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BIODIVERSITY AND INTERNATIONAL STAKES : A QUESTION OF ACCESS

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Abstract:

This paper examines three main questions: Is it possible to create a market for genetic resources? Is it a perfectly or an imperfectly competitive market? What impact could this market have on the management of Biodiversity in the context of sustainable development?

I analyse the conditions for "access" and "use" of knowledge of genetic resources and the genetic resources themselves. I then consider the consequences on the management of genetic resources and social welfare trends in the context of sustainable development. I present product and technology transfers in terms of access and user rights. I show that the lack of information on the quality of biological resources and on their value on both the demand and supply sides lead to an imperfect market model. I examine how benefit-sharing can be achieved via public research institutions in developed countries and the conditions of their access to private patent licences. My main conclusion is that a valorisation of developing countries' genetic resources is a means, among others, of accomplishing a sustainable management of biodiversity by an equitable access and benefit-sharing from the use of biodiversity: direct use of natural and biological resources; valorisation of genetic resources; development of new economic sectors, Etc. Furthermore, it enables taking part in the economic and social development of these countries (increasing the social welfare in a context of sustainable development) by widening the access to genetic resources.

Introduction

The stakes involved in the implementation of intellectual property rights vary for developing countries. They are linked to the implementation of the Convention on Biological Diversity (CBD), the International Treaty on Plant Genetic Resources for Food and Agriculture of the Food and Agricultural Organization (FAO) and the Trade-Related Aspects of Intellectual Property Rights (TRIPs) of the World Trade Organization (WTO). These various conventions may be contradictory for the management of biodiversity: The CBD recognizes each State's sovereignty on its genetic resources whereas the FAO proposes a multilateral system of exchange of genetic resources; The precautionary principle is at the origin of the biosafety protocol of the CBD for the circulation of Living Modify Organisms (LMOs) whereas the TRIPs agreement proposes a liberalization of trade.

In the Convention on Biological Diversity, the international community recognizes each State's sovereignty on its genetic resources and its responsibility in the management and conservation of biodiversity. The management of biodiversity is constrained by the implementation of national (local) incentive policies. At the local or national level, rights markets can be introduced to guarantee a minimum of self-financing of biodiversity (conservation) management programmes. There is an extensive literature on the economic implication of species conservation (Cardoso de Mendosa et al. 2003, Odom et al. 2003, Eisweth and Haney, 2002, Etc.) and on the potential benefits of genetic resources (Simpson et al. 1996, Koo and Wright 2000, Etc.). Some economists analyse the marginal value of species. Simpson et al. (1996) assert that: "we are able to derive an upper bound on the value of the marginal species […]. We demonstrate that this upper bound is relatively modest even under very optimistic assumptions and that the value of the marginal species falls off very rapidly if the probability of discovery differs from the one that maximizes the marginal value". In that paper, the substitutability between the species is a factor that determines the marginal value of species. The marginal value of species is close to zero, so Simpson et al. conclude "this paper is concerned solely with pharmaceutical researchers' willingness to pay for biodiversity as an input into commercial product […]. Our point is not that biodiversity is not valuable. If biodiversity is determined to have great value, however, the international community should be seeking other mechanisms to finance its conservation." But there exist some limits to the work of Simpson et al.:

- Polaski and Solow (1995) prove that there exists a share of characters between genetically close species (notion of dependence) and give the example of the anticancer drug taxol where there is no perfect substitutability and no independence;

- Rausser and Small (2000) explain that the marginal value of a species on an ecosystem is closed to zero, as Simpson et al., if researchers are able to ex-ante classify the species by there economic importance, but it is generally impossible. So they conclude, "the pivotal issue concerns whether every species -more generally every unit of biodiversity- can be consider equally marginal."

Moreover, in the agricultural valorization of Biodiversity, intra-species genetic diversity is very important for the improvement of seeds and for the agricultural sustainability according to pathogenic mutations or the migration of pathogens because of the climate change. This context of substitutability is presented by Kassar and Lasserre (2004), they propose that "the focus is on good or service provided by the species rather than the survival of species itself".

I propose an extension of these works. I analyse the market conditions (perfect or imperfect competition) of access to and use of genetic resources and their consequences on the management of those resources and biodiversity in a context of sustainable development. However, I do not analyse the definition of access rights to renewable natural resources (trees, plants and animals). In the first section I study the market conditions of access to genetic resources and knowledge. In the second section I present product and technology transfers in terms of access and use rights. Lastly, I analyse how benefit-sharing for developing countries can be achieved through the public research institutes of developed countries and their conditions of access to private patent licences.

