



The effectiveness of access and benefit sharing in Costa Rica: Implications for national and international regimes

Carmen Richerzhagen*, Karin Holm-Mueller

*Institute for Agricultural Policy, Market Research and Economic Sociology, Department of Resource and Environmental Economics,
Nussallee 21, 53115 Bonn, Germany*

Received 31 October 2003; received in revised form 21 May 2004; accepted 23 June 2004

Abstract

The Convention on Biological Diversity provides an international framework to ensure conservation and sustainable use of genetic resources. The realization of these objectives is based on the state's sovereignty over its biological resources and the idea of a fair and equitable sharing of the benefits arising out of the utilization of genetic resources. Due to the enormous technical progress in biotechnology the demand for genetic resources increases especially within the pharmaceutical industry and the agribusiness, whereas the biological diversity and with it the supply of diverse genetic resources decreases. The concept of access and benefit sharing takes these developments into consideration and creates a market for biological resources. We identify critical factors which can influence the effectiveness of this concept such as: assignment of property and intellectual property rights, enforcement problems, and bargaining power. Applying these factors to evaluate the access and benefit sharing regime in Costa Rica we identify the specifications of these critical factors which favor economic development and sustain biodiversity at the same time. We then discuss possible lessons of the Costa Rican experience for other biodiversity-rich countries.

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Keywords: Biodiversity; Institutional settings; Access and benefit sharing; Bioprospecting; Costa Rica

1. Introduction

During the last 10 years the enormous global loss of biodiversity has received growing attention. Biodiversity serves many important purposes as life-

support system, ecosystem services, and production inputs. Especially the decline of highly diverse genetic resources being potential elements of agricultural and pharmaceutical innovations causes concern. The potential and future use of genetic resources has thus been recommended as a source of funds for habitat preservation. For the first time in 1991 the idea was applied when Costa Rica's National Biodiversity Institute (INBio) and the pharmaceutical company

* Corresponding author.

E-mail address: richerzhagen@agp.uni-bonn.de
(C. Richerzhagen).

Merck and Co. announced an access-for-fee-agreement. The concept expanded into the [Convention on Biological Diversity \(CBD\)](#), adopted in 1992, aiming to promote both biodiversity conservation and sustainable development. Many parties began drafting and implementing access and benefit sharing (ABS) regulations, providing the basis for the conclusion of bilateral market-like contracts between the holder and user of biodiversity.

There has been some work in the past (see for example [Reid et al., 1993a,b](#); [Columbia University, 1999](#)) mainly from the legal and policy perspective, concerning the development of national ABS laws. All these contributions do not allow drawing conclusions about the effectiveness of the CBD's promoted approach ABS. Their analysis is more descriptive and speculative and lacks an evaluation of the effects of ABS. Recently [Dávalos et al. \(2003\)](#) attempted to evaluate ABS regimes on a comparative basis, but even by examining case studies the conclusions and recommendations remain either very general or very specific and are not related to the impacts of ABS on biodiversity conservation and economic development. Additionally, there is other work ([Rausser and Small, 2000](#); [ten Kate and A Laird, 1999](#)) estimating the private value of biodiversity as input into development and research or discussing the commercial use of biodiversity from the demand side. It shows the industry point of view, but does not attempt any evaluation from a societal point of view. The effectiveness of the ABS approach of the CBD related to its objectives is still not clarified. With this article we try to enter a new focus into the discussion.

With Costa Rica taken as an example this article evaluates an existing ABS regime. The objective is to assess the possibility of promoting nature conservation and economic development through the commercialization of biodiversity and to look into the reasons for the relative successful Costa Rican experience. After a short introduction to the institutional background, critical factors which determine the effectiveness of ABS regimes are identified mainly by using institutional economics. The case of Costa Rica is then analyzed in the light of these factors. The article closes with a discussion about the transferability of results to other biodiversity-rich countries.

