IICA TECHNICAL FORUM

Development and Safe Use of Agrobiotechnologies in the Americas

Implications for the modernization of agriculture and the reduction of rural poverty

ALBERT SASSON - KEYNOTE SPEECH

Directorate of the Technical Cooperation Secretariat
Directorate of Technology and Innovation
Directorate for Strategic Planning and Institutional Modernization

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Foreword

The countries of the Americas are faced with the common challenge of achieving the competitive and sustainable development of agriculture and agricultural trade in a way that is compatible with the conservation and sound management of natural resources, and the reduction of hunger and rural poverty. To meet this challenge, the countries must join in the scientific and technological revolution, one aspect of which is the development of biotechnologies applicable to agriculture.

The Inter-American Institute for Cooperation on Agriculture (IICA), within the framework of its Medium Term Plan and in response to mandates issued by the Inter-American Board of Agriculture (IABA), comprising the ministers of agriculture of the 34 member countries, is cooperating with them in several aspects of the development of agricultural biotechnologies. One very important action has been to facilitate dialogue between countries and institutions regarding the design and implementation of policies and the dissemination of information on the benefits and impact of such biotechnologies on development and trade.

In this context, on May 4, 2005, IICA organized, in San Jose, Costa Rica, a technical forum entitled *"Development and safe use of agricultural biotechnologies in the Americas: implications for the modernization of agriculture and the reduction of rural poverty,"* which was chaired by its Director General, Dr. Chelston Brathwaite. The forum, which was transmitted over the Internet to the IICA Office in each of the 34 member countries, was attended by participants from public and private organizations and representatives of international organizations, civil society and IICA.

The objectives of the forum were to share information on the latest advances in the application of biotechnology to agriculture and on the status of

the relevant institutions in the Americas, especially in Chile and Costa Rica, and to discuss the challenges inherent in the development and safe use of agricultural biotechnologies within the context of the opportunities and problems for agriculture in the hemisphere.

The keynote speaker was Dr. Albert Sasson, former Deputy Director General of UNESCO and international advisor in the field of biotechnology, whose address was entitled *"Overview of the advances in biotechnology and its impact on agricultural development and rural prosperity."* His presentation was followed by panel discussion involving specialists from Chile, Costa Rica and the United States, and IICA, who exchanged views on the status of biotechnology in certain countries of Latin America and the Caribbean, and on the socioeconomic impact and distribution of the benefits of the new agricultural biotechnologies.

This publication contains a transcription of the Dr. Sasson's address and key aspects of the ensuing dialogue. The relevant information on agrobiotechnology, at the regional level and worldwide, presented at the forum invites reflection on the challenges they pose and the opportunities they create for the countries of the region.

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Development and Safe Use of Agrobiotechnologies in the Americas

Implications for the modernization of agriculture and the reduction of rural poverty

Biotechnology is a product and it is a business; in the beginning, it is all laboratory work and research, but if it does not result in something that improves citizens' lives, it is not biotechnology, and it is not bioindustry, and it is not a part of the bioeconomy.

We have been on an exciting adventure since the early 1970s. It was then that the word “biotechnology” began to take off: a takeoff that has been based on the spectacular development of the life sciences. Over 50 years, we have had a landslide of results of all sorts in all the branches of the life sciences, with many Nobel Awards. This is going to continue, because the 21st century is going to be the century of biology. These advances in the life sciences have nourished the various fields of biotechnology, because they have been applied in such areas as health, both animal and human, medicine, and pharmaceutics, which in technological jargon is known as “red” biotechnology. They have also been applied to everything related to nutrition, horticulture and forestry, what we call “green” biotechnology, as well as on a set of technologies and products than include, for instance, the production of enzymes for nutrition, the agrifood business, mining, and cattle raising. Other examples include the production of biofuels, such as alcohol (ethanol), and plastics unrelated to the petrochemical industry; the treatment of solid waste, wastewater and industrial effluents; and cleaner production of pulp and cellulose. All this constitutes what we call “white”, or environmental, biotechnology.

In these three great branches of biotechnology, we are witnessing, at the beginning of the 21st century, a consolidation of the bioeconomy: that is to say, an economy based precisely on bioindustry, which derives from biotechnology, which in turn derives from the life sciences, hence is a knowledge-based economy. The bioeconomy is a palpable reality, since thousands of small, medium and large firms form a part of it. The countries that have persevered in investing in research, development and innovation nowadays reap the results of that investment. The first countries that are a part of the bioeconomy are the United States, Canada, Japan and those making up the European Union, among which the United Kingdom, Germany, France, Belgium and Spain stand out.