1. Access to living organisms and knowledge

The sovereignty of States on their genetic resources implies that each State must define the initial allocation of rights on plant, animal and microbial genetic resources.

1.1. The suppliers of living organisms

States must define the conditions of access to and uses of their genetic resources (e.g. CBD "prior informed consent"). These conditions are essential for the economic

growth of developing countries and for global development in a context of sustainable development[1]. The effective exercise of this sovereignty is carried out if States have the latitude to define who a State representative is, i.e. who signs bio-prospecting contracts and Material Transfer Agreements[2].

In situ management of genetic resources: A State defines the characteristics of the rights: property rights on land (public, private, collective, Etc.) and on genetic resources (access and use rights). It also grants these rights: to an institution (ministry, non-governmental organization, environmental institution, Etc.); to indigenous and local community (collective right); or to an individual, thus granting a private property right on genetic resources (Trommetter & Weber, 2003). The State decentralizes decision-making, thus instituting private or collective management of biodiversity at local level. The State representative manages the resources and the conditions of access and benefit-sharing (royalties, technology transfers, Etc.) when a laboratory (public or private) wants to bio-prospect an ecosystem[3]. The State representative becomes a supplier of living organisms and genetic resources, which enables her to negotiate with private firms[4].

Ex-situ management of genetic resources: there are several statutes for the collection of genetic resources, depending on the species and the date of bio-prospecting:

* *For collections carried out before* 1992: there exist private and public collections. A holder of a collection negotiates access to genetic materials with a Material Transfer Agreement (MTA).

* *For collections carried out after* 1992: the holder of the resource "in the country of origin of the resource" must implicitly grant its agreement to the holder of the collection to negotiate access to genetic materials. This clause has to be included in the bioprospecting contract.

* *For the collection of genetic resources for food and agriculture:* the International Treaty on Plant Genetic Resources for Food and Agriculture of the FAO proposes a multilateral system of exchange of genetic resources which leads the countries concerned to create National

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[1] In this paper my goal is not to make a critical view on the relationship between economic growth and sustainable development. I suppose that the decision maker takes into account the sustainability of her decision. If readers are interested by the relationship between economic growth and sustainable development: see Islam et al. (2003) or Tisdell (2001).

[2] The MTA is a contract to define the conditions of access to and uses of genetic materials that are conserved ex-situ in gene banks or in public and private research laboratories.

[3] Generally a two percent royalty was charged on genetic resources developed by local innovators in the South. When a particular firm wanted to bio-prospect in the Yellowstone National Park, the U.S government secured a 10 percent royalty share.

Collections. All the signatories of this treaty have facilitated access to National Collections (for more details see Section 3.1.).

1.2. The suppliers of knowledge on genetic resources

States have the obligation to "respect, preserve and maintain knowledge, innovation and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity" Article 8j of the CBD (1992)[5]. The implementation of the Farmers' rights (International Treaty on Plant Genetic Resources for Food and Agriculture of the FAO)[6] will be, *a priori,* the responsibility of each State. Each State must define conditions of access and benefit sharing to traditional knowledge. The States have to recognize a right (a statute) for the indigenous and local communities for their actions concerning management and knowledge of biodiversity.

Thus, the indigenous and local community or its representative negotiates a contract defining access to traditional knowledge on genetic resources, as in the case of access to genetic resources. In this context, the holder of genetic resources and the holder of the information on those resources can be different (even in different countries). That requires a dissociation between the right to the resource and the right to information on the resource.

1.3. What markets for biological resources?

Genetic resources can be considered as experience goods (Tirole, 1992) in that nobody knows *ex-ante* if they will have industrial or other economic uses. There is a lack of information (radical uncertainty) on the quality of the good (existence of an interesting molecule or not) and on its value (use of the molecule in cosmetics, in pharmacy, Etc.). This lack exists on both the demand side (relatively classic in economic models with asymmetry of information) and the supply side (less classic). It is therefore difficult to define a satisfactory equilibrium price based on the expected value of the genetic resources in a competitive market of genetic resources. There is no equilibrium price, because the supplier overestimates the expected value of the resource whereas the

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[4] For example, in Madagascar the State proposes a "local management contract" (GELOSE) to indigenous and local communities.

