservation through national and international programmes, where biotechnology plays a fundamental role in the multiplication of *in vitro* plants and phyto-sanitation.

In order to prevent the application of the aforementioned biotechnologies being catalogued as isolated activities with little importance and scarce acceptance on behalf of producers and consumers, it is necessary to channel said technologies under the concept of appropriate biotechnology. The objective is to orient the application of biotechnology in a viable and responsible manner, channelled towards the concrete necessities of the producers and consumers (Izquierdo et al. 1995). In this context, it is important to analyse the following issues before carrying out future activities.

- Importance of research for beneficiaries.
- Acceptance of the product on behalf of beneficiaries and consumers.
- Concrete availability of inputs to carry out research (human and financial resources, technologies, etc.) and viability.
- The potential risk for the environment and health.

The mentioned concept is regulated by various international agreements which are stipulated locally. Amongst the most important international agreements for the application of biotechnology is the Cartagena Protocol on Biosafety to the Convention on Biological Diversity, adapted in 2002, the Agreement on Intellectual Property Rights related to Trade (ADPIC) of the WTO approved in 1994, the same Agreement on Biological Diversity in 1993 and the FAO International Treaty on Phyto-genetic Resources for Food and Agriculture, approved in 2001. While the local application of ADPIC has progressed notably, due to pressure exercised within the framework of the WTO, the application of biosafety measures (Protocol of Cartagena), the access to genetic resources and the distribution of benefits deriving from its use is limited, not only in the Region but also world-wise. Nevertheless, there is keen interest on this issue shown by the success achieved by the negotiations of the International Treaty.

On applying the aforementioned to the case of Ecuador, the following conclusion can be reached:

At present, in biotechnological university research, emphasis is placed on the identification of population variables, selection and production of varieties in “naranjillo” (*Solanum quitoensis*), tree tomato (*Cyphomandra betaceae*) or Andean root and tubers.

Consequently, technologies regarding tissue culture are taken into account in nearly all the laboratories and the use of molecular markers such as RAPDs is relatively common. Actually, various laboratories are being restructured and have received new equipment. Such is the case of ESPE, the Central University, ESPOL and the Catholic University, which has enabled some laboratories to apply transgenic techniques. The laboratories of INAP and CIP apply a wide range of biotechnologies such as tissue culture and molecular markers (RAPD, AFLP RFLP).

Emphasis on food crops depends on the mandate and funding of each one of the institutions. Activities carried out by INIAP-DENAREF, financed mainly with public funds are centred mainly on the *ex situ* and *in-situ* conservation of Andean tubers. Other INIAP laboratories are focussed towards the phyto-improvement of wheat, cacao and rice. On the other hand, there are universities which, even though their regular programme is covered by public funds, their access to said funds to carry out projects is limited. Consequently, there are various thesis financed by the private sector in various universities on items such as roses or bananas, which are the main typical export crops. Other university projects deal with problems regarding cacao or fruit.

DENAREF-INIAP is the most important institution working on the conservation of phyto-genetic resources in the country. At present, there is a germplasm bank with 20 000 accessions. Conservation activities in INIAP are focussed especially on Andean tubers, quinoa (*Chenopodium quinoa*), amaranthus (*Amaranthus caudatus*), cucurbits, tree tomato and peppers. In addition, the work carried out by INIAP on the *in-situ* conservation and exchange of Andean tubers in various fairs in the province of Chimborazo and cereals and broad beans (*Vicia faba*) in Ibabura, must be pointed out. Besides INIAP, various universities have smaller germ-plasm banks, such as the Central University, the University of Loja and others. These centres have a relatively weak institutional framework and do not count with enough funds.