According to the Biotechnology Industry Association of the United States, while in 1990 biotechnology firms' annual revenues amounted to US$8 billion, in 2004 the number reached US$40 billion. On the other hand, currently 200 thousand people work in the biotechnology field, but according to the Memorial Batelle Institute, in 2007 more than 800 thousand people will be working in the sector. Each one of these people will earn on average US$26 thousand more a year that any employee of any other industrial or trade sector. These numbers underscore the importance of an economy based on biological knowledge.

During the last 30 or 35 years, we have seen large developing countries investing in the bioeconomy, bioindustry and biotechnology. We will also see small countries doing exactly the same, in order to adopt and adapt biotechnologies to their needs and aspirations. It must be stressed that biotechnologies are a spectrum of technologies from which each country can pick and choose; it is not a question by being the first, but of being the best in what one views as having the greatest potential, given one's strengths and competitive advantages, since we live in a globalized world where competitively is a key criterion. Not only do we need, therefore, to meet local, national needs, which should be the first goal of any democratic government, but also to go abroad to compete, to sell, and to buy.

Hence, a forward-looking policy is fundamental for the development of biotechnology. Examples thereof are well known and widely acknowledged. Take the case of Cuba; this is a small country of 11 million inhabitants, but today Cuba is respected worldwide for its efforts

in red biotechnology. Scores of biotechnology-derived drugs and products are not only used by Cuba, but also sold by the country. A very recent example, two years ago, was a contract for US$30 million signed with a United States company, with the approval of that country's Department of State, in spite of the embargo. Why? Because it involves producing a monoclonal antibody against cancer, which could be an equally beneficial drug for the inhabitants of the United States. We are talking about a monoclonal antibody against cancer, probably produced from tobacco. If there is one plant that Cubans know very well it is tobacco, which they can transform to produce a pharmaceutical product. I could quote a long list that would include the epidermic growth factor, the vaccine against hepatitis B, interferons, other vaccines, erythropoietin, etc. We are taking specifically of a 20 year policy involving more than US$1 billion in investment by one small country that, in spite of the embargo it suffers, nowadays exports medical drugs worth US$300 million a year; that is to say, Cuba has reaped what it sowed.

Other countries in the region (Mexico, Brazil, Chile, and Argentina) have made efforts, some more focused on green biotechnology, others more on environmental biotechnology. I already mentioned the case of ethanol, which is produced in Brazil from sugarcane.

After the United States, China nowadays is the country that invests the most in green biotechnology: US$1.5 billion a year in plant biotechnology; that is to say, more that the US Department of Agriculture, but much less than the United States if we take into account the investments by the private sector in plant biotechnology in that country. Why are the Chinese doing this? Because they consider, prudently and with determination, that this tool will be needed to feed the 50 million people that are being added every ten years to its population, which amounts to 20% of the population of the world in a country that only has 7% of the world's croplands. It is, thus, another tool, which does not replace agriculture, the mastery of irrigation, etc., but which is added to that which already exists so as to, precisely, meet local needs.

In South Africa they grow transgenic yellow corn for animal feed, white corn for human food, and transgenic cotton in Kwazulu Natal province, where most farmers are poor and enjoy the advantages provided by this

type of cotton, whereas they would not be able to grow normal cotton because they would not be able to afford the necessary amounts of herbicides and pesticides.

We can be poor, we can have weaknesses, but if we choose well, if we have a good vision, if we have the political will, we can be among the best. Who can deny that nowadays the first country in the world in rice genomics is China? Who can deny, for instance, that in the world of flowers, carnations are Colombian, orchids Thai, and ornamental plants come from countries like Zambia and Kenya, which are poor countries but have chosen the right path for being among the best and compete? Who can deny that in copper bioleaching Chile aspires to be the first country in the world, which implies investments and a policy? Who can deny that Brazil and Argentina are today the main producers and exporters of soy in the world?