[5] Source: http://www.biodiv.org.

[6] The Farmers' rights recognizes successive generations of farmers' contributions in "conserving, improving, and making available" these plant genetic resources (for more details, see Section 3.1.).

demander underestimates the expected value of the same resource (risk averse because of a small probability of success 1/10,000)[7].

Bilateral or multilateral negotiations could make up for the absence of a price equilibrium in a competitive market of genetic resources. The co-contractors must dissociate access and use rights when drafting a contract: the demander pays for access to a genetic material *ex-ante* to the creation of an innovation, and pays to have the use right of a resource in the event of success (creation of an innovation). The contract between the parties must be complete rather than incomplete. If not, the agents have two options in case of innovation: a supplier can try to appropriate a producer's entire surplus by means of a high price to give the use right to the demander; or a demander tries to find another sample of this "same" resource in another country, with a view to appropriating the totality of a supplier's surplus.

Benefit-sharing is generally associated with monetary sharing (royalties) but we can consider various types of benefit-sharing that will also benefit the developing country (particularly its social welfare in a context of sustainable development), e.g. transfers of research results and of innovative goods on advantageous terms, and technology transfers to develop research activities in developing countries (R&D)[8].

Suppliers of genetic resources and (or) of information on those resources (if they are different) prefer a bilateral relation because they can own the quality of genetic resources related to an endemism and/or to information (of the indigenous and local community) on genetic resources. Genetic resources, with and without information, can be differentiated (negotiation of access to the resource and to the information on that resource) and cannot be dealt with in the same manner. The solution is to build a model with asymmetry of information (model of adverse selection on the quality of the good). In this case, demanders can offer to pay suppliers more, so that they reveal their information, but in so doing they take the risk of the information being false or incomplete[9].

In the particular case of access to ex-situ collections of genetic resources, this access is linked to a material transfer agreement in terms of which it is generally free of charge (or with a charge that represents carriage costs) except for a payment of royalties in case of commercialization of an innovative good.

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[7] Firms propose R&D risk sharing with local and indigenous communities.
[8] In 1991, Merck has proposed this type of contract to InBio in Costa-Rica (discussed in Section 3.2.)
[9] That is especially so for multi-gene functions or for local drugs which are a combination of different plants.

2. Access to innovations

The conditions of developing countries' access to techniques, technologies and innovative goods are an inevitable topic of debate in international negotiations. This is particularly so in the case in the CBD negotiation on "Access and Benefit Sharing".

2.1. The general context

The advancement of developing countries depends on the conditions of access to the innovations of industrialized countries but also of the most advanced developing countries in biotechnology (Brazil, China, India, Etc.). This access is twofold: access to innovative goods resulting from biotechnology - drugs, seeds, Etc. - and access to techniques for producing innovative goods. These two levels of access are necessary since agricultural and health-related emergencies in many developing countries (especially in the case of AIDS) require a sequential approach: first the diffusion of drugs and then the transfer of production techniques and R&D technologies to develop scientific research in developing countries. This sequential organization is like the organization opted for by the international community during the Green Revolution in the seventies: direct food aid for developing countries and, in parallel, research and development of varieties well-suited to the developing country. These technology transfers can be carried out at national or regional level, first to coordinate the production of food and pharmaceutical products and second to coordinate the R&D of developing countries by guaranteeing a "critical mass" of researchers'[10].

Thus, the stakes for biotechnology research in developing countries depend on the intellectual property rights that must be implemented in each country. The interactions between developing countries and the developed countries - transfers of innovative goods, technology, research partnerships - should have various impacts on the economic growth and on the sustainable development of all of the countries. It is always necessary to keep in mind that intellectual property rights - patents or any other system - are valid in the country in which the rights are institutionalized by law, and are under the constraint to respect the minimal level of harmonization negotiated within the framework of international institutions like the TRIPs (e.g. Article 27.3b on the harmonization of intellectual property rights on plant

variety protection). The choice of the intellectual property right regime must be analysed in a strategic way. It is a question of choosing the protection system that will maximize the social surplus of the country and its economic growth in a context of sustainable development, i.e. taking into account the specific characteristics of its research organization, its development and the markets it strives for, including its environmental constraints.