2. The institutional framework for biodiversity conservation

Between the 70s and 80s it became obvious that neither the public nor the private sector in biodiversity-rich countries – mostly developing countries – could provide sufficient funds for nature and especially biodiversity conservation. The concern and general willingness within the international community to conserve biodiversity were not sufficient to counterbalance these deficiencies. After long-lasting negotiations the United Nation Convention on Biological Diversity was adopted during the Earth Summit in Rio de Janeiro in 1992. The essential objectives of the CBD are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources under the umbrella of sustainable development (CBD art. 1).

The agreement covers all fields of biodiversity: ecosystems, species, and genetic resources and also biological material stored in ex-situ collection after the adoption of the CBD (CBD art. 2). It links traditional conservation efforts to the economic goal of using biological resources sustainably. Contrary to the classical protection concepts claiming for not using the resources at all the CBD recognizes that biological resources can be conserved and used simultaneously (CBD, 2000, p. 8). According to its objectives the agreement sets principles for the fair and equitable sharing of benefits arising from the use of genetic resources. It also covers the rapidly expanding field of biotechnology addressing technology development and transfer, benefit sharing, and biosafety. This new international framework of biodiversity management takes up different developments: the increasing loss of species, new insights about biodiversity conservation but also the technical progress in the area of biotechnology, and the increasing demand for biological material.

The CBD places emphasis on the recognition of and consistency with intellectual property rights (IPRs), especially patents in the area of biotechnology (CBD art. 16). The convention confirms the existence and extension of IPRs as a precondition for bioprospecting, a sustainable form of exploitation. On the international level the World Trade

Organization's (WTO) agreement on Trade-related Intellectual Property Rights (TRIPs) harmonizes the national IPR laws and sets detailed minimum standards for protection of inventions. Every member of the WTO has to implement IPR protection to comply with its obligations instituted by the TRIPs agreement.

IPRs play a major role in the biotechnology industry and have a high impact on the developments in these knowledge-intensive sectors. In 1997, biotechnology patents already accounted for about 6% of all US patents (OECD, 2001). The possibility to protect inventions with high research and development costs by IPRs is a major condition for ongoing developments (Lele et al., 2000, p. 7).

The CBD recognizes every state's sovereignty over its own biological resources and affirms that the conservation of biological diversity is "a common concern of humankind" (CBD preamble, art. 3). By confirming the state's sovereignty over its own biological resources the open access status of biodiversity is abolished and the CBD assigns the responsibility for the conservation and sustainable use of biodiversity to the provider countries. The confirmation of the state's sovereignty creates a legal regime, being a precondition for the introduction of bilateral market-like contracts between the holder and user of biodiversity (Boisvert and Caron, 2002, p. 152).

The definition and the consequences connected with the principle of state sovereignty are still not very clear though. The CBD states that governments have the responsibility to establish national regulations about the way of dealing with their biological resources and regulating ABS (CBD art. 15.1). It is the government's decision to establish and design national ABS regulations as well as to define and to assign property rights over biological resources, but the conditions have to ensure facilitated access to genetic resources (CBD art. 15.2). Access to valuable biological resources must be carried out on "mutually agreed terms" (MAT) and be subject to the "prior informed consent" (PIC) of the country of origin (CBD art. 15.1/4/5). These important criteria are not regulated in more detail in the CBD. The determination of rules and regulations concerning the "prior informed consent" is the responsibility and burden of the national governments.

Only lately the roles and responsibilities according to ABS regulation have been addressed with the adoption of the Bonn Guidelines in 2002. The guidelines propose a range of measures that user and provider countries should consider when implementing the CBD's ABS specification (Bonn Guidelines, 2001). Hence, the obtaining of PIC includes the consent to access of relevant national authorities in the provider country which have to be identified by national regulation. The provider countries have to establish a transparent PIC system, including legal certainty and clarity and facilitated access at minimum costs. (Bonn Guidelines, 2001, p. 19).