The soy grown in Argentina, which does not deny it, is 95% transgenic. That country has never had any difficulty selling it, because there is a country called China that buys it, and then there is the European Union, which in spite of the opposition to transgenic crops, buys that soy to feed its domestic animals. Accordingly, what worries Argentinean farmers are the vast subsidies that rich countries devote to the production of their agricultural commodities; but that is another fight for other forums, like the World Trade Organization. You will have seen in the latest news that developing countries are winning in the fight over cotton, bananas and sugar. That is to say, there are two fights going on at the same time: investing in more science and more technology and, at the same time, trying to achieve equity in international trade.

From this spectrum of biotechnologies, the most adopted and adapted in developing countries has been and continues to be green biotechnology. The example of Cuba is the exception that proves the rule. We all know the importance of developing textile crops, which is a routine technique applied with minimal investment in all the laboratories of the world's developing countries. Many countries have been able to move from the laboratory stage to that of the greenhouse and thence to the level of industrial production; for instance, the case of Cuba's famous biofactories, which produce millions and millions of vitroplants year round to meet the needs of farmers; the case of

Thailand (flowers); the potato in Vietnam, which 20 years ago became the second basic food item after rice, a success due to the clone propagation of the potato in the area of Dalat, which is the Switzerland of Vietnam (the potato is a plant of Andean origin that must be grown at a certain altitude).

We are also aware of the importance for the forestry industry of vitroplants (Chile, New Zealand). Perfecting the technology is a very important aspect. I have read that in Argentina, in an experimental station in Balcarcel, they can produce in less time potatoes grown as micro-tubers; this process normally lasts a few weeks, but in that experimental station the same result can be achieved in a matter of days. Technology not only enables progress; it also reduces costs. It used to be said: "These technologies are for the rich; the poor will not be able to benefit," but it became apparent, when the price per unit of vitroplants fell over time, that the small also had access to the benefits.

The success stories are many: for instance, oil palms in Malaysia (nowadays, all the oil palm plantations in Malaysia are made up of clones and crosses of clones, and Malaysia is the first producer worldwide of palm oil); and bananas and plantains in Costa Rica, Honduras and Ecuador. In Uganda, a country in Central Africa, two years ago they established one of the best laboratories worldwide for plantain micropropagation and genetics. Why? First, because it is a country where plantains and bananas are consumed in large quantities, and where there is a visionary President who wants to invest in biotechnology. It is also a country that has a very good policy for fighting AIDS. There is, therefore, political will, vision and strategy; moreover, funding is provided by the countries that wish to help a Third World country that is striving to develop. In this laboratory, which has links to the best laboratories on plantain genetics, we can be sure that in coming years, great progress will be made in this field.

I will end this section on the growing of textile crops by referring to the field of floriculture, which is a very important market of US$150 billion a year. Sixty percent of the market belongs to Holland, but many developing countries export, produce, disseminate and are even involved in the transgenesis of flower species; for instance, in

Colombia, tests have been carried out by an Australian company on genetically modified carnations for producing a purple carnation or other colors.

Developing countries have adopted other techniques: for instance, the selection of varieties with the assistance of molecular markers. Put simply, this means that we can locate markers in the genome of a plant and through them try to identify interesting features (for instance, fast growth, or resistance to certain diseases) and, thus, be able to select a variety in a much shorter time than that the normal amount required for conventional breeding. For instance, in India and China, work has been carried out and continues to be carried out on the production of new rice varieties through this type of selection. Much work has also been done on tomatoes, cotton, and trees like the pine and the eucalyptus. Another technique makes it possible to grow pollen grains (that is to say, the sex cells of plants) for acquiring haploidic lines. Afterwards, in these lines, the stock of chromosomes can be disseminated, thereby accelerating the selection process. Finally, some have gone into genetic engineering, which is one technology that can be using in red, green and environmental biotechnology. It involves transferring to a plant, in a very refined way, one or more supplementary features through the transfer of the genes that control those features; the transferred genes come from another plant, such as a plant that grows in the wild, or a microorganism. It is a question of transferring genetic information.

Today, 81 million hectares of genetically crops are grown worldwide - I should say, genetically improved. More than 8 million farmers cultivate them in 14 countries, of which nine are developing countries, a significant proportion. The United States has 46 or 47 million hectares of these crops, and Argentina follows with 17 million. Then come Canada, Brazil and China, with 3.7 million hectares. Paraguay follows, with 1.2 million hectares; then India and South Africa, with half a million hectares; and finally Uruguay and Australia, with 200 thousand hectares.