These intellectual property rights, in the context of the CBD, must facilitate the technology transfers of developed countries and of the most advanced developing countries in the biotechnology field. Access should be facilitated and can be free-of-charge or at a low price (the function, for example, of a macro-economic indicator) for developing countries. The rights should also support the establishment of research activities with, in particular, cooperative research programmes (Ramani, 2000) or even partnership research programmes with the most advanced developing countries in biotechnology such as India or China. Access to the plant genetic resources that make up the seeds is free of charge for the traditional selection, if the seeds are protected by "plant breeders rights"[°11] of the UPOV *(Union des Professionnels des Obtentions Végétales),* and limited for the development of Living Modified Organisms that are protected by patent (for more details see Section 3.1.).

2.2. The pharmaceutical example

The two levels of access - to products and to technologies - are necessary in most developing countries, in particular in the case of AIDS (Henry, Trommetter and Tubiana, 2003): first, for the diffusion of drugs and, second, for the transfer of drug production techniques and R&D technologies. It is necessary to guarantee access to therapies at a low cost. For example, the price of tri-therapy is differentiated according to countries:

* In developed countries pharmaceutical firms integrate into the price of a therapy a reasonable return on their R&D investments and production costs. The cost of tri-therapy is approximately 750 €per month (Ciblé SIDA, 2003)[12]. Otherwise the firm would not be able

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[10] For example, the Global Environment facility finances, in the Magrab, a regional organization for the *ex-situ* conservation of plant genetic resources. "The GEF helps developing countries fund projects and programs". Source: http://www.gefweb.org.

[11] The Plant breeders rights is a system of protection for varieties of seeds for agricultural and agri-food use, which guarantees access to the genetic resources constituting them and to the new genetic resource that they constitute, for research and plant selection purposes. In this case it is a matter of free-of-charge unrestricted access to genetic resources (Ducos-Joly 1996).

[12] Source: http://www.

to invest in R&D and develop new drugs to contribute to the economic growth and social welfare of developed countries (classic in the economic models of R&D incentives);

* In developing countries this price can be reduced after an agreement with the pharmaceutical firms, to between 10 and 25% of the tariff applied in developed countries (e.g. in Côte d'Ivoire or Senegal), and even less today according to the "Clinton Foundation", so that it corresponds at least to the marginal cost of the drug;

* Last1y, the price can be even lower by using generic drugs manufactured in developing countries where the pharmaceutical field is organized (India, Brazil, Etc.) and where the marginal cost of production is lower. Today the cost of a generic therapy, for a patient, can be less than 150 US$ per annum. The Clinton Foundation (2003)[13] negotiates prices, between 35 and 38 US cents per day, with generic drug companies.

In a vision of global social welfare, we could conceive of a transfer of drug production techniques to developing countries which would then be allowed to export to other countries that do not have the possibility of supporting the price of the drug manufactured by the patent holder. That would lead to reduced production costs of the drug for developing countries, to a consequent increase in the number of patients of developing countries who could have access to these therapies (to increase the social welfare) and, finally, to a contribution to the economic growth of developing countries. This transfer of techniques can be carried out at national level but also at regional level to coordinate the production and research of various countries.

2.3. Developing countries' access to patents and R&D for innovation

Technology transfers suppose that the countries concerned have the capacities to develop production and/or R&D in the plant breeding, pharmaceutical and biotechnological fields. However, few countries have such capacities. In the context of "Access and Benefit Sharing" of the CBD, it is then necessary to facilitate the development of research by the public research institutes of the developed countries for developing countries. These public institutes could be national institutes of the developed countries or such international research institutes as the International Agricultural Research Centres (IARCs). However, in order to carry out research, public laboratories have a problem of access to the patents of private firms. US universities realized that, to carry out their research, they could depend on