With regard to the issue on biosafety, it must be pointed out that a Commission on Biosafety has been created in the country, integrating representatives of the Ministries of the Environment, Agriculture and Husbandry, Foreign Trade and Public Health. In May 2002, ILSI carried out a workshop with representatives from the aforementioned Ministries to create a framework for a national biosafety system. In addition, the Ministry of the Environment which is, by law, the corresponding local authority on this matter, is channelling efforts towards creating a GEF project on the development of a national biosafety system. The participation of ILSI and Ecologic Action, a NGO whose activities are geared towards environmental issues, is also foreseen within the project. The project is due to start operating in August 2002. One of the key results of the project is the regulation of genetically modified organisms and the creation of a hazard analysis system, including the

elaboration of guidelines and accredited laboratories, which, at present, correspond to the National Petrology, Normalization, Certification and Accreditation System.

Another important aspect which has a strong impact on the management of biotechnology is public awareness. In the case of Ecuador, this perception is under-developed due to the lack of information and education programmes on the matter. The only institution dealing with this issue is ILSI, which is studying the possibility of producing a radio novel including a comic strip to inform the general public regarding the application and use of biotechnology.

Regarding the issue on intellectual property rights (DPI), linked to genetic resources and biotechnology, we can say that three points must be considered: access to genetic resources, protection of patents and plant breeder rights (DOV).

The access to genetic resources in Ecuador is regulated by Decision 391 of the Andean Community. At present, an examination is being made of the draft project on the national regulation of Decision CAN 391. The corresponding local authority on the matter is the Ministry of the Environment. Any institution interested in having access to local genetic resources must negotiate the conditions for access and use through this Ministry by signing an agreement to transfer information including the mechanisms for granting benefits deriving from the use of the accessed resources. A key issue to have access to genetic resources for food and agriculture still pending in Ecuador is the signature and ratification of the FAO International Treaty, which would be most beneficial for the country as it would allow access to the funds of the Multilateral System to finance projects directed towards the conservation and sustainable uses of agrobiodiversity (Wendt and Izquierdo, 2000).

The protection of agricultural innovations through patents has, at present, no real importance in the country even though the protection system of the DPI in the country is well developed. In addition, Ecuador is a member of the Patent Cooperation Treaty (PCT), which substantially facilitates the formulation and approval of international requests for patents (Alvarez, 2001).

The protection system for new varieties through the Plant Breeder Rights (DOV) is, in practice, limited to flowers (roses, Ghypsophila), mainly protected by European firms (Germany, France and The Netherlands). Recently, some firms from Ecuador such as AGDROGENOTEC or SENACA are considering the possibility of protecting their varieties (flowers and rice) (Cabrera, 2001).

A very interesting project is being developed by the Ministry of the Environment, *i.e.*, the creation of a *corporation for the promotion of biodiversity*. The idea is to form a transparent and efficient system to regulate and

facilitate access and use of local genetic resources in a sustainable way.

The key tool within the system is the formation of strategic alliances among the local and international actors from the academic and private sectors, the civil society and the Government. One critical focus must be maintained to access potential spillover benefits from existing research and development investments. For this purpose the strengthening of institutional capacities is required as: to establish a functional IPR framework (minimum PBR) with biosafety regulatory capacities jointly with complementary scientific and technical capacities to support technology acquisition.

In conclusion, Ecuador's high potential for applying appropriate biotechnology must be pointed out. This is due to various factors, one of which is the important biodiversity existing in the country, which has not been sufficiently investigated and documented.

Another important aspect is connected to the fact that various scientists who have been trained abroad are returning to the county, bringing new know-how, ideas and contacts with research institutions at the international level, which could result in joint projects (ventures). In addition, various university laboratories are being restructured which means acquiring new equipment which at the same time leads to a better academic formation within the field of biotechnology and an increase in capacity to carry out research projects.

The enormous potential of the political media which recognizes and considers biotechnology as a useful tool for the development of agricultural production is worth mentioning. In addition, public perception has still not been formed regarding the issue. In consequence, the possibility exists of educating the public in general based on scientific information to avoid the apparition of myths and inadequate prejudices, as has occurred in other countries of the Region. Nevertheless, the potential risks and benefits of these technologies should be shown in a transparent and simple way, to enable the mass media to count with sufficient knowledge to understand and interpret governmental decisions on the matter.