3. The promise: conserving biodiversity by commercialization

Biodiversity and its components have characteristics of public and private goods. While many of the benefits of biological diversity accrue to the public as a whole in the form of cultural, social, and economic benefits, a number of its components have private values (OECD, 2003, p. 23). The public value of biodiversity is not assessable, but probably very large. The private value of any specific status of biodiversity varies and depends on the institutional settings. This private value determines decisions and economic behavior regarding the handling of biodiversity (Simpson, 1999). People convert biodiversity-rich forests to cultivated land if this allows them to increase their income. Conservation of biodiversity can only be obtained if the private benefit of conserving biodiversity exceeds the private benefits of cultivating land or of any other biodiversity damaging activity (e.g. commercial logging).

The utilization of biodiversity as an input in research and development embodies a private value. Due to evolution and the selection process, nature provides a number of successful strategies which can be used against the dynamic occurrence of existence-threats, for instance pests, and predators of the primary food system or non-curable diseases. Therefore, diverse wild plant genetic resources are of high interest (Swanson, 1996b, p. 3). They are used as production inputs in research institutions and in the so-called life science companies, combining pharmaceutical, food, seed, and chemical divisions. The

pharmaceutical industry, the crop protection sector, the agricultural seed business, the horticulture, the botanical medicine, and the cosmetic and personal care sectors have a high interest in obtaining genetic resources for research and development (A Laird and ten Kate, 2001, p. 295). The contribution of natural products to sales in the world's top pharmaceutical companies ranges from 10 to more than 50%. Of the 25 best-selling drugs worldwide in 1997, 42% of sales came from natural products, with a total value of US\$ 17.5 billion (ten Kate and A Laird, 1999, p. 34). The economic value of genetic resources as inputs for medicine, products for material science, genes for resistance to plant pathogens, and crop pests was estimated at US\$ 79 per hectare per year (Constanza et al., 1997, p. 256). The potential of the commercial use of genetic resources is therefore obvious. But the reality shows that this potential has not been exploited. Some companies have recently scaled down or closed the section of natural product development, but all leading companies still run natural product programs within the company or through subsidiaries (Laird and ten Kate, 2001, p. 249).

The market structure of the sectors using and providing biodiversity is characterized by an asymmetric distribution of resources and technology. The sectors having the potential to commercialize and therefore demand genetic resources (provided their IPRs are protected) are mainly located in industrial countries whereas most of the provider countries can be identified as developing countries (Myers et al., 2000, p. 855). The ABS concept is a response to this situation by aiming at a participation of provider countries in the economic gains stemming from their biological resources.

According to the CBD access to genetic resources and therefore bioprospecting is regulated and aligned with costs. A country, being rich in biodiversity, is supposed to allow access to genetic resources in exchange for monetary or non-monetary benefits like technologies and especially biotechnologies (Bonn Guidelines, 2001, Appendix II p. 28). The exchange is based on negotiations between the provider and the user of genetic resources until they agree on a contract about the planned bioprospecting activities and the benefit sharing procedure. Thus, one part of the possible profits realized by the commercialization of genetic resources in the pharmaceutical and seed

industry should flow back to the provider of the resources and give an incentive to continue conserving biodiversity. In order to create incentives for biodiversity conservation and assure a continuous supply of genetic material the benefits earned through commercialization have to be channeled to the land owner or local community in charge of the resource management and bearing the conservation costs. Then, these benefits create a new source of income for these agents and biodiversity comes out as a by-product. This shows the important role of the national institutions defining property rights and thus distributing income opportunities.

Consequently, this concept does not only address biodiversity conservation. The new income realized by the commercialization of biodiversity promises to serve the dual purpose of alleviating poverty through economic development and sustaining natural resources (Simpson, 1999). Within the sustainable development strategy, the poverty issue is clearly linked to biodiversity degradation and identified as the major underlying reason for converting biodiversity-rich habitats (Swanson, 1996a, p. 21). It is expected that bioprospecting contracts provide sufficient flows of investment and technology in the area of biotechnology to promote economic development in the provider countries. It should also allow provider countries to establish their own industrial sector related to genetic resources (Reid et al., 1993a,b, p. 33).

The high number of newly established and drafted ABS regimes indicates that many countries hope for success when applying this approach. In the next section different critical factors of the ABS concept which impact its promises and effectiveness are identified.