many patents. The negotiation of licences can lead to: transaction costs that can become dissuasive because of the existence of too many claimants" (Slager and Ostrom, 1992), with upstream inventions that can block a later innovation (cumulative research). There are then risks related to phenomena of horizontal and vertical integrations, so that in the medium term the number of patent owners is restricted and thus harms future research. This situation is known as the tragedy of the anti-commons (Heller and Eisenberg, 1998) because of an oligopolistic structure. The current situation leads to R&D barriers, including fields where the firm that owns the patent is not present. In this context, there is a risk of a university or a small firm infringing on a right of which it is unaware what Shapiro (2000) defines as a situation of hold-up. For instance, in the case of the Golden Rice, much time and effort were necessary to eliminate the barriers linked to access negotiations to more than seventeen patents and twelve different patent owners (Kryder et al., 2000). In that case, the US example of the implementation of a "clearing house mechanism" (CHM), for the management of public patents, was based on the search for complementarities and "patent thickets" to propose pools of patents, with a view to facilitating the creation of new innovations. This CHM was designed to better fulfil the public service duty of the universities (specialty crops of no interest to private firms or crops adapted to developing countries) and to acquire more power of negotiation vis-a-vis the large biotechnology multinationals (Atkinson et al., 2003 and Graff et al., 2003). Public laboratories are found in competition with private firms to have access to patent licences of other public or private laboratories, whereas private firms know the patent environment better than the public owners themselves. The implementation of these CHM makes it possible to identify the fields where the public sector is strong and those where the patent portfolio is weak compared to the objectives of public institutions[14]. One important goal is to guarantee access, for developing countries, to the technologies of developed countries by way of their public research institutions (licence negotiation for private patents) or international institutions such as the IARCs.

3. Four examples of contracts

I will now present the philosophy of four types of contractual organization in genetic resources management. These examples are analysed with regard to the implementation of

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[13] Source: http://www.

the various conventions FAO, CBD and TRIPs: the multilateral system of exchange in plant biotechnology (FAO and CBD); to types of bio-prospecting contract: Merck Inbio in Costa Rica and Biodivalor in Gabon (CBD and TRIPs); and licence agreements in research relations between public organizations and private firms (CBD and TRIPs).

3.1. The multilateral organization for plant genetic resources proposed by the FA O

From time immemorial genetic resources in the plant field have been regarded as a common heritage of humankind. That is still the philosophy today, with the International Treaty on Plant Genetic Resources for Food and Agriculture of the FAO (for a historical survey on the FAO, see Petit, 2003). A large part of plant genetic resources are conserved, ex-situ, in international collections within the framework of the IARCs. "The Treaty recognizes the enormous contribution that farmers and their communities have made and continue to make to the conservation and development of plant genetic resources. This is the basis for Farmers' Rights, which include the protection of traditional knowledge, and the right to participate equitably in benefit-sharing and in national decision-making about plant genetic resources. It gives governments the responsibility for implementing these rights.". The international Treaty on Plant Genetic Resources for Food and Agriculture is a multilateral exchange agreement that guarantees access, without exclusion, to the collections of genetic resources.

This treaty stipulates compensations for developing countries, in relation to the innovation but especially to the relevant intellectual property rights.

* With plant breeder rights, this protection guarantees free access to the genetic resource for innovations that are not "essentially derived". In that case, there is a voluntary benefit sharing contribution to an international compensatory fund.

* With patents (e.g. on living modified organisms), there is a risk of blocking access to genetic resources. In that case there are compulsory fees to a compensatory fund.

The international Treaty on Plant Genetic Resources for Food and Agriculture is a "paid free access mechanism" but limited to a list of species. The species not on the list are managed by the CBD, and therefore by contract between the supplier of a resource and the demanders.

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[14] Hence, the economic sectors where the public sector has to negotiate licences for patents belonging to the private sector.

3.2. A bi-lateral contract in the context of the CBD: The Merck /InBio contract

The system of access and benefit-sharing suggested by the CBD entails the signing of bilateral agreements between firms and States (or their representatives as define in Section 1.). A case in point is the famous agreement concluded in 1991 between the US pharmaceutical firm Merck and the *Intituto Nacional de Biodiversidad* (InBio), a private not-for-profit organization. InBio provided 10,000 biological samples to Merck, in exchange for US$1,135,000 (the price is US$113 per sample). In parallel, Merck is committed to pay royalties (between 2 and 6%) on commercial products obtained with the prospected biological resources. While Merck hopes to be able to discover pharmaceutical molecules (exclusive rights in exploitation of the samples for 2 years) and to file patents, InBio finances a part of the complete inventory of the biological diversity of Costa-Rica. In addition, 50% of the cash charged by InBio must be transferred to the National Park of Costa-Rica to finance conservation programmes. Until now, Merck does not develop any commercial product from InBio's genetic resources so Merck do not pay any royalty.