Looking at these numbers, the first thing that can be said is that the growing of genetically modified crops is a fact. Secondly, the surface area is growing: last year there were 67 million hectares; now there is 81 million, and the forecast for 2005 is greater: we might reach a

hundred million hectares. Of course, that is not a great deal in comparison with the total surface dedicated to agriculture in the world, but it is significant, and it is all the more remarkable for the involvement of small and poor farmers. All the transgenic cotton in China, India and South Africa is grown by small and poor farmers; in Argentina, of course, small, medium and large farmers all take part. These countries, and here I quote President Lagos of Chile, have done things well, since not only have they adopted these crops, but they also have a national biotechnology program, a national biosecurity committee, and a regulatory framework; that is to say, before any species is released for growing it in the countryside, 10 to 12 years of work is carried out in the laboratory, the greenhouse, and field tests.

Agrobiotechnology does not arise from spontaneous generation. It takes long, hard, meticulous work; it is the most regulated technology in the world. We cannot stop simply because of concerns that there might be some risk, because there is no technology that is 100% risk free. But human beings have always dared to minimize such risks in order to move forward and open up new avenues to progress. What needs to be implemented is biovigilance; that is to say, releasing and monitoring, because if something happens we can reverse course, which is what we do with pharmaceuticals. You will have noticed that in recent months Merck's Viox has been withdrawn from the market, as has one of Bayer's products. Drugs like these went through stages one, two and three of clinical tests and were released based on scientific criteria; but it was noticed, after years of use, that there was some cardiovascular risk, and the Food and Drug Administration (FDA) itself decided one day to withdraw them from the market as a precautionary measure; it was reasonable, therefore, to withdraw them. A cost-benefit analysis underlines the use of any drug; the patient and his or her doctor engage in this analysis in order to move forward. Hence, developing countries, whether they be Asian like India or China, those in Latin America, countries such as Egypt, South Africa or Sub-Saharan Africa, have chosen this route, doing things well and improving their regulatory frameworks.

It is true that those crops that we currently have only display two or three different traits; most are herbicide-tolerant or pest- and insect-resistant. It is true that those who have benefited from these advances are the farmers; but farmers are a part of society and, if the costs of

producing agricultural commodities fall, the consumer will also indirectly benefit. In the years to come many interesting traits will be seen, such as resistance to a given virus, resistance to fungal or bacterial diseases, in the case, for instance, of crops like batata and cassava; that is to say, those crops called orphans.

Also, through IICA, the FAO, and CGIAR, efforts are being made to encourage public-sector research, because the private sector is not as interested in research. Now then, little by little that sector could become involved in research for producing, for instance, a variety of cassava that is resistant to the mosaic virus. When it is discovered, it must be brought to market, and that calls for millions of dollars in order to satisfy the regulatory framework: that is one handicap affecting poor countries, so someone has to help them. The same is true of golden rice. After 12 years of work we already have it, but now clinical tests must be performed to verify that 200 grams of rice a day can meet the daily need for vitamin A. For these clinical tests to be carried out we need one ton of rice; that is to say, it will have to be grown. Field tests are being completed in Louisiana, and will start in the Philippines and India. The Syngenta Company, which filed these patents, has just reported that it has isolated another variety of golden rice that doubles the quantity of provitamin A.

There is hope, in this field, of securing other qualitative traits, this time to benefit the consumer, and not only the agricultural traits of interest to the farmer. Do you recall that, in 1995, the famous slow-ripening tomato was introduced in the market, and that after a few years it was removed from the market because the Frankenfood campaign was launched in the United Kingdom and supermarkets did not wish to damage the reputation of their other products? Tins of tomato sauce made from these tomatoes were removed from the aisles, even though the sauce was of good quality, it sold well, and it was cheaper than normal tomato sauce. That is all history now, but it was the first transgenic crop in the field and in the business. Now Syngenta, the great Swiss seed company, is working on late-ripening bananas, with the goal that the fruit from countries like Ecuador or that from this region, which is so far away from European markets, can survive the journey without the need to apply ethylene to accelerate ripening. This will probably be accomplished within five or six years, but Syngenta will have the money to bring it to market. The tests cost between half a million and over one

million dollars to meet the regulations and monitoring required for bringing it to market.