4. Critical factors of an efficient access and benefit sharing regime

The effectiveness of ABS regimes is influenced by various factors. These are identified in the next section through the use of institutional economics. The main objective of any ABS scheme is setting the incentives right which can be complicated by unclear or inefficient property rights regimes, by enforcement problems due to time lags and informational asymmetries, and by administrative complexity. The dis-

tribution of benefits and thus the CBD objective “fair and equitable benefit sharing” is strongly affected by the distribution of bargaining power which is closely linked to market structure.

4.1. Assigning property rights and intellectual property rights

According to genetic vocabulary, biodiversity can be divided into two parts: the phenotype, that is the tangible biological material, and the genotype, that is the genetic and biochemical information of the resource. Tangible resources (e.g. plants) in general are subject to private property rights. Intangible resources such as products of research and development can be protected by IPRs (Sedjo, 2000, p. 111).

Companies or research institutions who sign bioprospecting contracts with the provider countries receive property rights for the purchased material in exchange for sample fees and up-front payments. In case of successful development, research and commercialization, the inventor can receive protection by IPRs, which are internationally harmonized by the TRIPs agreement in all WTO member countries. The contribution of the provider countries is rewarded by royalties and milestone payments or other non-monetary transfers.

Still on the provider side the absence of clear property rights can hinder the realization of profits and consequently, biodiversity conservation. This problem appears at the level being responsible for the resource management. Apart from the confirmation of the state’s sovereignty over its biological resources and the emphasis on the existence of IPRs, no property right allocation is demanded by the CBD. The definition and assignment are in the responsibility of the national governments. Whether they transfer their authority and rights to other stakeholders depends on the national legislation.

Possible property right regimes relevant to natural resources are: state property, private property, communal property, and the open access situation, characterized by no defined rights and unregulated access (Feeny et al., 1990). The regimes differ in their consequences on the negotiations and their influence on incentives for conservation. Private, communal, and state property rights can be adequate for negotiations and have the potential to institute

incentives for conservation measures, whereas open access results in depletion of the resource (Hardin, 1968, pp. 1243–1248). Property rights should be placed at those levels which are most effective at maintaining and investing in the concerned asset (Swanson and Goeschl, 2000, p. 77).

The property rights regime is also important for the design of ABS regulations. In the case of state property, the government is responsible for the provision of biodiversity. If it can enforce its property rights, sharing benefits with individuals or communities who contributed to the existence of biodiversity in the past may be important in terms of equity and fairness (Bonn Guidelines, 2001, p. 23). It is not important from an incentive point of view though. If the local level is in charge of the resource management and the supply, its participation in the benefits of bioprospecting plays a major role. The CBD demands only the PIC, which is a rather weak form of participation and can be organized without any form of benefit sharing with the local agents. In this case these agents will estimate the value of wild genetic resources to be very low, even if the value of bioprospecting is high to the companies in the life science sector.

The relationship between property rights and values of biodiversity depending on the stage of process of genetic resources in the production chain play an important role for the effectiveness of the ABS concept. By comparing property rights of the different stakeholders (individuals, local communities, government, intermediary, companies, and researchers) allocated by international regulation, it can be concluded that level by level, the strength of property rights of the concerned party increases as well as the economic market value. By granting intellectual property rights over developed, marketable products companies and research institutions receive strong property rights for high valued goods. Governments have also strong rights over their biological resources which are confirmed by the state’s sovereignty principle of the CBD. The convention does not allocate rights to the local level. This level will profit from biodiversity conservation and have an incentive to conserve nature only if national legislation fills this gap.

Thus, strong IPRs in the form of patents and plant breeder rights for the marketable product will not be sufficient for biodiversity conservation. Conservation

incentives in the form of rights or benefits have to be instituted for the economic agents who decide on the use of the biological resources. If these are local agents, national legislation has to ensure that they benefit from any ABS contract. Benefits can be monetary as access and sample fees, up-front and milestone payments or royalties, or non-monetary, affecting national research and development, local economic development, and capacity-building (Columbia University, 1999, p. 75). A necessary condition for the effectiveness of the ABS concept is that the benefits, either monetary or non-monetary, can compensate the costs related to the conservation activities.