3.3. A market approach of the CBD: The Biodivalor contracts

Within the framework of the Biodivalor contract in Gabon (Africa), there is a situation of monopoly with only one supplier of genetic resources and several demanders. The aim of the project is to share the benefits with the indigenous and local communities and to support conservation programmes. There is a fund specially created to finance local sustainable development projects (thus *a priori* favourable to the management of biodiversity, Robinet, 2003). However, the Jack of control of bio-prospecting in neighbours States and the absence of indigenous and local communities on the fund's management board raise the question of the efficiency of this organization for the indigenous and local communities (in compensatory terms) and for biodiversity. Of the twenty firms contacted, only four agreed to negotiate access to genetic resources (Aventis, Dior, Fabre and Novartis-Syngenta). Two thousand one hundred samples have been sold, at a cost of €115,000 (50 € per sample). At the same time, Dior is interested in Okoumé resin for cosmetic R&D (420 kg are worth €52,000, or €125 per kilo (Robinet,

2003)). This is not about the valorization of genetic resources, it is a matter of exporting a raw material to the cosmetic industry.

3.4. An example of the implementation of the Access and Benefit Sharing of the CBD: the clearing house mechanism

Within the framework of the clearing house mechanism (presented in Section 2.3.), US universities have noted that the University of California is the owner of 1.7% of all biotechnology patents. If we compare this to Monsanto's 14%, Dupont's 13% or Syngenta's 7%, the weight of universities is particularly weak. But if we look at the universities as a whole, the share of public patents in plant biotechnology is from 25 to 30%. For citations of patents in other patents, the share is 22% for universities and 19% for Monsanto (Graff et al., 2003). Thus, if universities collaborate, rather than competing, in the management of their intellectual property rights, they have a considerable power of negotiation with private companies to realize their public mission duty. That does not mean that universities should no longer cooperate with the private sector: "The objectives of public institutes is to develop strategies that allow them to continue their work with the private sector to develop opportunities for commercialization of new technologies, while at the same time enhancing the broad public benefit of technological innovation." (Graff et al., 2003). In this context, the organization of research evolves from a situation that can be apprehended as an oligopsony to a situation of an "organized oligopsony". There are always as many suppliers but they coordinate one another and converge on a situation that is close to a bilateral oligopoly. There is thus a reinforcement of the universities' capacity, compared to private firms, for negotiation the access to patent licences to better fulfil there public service duty for developing countries. US Universities capacity reinforcement should not infringe the antitrust laws and the TRIPs agreements on anti-competition practices.

3.5. Synthesis

Within the framework of the management of genetic resources for food and agriculture, the multilateral system of exchange guarantees facilitated access to genetic resources and benefit-sharing whose equity is negotiated between the various countries. Nevertheless, the actual negotiations on the conditions of benefit sharing by means of

international funds, technology transfers and the development of products for developing countries, show the way.

In the last three examples the goal is to rebalance relationships between suppliers and demanders in an imperfect competition model with asymmetry of information (quality of resources, valorization of resources, Etc.). The objective is to limit claims for exclusive access to and use of genetic resources by private firms (plant breeders or pharmaceutical companies). Merck-InBio is a bilateral contract whose organization is registered today in the "Megadivers"[15] agreements and whose claims are rejected by Merck, which has disengaged (Morin, 2003). In the case of Biodivalor, the relative failure is probably related to an absence of a regional organization for the management of genetic resources (creation of trusts to limit competition between genetic resource suppliers) vis-a-vis a small number of demanders. Out of a total of twenty proposals, only four firms are interested in Biodivalor genetic resources. The other demanders may be going elsewhere, where access to genetic resources is less regulated. The bargaining power between suppliers and demanders, at every level (access to genetic resources in and ex-situ; access to innovations; access to patent licenses), is not neutral in the management of biodiversity and in the development of developing countries and the growth of global economies. Finally, in the case of a clearing house mechanism, the exchange of information and the constitution of a "club" around public patents make it possible to better negotiate access to patent licences. This facilitated access to licences for universities allows them to carry out their mission of public service duty more effectively, particularly in favour of developing countries. Bargaining powers between suppliers and demanders and a definition of conditions of access to the various markets (resources, products, licenses to patents) are the keys to successful implementation of the CBD, the International Treaty on Plant Genetic Resources for Food and Agriculture of the FAO and the TRIPs agreement.