Very interesting work is also been done on tolerance to salt, drought and cold. In Vietnam, an interesting collaboration is taking place with a French organization. In France, which also suffers from drought in the summer (two years ago, during the dog days, 14 thousand elderly people died), the firm Biogemna, which is owned by a large seed cooperative, Limagrain, the fourth largest in the world, has just isolated a variety of corn with one sorghum gene that can withstand drought and tolerate very hot summers. I could also refer to biopharming: that is to say, the production of pharmaceuticals in plants; to the case of Cuba, which I have already mentioned; and to a Californian company that is working on rice.

Plant genomics are the future; we must learn more about, and decipher, the genome of plants. Why? Because the better we know plant genetics, the better we will be able to improve selection. Genomics will likely provide us with new tools that will make the controversy on transgenics vanish, because we will not rely any more on gene transfer; with the advance of genomics we might, instead, stimulate some genes and silence others. This is only to show that polemics in science come and go, and that today's hot issue of debate will be irrelevant tomorrow, precisely because science advances, makes discoveries, and goes from one enquiry to another.

Developing countries are not in the rear. In China - I already referred to rice - they have just published the map of the chicken genome in collaboration with an international consortium. Moreover, Chinese pigs are very prolific and sometimes are crossed with Danish pigs to improve the flavor of the meat; another consortium involving Danish and Chinese companies is also working on pig genomics. Moreover, over a fortnight ago, the Vice-president of the University of Beijing and the President of Agricultural University announced, at the BioVision forum that was held in the French city of Lyon, that Chinese scientists have recommended the release of transgenic rice that is insect-resistant. Now comes the work of the regulators; eight ministries have to give the green light for the product to reach the market. I am certain that within a few months we will have, for the first time, transgenic rice in China, and as a result in the international market, which will be an extraordinarily hopeful event.

India has approved a plant genomics program for the period from 2005 to 2015; that is to say, over ten years they will invest a great deal in this field, because it is necessary, and because they do not want their vast Chinese neighbor to take the lead.

Brazil, a few years ago, was not to be found on the world map of genomics. Suddenly, thanks to the Foundation for the Promotion of Science of Sao Paulo (FAPESP) and an investment of US$200 million, that country has launched a magnificent plant and animal genomics program based on networking. There was no need to build another white elephant, another concrete and glass building; it is a question of taking advantage of competencies wherever they may be, setting up an information network to build, for instance, the map of the genome of a citrus parasite. At present the most well regarded group in the world on the genomics of sugarcane is a Brazilian group that has involved the establishment of small and medium-sized firms that work precisely on the application of this knowledge or on selling the results abroad. For the first time ever, these researchers were joined by Votorantim, the largest industrial conglomerate of Brazil; that is to say, the private sector, which is always accused of being very conservative, of not wanting to do science, of not running risks, now wants to get into the game.

There are other highly interesting initiatives. Chile has a program called "Genome Chile", which examines the genomics of plants such as the grapevine, and microorganisms for bioleaching. To improve the process of biolixiviation there is a need for more resistant, more efficient strains, because it is not just a matter of extracting the little copper left in mine waste, but also of making sure that that waste is not toxic, since it contains a great deal of arsenic. These non-toxic waste byproducts can be planted over, recomposing the landscape.

In Rosario, the heart of soy production in Argentina, with the cooperation of Spain, a new plant genomics institute is being built. In Mexico, the decision has been made to spend US$50 million on a new institute on corn genomics. Mexico is the birthplace of corn, so it makes sense for Mexico to study corn genomics. In the case of sugarcane, it makes sense for Brazil, the largest producer and exporter of sugar, to study sugarcane, as is also the case of citrus fruits, because it is also the largest world exporter of orange juice. All this is not coincidence; there is a reason.

Conclusions

The **first lesson** that can be learned from all this is that the vast majority of developing countries have decided to believe in biotechnology; many have programs, commissions, strategies, a vision.

The second lesson: These countries do not want to miss the boat; this is another phrase from President Ricardo Lagos. We already missed the boat of the industrial revolution in the 19th Century; we have already missed the boat of the personal computer. Let us not also miss the boat of biotechnology, because it has to do with living resources, it has to do with genetics, of things that we know and are the property of these countries. We need to develop them and be competitive, because the boat will not stop twice at the same harbor; that is to say, we need to get on the boat now. Cuba will not complain, nor will Brazil or China, but we have the duty of helping the countries in the region that have not reached the same level. That is an ethical imperative.