4.2. Accounting for time lags

The main reasons, hindering the realization of the third CBD objective “fair and equitable benefit sharing” are the time lags between the collection and provision of promising samples and the development of a marketable product, the low probability that a sample will succeed in a product, and the wide geographical spread of genetic resources (Dutfield, 1999, p. 2). The variation between industry sectors in the cost and the time it takes to develop a marketable product from a natural sample as well as the probability for a successful product is enormous. In the pharmaceutical sector 10 to 15 years of research and development are necessary, whereas in the crop protection sector only 2 to 4 years. The probabilities of success vary from 1 in 5000 to 1 in 10000 (ten Kate and Laird, 1999, p. 10). Income substitution for changing economic activities and refraining from biodiversity damaging actions have to be paid directly to be effective and not 15 years later. Otherwise, the benefit sharing will fail in instituting an incentive.

4.3. Political and legal security in provider countries

The political and legal security in a country is closely connected with the allocation of property rights. The absence of or the uncertainty about ownership creates difficulties in obtaining PIC, in negotiating about ABS, and in concluding contracts and raises the transaction costs of a bioprospector. For example, by approving an ABS contract bioprospectors receive exclusive rights for a special region and a

certain period of time in return for some compensation. If the company distrusts the legal security in a country it will react with country substitution and move to a country with a transparent regulation or without any access legislation (Richerzhagen and Virchow, 2003).

4.4. Information asymmetry concerning the behavior of the investor

For provider countries it is important to ensure that in return for access to biological material, companies fulfill their obligations regarding the obtaining of material, liability, and payments (Reid et al., 1993a,b, p. 38). The possibilities of national regulations are very limited though, as patents will generally not be issued in the provider countries. As a result of bad experiences bioprospecting has got a bad image resulting in a low acceptance within the provider countries or non-governmental organizations in industrialized countries. “Biopiracy” is the expression often used to describe the illegal obtaining of biological material. In many countries environmental and indigenous groups object to the implementation of the ABS concept, because they feel that PIC and a fair and equitable benefit sharing is not ensured by the present legal and policy environment (A Laird and ten Kate, 2001, p. 243). It is mainly criticized that the CBD promotes IPRs as basic elements of benefit sharing, while indigenous rights and traditional knowledge, often inputs for biotechnological innovations, are not protected. They propose the introduction of an additional property rights system (sui generis rights system), for example intellectual community rights, which will give communities the opportunity to protect their resources and knowledge.

The missing control mechanisms can also result in over-regulation in the form of very restricted access. The providers are unable to observe the actions of the user as soon as he has left the country with the collected samples of genetic resources. It is possible that at this stage the user does not comply with the agreement and uses the obtained samples for different purposes or pass the material on to a third party without informing the provider. Potential benefits can get lost (Richerzhagen and Virchow, 2003, p. 16). Bad experiences or worries of the provider countries can lead to very strict and complicated over-regulation,

making access almost impossible (Richerzhagen and Virchow, 2003).

A strict legislation may negatively affect the research in the own country (local universities and research institutions) and prompt foreign interested parties to move their investigations to another country with a bioprospecting-friendly climate. An internationally implemented obligation to provide a certificate of the country of origin and the proof of prior informed consent in the patenting process can be a possible control mechanism and supersede over-regulation. Similarly, on the national level an appropriate access regime regulating but not restricting access and ensuring legal security is needed for a bioprospecting-friendly climate.