The initial allocation of rights on genetic resources and biotechnological inventions is not unrelated to the success or failure of transactions. Thus, does a State have to yield its rights on genetic resources by auction or must it freely yield them to indigenous and local community? Does it have to impose, in the initial allocation of rights, the conditions of benefit-sharing and the duties for a holder of rights on the management of ecosystems? Does it have to create development funds associated with

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[15] Megadivers is a trust organization of some developing countries, e.g. Brazil and China.

local conservation programmes (conservation of biodiversity)? Moreover, how can a State be sure that a manager does effectively work in the interests of sustainable development? There is an asymmetry of information of a moral hazard type with States and of an adverse selection type with private firms. In this context, the supplier of genetic resources becomes a key element in the management of biodiversity. Thus, contrary to the greenhouse effect where a State can sell its rights if it reduces its carbon emissions, in the case of biodiversity the sale of genetic resources (rights of access and of use) does not imply their long-term conservation.

Conclusion

The debate on intellectual property rights is a major issue in economic development. Intellectual property rights influence the conditions of technology transfers. They can facilitate or, on the contrary, discourage foreign investments, and facilitate or slow down diffusion of innovations (seeds, drugs or technology transfers) in the economy. The choice, by a State, of intellectual property rights can be positive or prejudicial to economic and social development, depending on the type of existing public institutions and the production and/or scientific capacities of the country. An intellectual property right can also be a possibility of protecting local discoveries and innovations and preserving traditional knowledge and resources from abusive appropriation (for more details sec Article 8j of the CBD).

In this context:

* The capacity of developing countries to negotiate access to products or technologies, with large firms, is crucial. For example, in the case of the AIDS, developing countries have difficulties "to make their voice heard" on questions of the price of therapies and of developments and uses of generic drugs, even if the issue is under negotiation within the WTO framework. The United States remains hostile, except for a very limited number of drugs, to authorizations for importation of generic drugs by the least developed countries.

* The credibility of a commitment by a developing country or even a region ("country groups") is tricky. Even if they implement intellectual property rights to facilitate technology transfers and diffusion of innovative drugs or seeds in the context of benefit-sharing, there has to be an institution to ensure that rights and commitments are observed. Moreover, a country's access to resources and traditional knowledge must be formalized

(institutionalized) to guarantee better (equitable?) conditions of benefit-sharing and technology transfers.

* The question of the creation of bargaining power is increasingly present in negotiations. For instance, pressure is put on developing countries not to institutionalize compulsory licenses, whereas all the developed countries do so. If the goal is to maximize social welfare on a global scale, further investigation is required into the conditions of access to various elements of research in biotechnology (from resources to patents). It is necessary to seek a sustainable and equitable equilibrium between, on the one hand, holders and users of genetic resources and, on the other, inventors and product and technology users (manufacturers of generic drugs are of course users). The implementation of intellectual property rights could be different from one country to another (even if there is a tendency to harmonization in Article 27.3b of the TRIPs agreement). Developing countries can also impose equitable constraints on the access to genetic resources and to the traditional knowledge of indigenous and local communities to guarantee their access to products and technologies developed by public laboratories and private firms of the North. But the efficiency of such a mechanism depends on the coordination capabilities of developing countries that should be at a regional level at least (creation of trusts like the Megadivers organization).

Developing countries must be realistic as regards the real impacts of the valorization of genetic resources on the conservation of biodiversity and on the social welfare. The valorization of genetic resources alone cannot guarantee a sustainable management of biodiversity and even least a sustainable development. It is thus necessary to study the initial allocation of rights on genetic resources to ensure an equitable arrangement for the holder and the user of genetic resources. Developing countries may believe that they could live on their "private incomes" from the valorization of their genetic resources, and that those incomes could be sufficient to limit the impact of all anthropic uses on biodiversity (conservationist approach). However, a valorization of developing countries' genetic resources is a means, among others, to accomplish a sustainable management of biodiversity by an equitable benefit-sharing from the use of biodiversity: direct use of natural and biological resources; valorization of genetic resources; development of new economic sectors, Etc. But it is also a means of taking part in the economic and social development of these countries (increasing the social welfare in a context of sustainable development) by widening access conditions to genetic resources. Hence, benefit-sharing could include

developing countries' access to technologies and research, via public research institutes' access to private patents in the interests of their public service duty.

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