In addition to the issue on potentials and among the policy tools required as IPR legislation (UPOV, Patents); biosecurity regulations and enforcement capacities; regional IPR information/management support mechanisms; additional support to NARS for infrastructure and human resources development and modern seed legislation, support for seed trade associations, there are various restrictions have been identified on the improvement of biotechnology management in the country which should be confronted with concrete measures.

Mention should be made, first of all, of the lack of a biosafety system which derives in two situations. First of

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all, the institutions and enterprises which are able to carry out research on transgenics cannot take advantage of said capacity due to the lack of production regulations and secondly, the existence of possible illegal and uncontrolled production of some transgenic crops. To tackle the problem, a GEF project is being elaborated to form a local biosafety system for the creation of a regulatory framework on the matter.

Together with the creation of a biosafety system, it is necessary to train decision-taking politicians on biotechnology management on issues such as benefits and the potential hazards of its application. Nevertheless, an education and training programme for the general public is necessary to form opinions, based on scientific information within the civil society. The programme will also make the decisions taken by the Government and the biosafety system more transparent, as the civil society will be able to understand and interpret said decisions more easily. The further participation of Ecuadorian policy makers at on-line distance learning courses on biotechnology that are organized by FAO is highly recommended.

Finally, it is important to mention that it is necessary to count with improved varieties in almost all the crops. Plant breeding and integrated crop management should be focussed especially on varieties resistant to diseases and insects and on yield, particularly of the following crops: i) cacao due its importance and potential as a high quality export product and its importance for small producers; ii) Andean tubers, in view of their genetic degradation and the danger of losing high diversity; iii) banana, due to its commercial value for the country and wheat and soybean to substitute the imports of these crops for animal feed.

The following recommendations are made as short-term and follow up activities to the present document: First of all, it is necessary to strengthen the national branch of the REDBIO/FAO network within the country, embracing not only the reestablishment of links among members and the extension of the network at the national level, but also improve integration of the country members in an international network. To achieve this objective, it is indispensable to count with a national coordinator or focal point in the country accepted by the members, having close contact with the rest of the members of the network and who has the time and the desire to carry out this task. Secondly, and related to the previous issue, is the organization of a REDBIO national workshop to discuss the results and recommendations of the present document and carry out research on the possibility of putting them into practice, together with giving priority, coordinating and materializing activities to strengthen appropriate biotechnology in the country.

Annex. Interviewed institutions

1. Escuela Superior Politécnica del Litoral (ESPOL)

2. Instituto Ecuatoriano de la Propiedad Intelectual (IEPI)
3. DITTE – MAG (Dirección Nacional de Investigación, Transferencia de Tecnología y Extensión Agropecuaria)
4. Ministry of the Environment
5. Servicio Ecuatoriano de Sanidad Agropecuaria (SESA)
6. Procesadora Nacional de Alimentos (PRONACA)
7. San Francisco University of Quito (USFQ)
8. Instituto Nacional Autónomo de Investigaciones Agropecuarias (INIAP), National Department of Phyto-genetic Resources and Biotechnology (DENAREF)
9. International Potato Centre (CIP) – Ecuador
10. Central University of Ecuador
11. Escuela Politécnica Nacional (EPN)
12. International Life Sciences Institute NOR-Andino (ILSI)
13. Pontificia Universidad Católica of Ecuador (PUCE), Cooperación IRD-PUCE (IRD= Development Research Institute, France)
14. Pontificia Universidad Católica of Ecuador (PUCE), Department of Microbiology, Vitroplant Foundation.
15. Pontificia Universidad Católica of Ecuador (PUCE), Department of Biology
16. Escuela Politécnica del Ejército (ESPE), Faculty of Biotechnology
17. Agrogenotec
18. Escuela Politécnica del Ejército (ESPE), Faculty of Agricultural Sciences
19. Technical University of Ambato

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