4.5. Administrative complexity

Institutional capability is a major condition for an effective ABS regime and can be a weak point especially in developing countries. Competent, multi-functional institutions are required to design and allocate rights, manage conservation areas, coordinate activities, negotiate, control, and sanction in the area of bioprospecting. In most cases such institutions do not exist so that adequate funding is needed for their establishment. For many countries the realization of an ABS regime is a challenge and aligned with high costs and transaction costs arising for instance from the additional need for consultation, work, employing extra staff, and creating of institutions. (Liebig et al., 2002, p. 72) The implementation of the CBD, which affects many different areas, requires legal and technical capacity. The concern of provider countries of not being able to cope with the complex ABS issue can also result in an over-regulation of ABS (Richerzhagen and Virchow, 2003, p. 16). Many companies regard ABS legislations in some countries as unclear, bureaucratic, time consuming, and expensive to comply with and intend to relocate their research activities (ten Kate and A Laird, 1999, p. 7). The Bonn Guidelines (2001) were adopted by the members of the CBD as an instrument to guide both providers and user through the ABS process. They stress the importance of a national focal to inform applicants about the specific ABS procedure (Bonn Guidelines, 2001, p. 16). Meanwhile, more than 50 countries are in the process of developing and

implementing laws and policies on the subject (UNU, 2003, p. 15).

4.6. Market structure

The bioprospecting market is characterized by a diverse structure. The market is dominated by a small number of large buyers and can thus be described as an oligopsonistic competition. In the past years mergers between agro-chemical, agro-seed, and pharmaceutical firms have created large, global life science companies and strengthened their position in the market (Braga, 1996, p. 360). Apart from these companies, a large number of small biotech firms exist in the market, but their influence seems to be limited. There is a growing tendency of large, established pharmaceutical, agricultural, and other life science companies cooperating with smaller, start-up biotechnology research companies. Through this arrangement large companies receive the innovative research critical to the development of new products. They then use their financial and technological capacity to manufacture and market the products. This in turn allows biotechnology research companies to receive additional revenues for funding expensive research efforts (Hill, 1999). Due to this relationship, large life science companies still dominate the market for genetic resources. These developments increase the bargaining position of users and also point to another category of problems: it is essential though perhaps difficult to keep track of the movement of genetic resources between users, otherwise the fair and equitable benefit sharing cannot be ensured.

Due to evolutionary migration in many regions genetic resources are very similar in neighboring countries. Companies can always threaten to move their research activities to another country. In addition, companies often have better negotiation skills and legal assistance supporting them in the ABS negotiations than provider countries. This results in an unbalanced bargaining process.

The existence of ex-situ collections is also an important issue for the benefit sharing. If material has been stored for a long time, it can often be very difficult to define the country of origin and the potential recipient of shared benefits. According to the CBD genetic materials acquired before the entry into force of the convention are excluded from the

ABS regulations (CBD art. 15.3), but the onus is on governments to introduce such regulations. Even though some material from ex-situ collections is only accessible through Material Transfer Agreements (MAT) which provide a basis for tracking the transfer of the material and regulate the issue of benefit sharing, the majority of material can still be accessed without any commitments to share benefits due to weak implementation of access and benefit sharing regulations. Access and benefit sharing for certain crop genetic resources have been introduced since 2001 and are regulated by the FAO's International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGR), which establishes a multilateral benefit sharing system that comes into force June 2004. The CBD regulations apply to the remaining ones.

5. The case of Costa Rica

The regulations in Costa Rica have been taken as an example to provide an insight into an existing ABS regime. Costa Rica is not only chosen due to its popularity (it is probably one of the most studied ABS cases) but at the same time, it is the most advanced, transparent, and experienced one. Even before the adoption of the CBD in 1992, Costa Rica and INBio closed bioprospecting contracts with companies. The country implemented the CBD by the comprehensive Law of Biodiversity in 1998. Many years before it established a quasi ABS regime which is still in practice. In Costa Rica, the concept of ABS seems to work well. The environmental situation has improved due to the expansion of protected areas, the removal of perverse incentives against conservation, and the implementation of conservation measures. Since the late 90s Costa Rica's biodiversity conservation policy focuses even more on the sustainable utilization of biodiversity as a way to promote its conservation. In addition to bioprospecting, ecotourism and payment programs for environmental services are established as instruments for internalizing the cost of providing environmental services and mainly biodiversity. Bioprospecting and INBio's work are part of a strategy embedded in a bunch of measures striving for biodiversity conservation.