Third lesson: Improved competitiveness and the satisfaction of needs are not in contradiction. Going to the national, regional or international market does not exclude local needs, particularly for poor farmers, and that is a very high priority. Why? Because poverty is greatest in rural areas of the developing world; the way to fight poverty is to improve agriculture.

But as the Castilian Spanish say, you cannot ask an elm tree for pears. Biotechnology should not be asked to provide everything; biotechnology cannot be asked to get rid of world hunger. One would be lying if one said that biotechnology will end hunger. Hunger is a multifaceted disease. In order to alleviate it, long before biotechnology, what is needed is better governance, greater social justice, greater solidarity and less corruption. Biotechnology comes well behind in this list. Thus, biotechnology is not a panacea.

Fourth lesson: We must do things well. Biotechnology means a regulatory framework, intellectual property laws, capabilities, capital, risk; it means that the private sector is "getting its feet wet" and not waiting in the sidelines for the public sector to take all the risks. The public and private sectors must work jointly, because the benefits will be shared.

Finally, it is necessary to find one's own path. In this controversy, we cannot say that we will head over to the United States, or that we should head over to the European Union, because one or the other is more permissive. There is one path for developing countries, which is based on common sense. What are the interests of these countries? It is true that there are commercial interests, but there are also national interests. Hence the need to put an end to the policy of mirroring others. Argentina did it when in July 2004, the Minister of Agriculture and the Minister of Finance announce in a press conference the approval of the NK603 variety of transgenic corn produced by Monsanto. The European Commission had not approved it yet. They said that they had approved it earlier precisely because it was important for their country. Once again, we do not want **to miss the boat**, which is my conclusion. Many thanks for your attention.

Q&A Session

Question by Chelston Brathwaite, Director General of IICA: Over the years, in our countries, there has been a great deal of controversy, debate and concern over the use of biotechnology in agriculture, but there has not been any controversy regarding biotechnology and its use in health or medicine. I would like to pose the following questions to Professor Sasson: To what do you attribute that difference? If we can understand the cause of that difference, how can we devise strategies

for reducing the level of debate and controversy on the use of biotechnology in agriculture? How we can help countries to advance strategically in the use of science and technology for the improvement of agriculture and, at the same time, generate confidence among consumers?

Question by the IFPRI representative: The issue of intellectual property rights and patents is very controversial, due to the large investments that need to be made for the products of biotechnology research. Based on your experience, professor, will we ever reach a point of equilibrium, with the knowledge acquired, between those rights and patents and public wellbeing?

Question by Juan Carlos Hidalgo, of the International Policy Network: I would like to know your opinion regarding the Cartagena Protocol, which, as I understand it, contains certain precautionary principles that could eventually hinder the worldwide marketing of biotechnology products. The Cartagena Protocol has not been ratified here in Costa Rica, and we expect that at some point it will come to the attention of the representatives in the Legislative Assembly.

Answers by Dr. Sasson: The last question is to some degree related to the independence of some countries regarding the whole issue of the precautionary approach. You know that one should not speak of a precautionary principle, but of a precautionary approach. That was decided at the Johannesburg Summit, at the Earth Summit. It is a subtle point, because the precautionary principle is one principle that is not very well defined from a philosophical perspective. That does not prevent some constitutions, like the French Constitution, from introducing the precautionary principle, in spite of the negative opinion of the scientific community, for instance of the Academy of Sciences, which has said that it would probably be an obstacle to scientific research.

That the Chinese do not pay so much attention to the Europeans! I would not totally agree with that, because the Chinese are members of the World Trade Organization and, since their entry, China has had to change many things, for instance their intellectual property law. Before, in China, like any good communist country, patents did not have to be

filed; nowadays, they file patents and force their researchers to file patents, because they assume it is another tool to increase their competitiveness.

Second, policy is very important. Some suspect that the Chinese are delaying their approval of transgenic rice as part of their trade negotiations; that is to say, they are using that as a form of applying pressure. Remember that over several months they stopped soy imports from the United States and that, when the President of that country met with his Chinese counterpart, the issue was resolved in a fortnight and exports resumed. We are in a world of relations and powers. The Chinese have significant needs and challenges, due to the size of their population and the fact that it is a major commercial power, probably the major one in 20 to 30 years. This gives them certain advantages, but also forces them to do things well. China invited European researchers to monitor how they carried out the clinical tests of rats fed on a particular transgenic crop. Those researchers returned to Europe saying that the Chinese are doing things well and that they have a regulatory framework, one that is worthy of respect. In fact, eight ministries will finally have to approve the transgenic rice.

Hence, I only disagree somewhat on whether the Chinese can do whatever they want. That they do things well, we totally agree on. In that sense, China will prove to be a model, at least for neighboring Asian countries.

As for the Cartagena Protocol, it came into force on September 2003, after the necessary number of ratifications. The Cartagena Protocol sets out from the hypothesis that there is something harmful in the process of producing transgenic crops, that is to say, these crops are not given the benefit of the doubt. The starting point is that they are bad, hence the need for the strongest possible regulation. But we should not forget that the Cartagena Protocol is part of the Convention on Biological Diversity, that is to say that the priority is environmental damage, damage to biological diversity, although there is some reference to the potential damage to human and animal health. Its attendant measures should not be used to mask trade protectionism; that is to say, if you tell me that a given crop that I am going to import is harmful to my health and to my country, you should provide scientific proof to demonstrate it; otherwise, it is just an obstacle to trade. And in this sense,

negotiations are currently underway on which information should be provided in detail by the exporter to the importer. In other words, the precautionary approach of the Cartagena Protocol is still being debated, and that struggle will take place within the World Trade Organization. That takes us back to the comment by Dr. Ingo Potrykus, the father of golden rice, who said that overregulation kills regulation.

I would also like to address the question posed by IICA's Director General. It is true that nobody complains when recombinant insulin is prescribed, even though that insulin is produced with the same technology used for transferring the gene of one microorganism, like Bacillus thuringiensis, to a plant, a type of yeast, or a unicellular animal, as is done with the gene that allows our pancreas to produce insulin. Nowadays, we use human insulin, but before we were using pig or cow insulin. Human insulin is safer, and health is the most important thing in life. Hence in most cases involving red biotechnology there is no alternative, it is what's on offer or nothing at all.

When it comes to food, we are surrounded by myths. Even though this is the 21st Century, we still think that we are what we eat; that is to say, food is a part of what we call culture. North Americans are less involved in gastronomic culture and are now better able to pick their food, but eating is consuming acceptable quantities of vitamins, proteins, etc.; hence the importance of not eating too much fat. In Europe, food is closer to the countryside and many Europeans are convinced that what they eat at noon has come straight from the countryside, without imagining that the food has been processed many times before reaching the table.

This is where education comes into play: explaining that in most cases our food has been processed. We do not eat corn, but rather modified corn in crackers; we consume precooked and cooked rice, and all this is the work of agribusiness. There are a program by the European Commission called *From the Farm to the Fork*, in which the whole food chain is analyzed, which stages food has gone through, what is the process, what has been modified, etc. North Americans assume that what counts is the safety of the final product, of what you are eating, as in the case of pharmaceuticals. The label on a drug says what it is for and the quantity that should be taken daily, and if you take it is your responsibility or you could die.

In the food controversy, major crises, like that of mad cow disease, or dioxin in chicken, made consumers lose confidence because governments lied and confessed to the crisis only much later. However, confidence can be regained by explaining these things without acrimonious debates, and also with a good regulatory system: a well devised system that involves all stakeholders, not just scientists, agronomists, etc., but also jurists, religious leaders, and so on. This is a complex and difficult process, which scientists cannot undertake on their own; contributions are needed from those who know the human mind, specialists in other sciences like psychology, sociology, and linguistics.

Finally, intellectual property is not a dogma like religion. Intellectual property is an interesting tool for encouraging research and justifying the investment made, but all along the years the ethical aspect has been raised. For the poor, it seemed normal that they should pay a high royalty for an antiretroviral drug, but the decision was made that they should not pay. Then, under the auspices of the World Health Organization, and with the collaboration of major NGOs, among them Medecins Sans Frontières, we have come to the agreement that poor countries can purchase these drugs without paying royalties to the manufacturers, with the condition that they do not reexport them.

In the case of golden rice, it was decided that farmers with an annual income of less of US$10 thousand should not pay any kind of royalty for the seeds. That means that little by little, human beings are coming to realize that in today's world, attention must not only be paid to commercial issues, and that there are also ethical questions. Poverty is immoral. Intellectual property is never going to be eradicated by anyone. We would need, therefore, to negotiate something reasonable and responsible so that exceptions are made to intellectual property rights, in order to contribute to the fight against poverty.