It is assumed that the sustainable utilization of biodiversity is already making significant contribu-

tions to the social and economic development in Costa Rica in several ways. Costa Rica's popularity accruing from the bioprospecting contracts affects other economic activities including nature-oriented tourism. INBio developed itself to be an outstanding research institution with high scientific and technological capacity in Central America. The national university also benefits from the work of the institution. Successful partnerships with local enterprises in the agro-industrial area developed through Costa Rica's bioprospecting program have created jobs and also benefited the local level through the development of new products for the local market.

For instance, the corporation between the National Biodiversity Institute (INBio), the British Technology Group (BTG), and Ecos La Pacifica aims at producing a nematicide for tropical crops. The nematicidal activity (DMDP) comes from a tree in the Costa Rican dry tropical forest. It is expected that a product will enter the market soon. BTG has paid a small amount of money to both INBio and Ecos for the licensing of a patent related to the DMDP use (Cabrera Medaglia, 2002, p. 20).

INBio's cooperation with international companies supported its scientific and technological capacity and is a prerequisite for the realization of such projects. Through funds from the Inter-American Development Bank, small local enterprises, using biological material as production inputs are able to initiate low-cost projects for the local market, requiring relatively simple technologies and limited time of development. Contrary to the projects carried out with large international corporations, these small and simpler projects, while not totally completed yet, are already considered to be successful initiatives, likely to make contributions in terms of profit, employment, and more value-added agro-industrial developments (Gámez, 2003, p. 10).

We will now evaluate the case of Costa Rica by using the critical factors identified above. We will ask whether the specifications of these factors in the Costa Rican case can explain its success. Our data are based on expert interviews, conducted in Costa Rica in November and December 2002. Twenty-five experts were interviewed, who represent the variety of stakeholders, including individuals, communities, government, universities, NGOs, scientific institutions, and industry involved in the ABS process or having

expertise related to the ABS issue. ‘Stakeholders’ are defined here as persons who are affected by or who have an influence on ABS regulations in Costa Rica. In this research semi-structured interviews were used as the method of gathering and analyzing qualitative data. Throughout the interviewing process different thematic areas in line with the identified critical factors were addressed.

5.1. Access and benefit sharing in Costa Rica

5.1.1. State of biodiversity

The tropical zones of the American continent contain more species than other tropical regions of the world and many more species than the temperate and cold zones. Costa Rica covers 51,100 km² of the world’s terrestrial surface, representing only 0.03% of the global territory, but it is considered as one of the most diverse regions and identified as a biodiversity hotspot (Myers et al., 2000, p. 855). According to estimations, 4% of all living species are found there. During the 70s and 80s, a series of reports predicted that based on the actual deforestation rate, Costa Rica’s productive forests would vanish before the end of the century. The first undertaking to conserve its rich biological heritage was the introduction of protection measures. Since 1970, the country has dedicated 25% of the national territory to conservation (Castro-Salazar and Arias-Murillo, 1998, p. 5). The second response was the creation of the technical, institutional, and financial structure for a system of incentives and payments of environmental services. Costa Rica developed a diverse strategy to conserve forest areas and biodiversity with international and national support and bioprospecting played an important part within this strategy. The country managed to stop the ongoing decline of forests and biodiversity and even reverse it. After years of high deforestation rates during the period 1987–1997 a net gain in forest cover of 5857 hectares per year was recorded. In 1997, Costa Rica had the same percentage of forest cover as 20 years before (Castro-Salazar and Arias-Murillo, 1998, p. 15).

5.1.2. Regulatory environment: legal and institutional setting

The country’s stable socio-political climate has also been favorable for those developments. Costa

Rica is one of the most stable and robust democracies in Latin America, with a long-standing commitment to economic growth and substantial advancement in social indicators (Gámez et al., 1993, p. 54).

With the establishment of the Ministry of Natural Resources and Energy and Mines (MINAE) in 1986, Costa Rica’s environmental issues entered daily policy. The new ministry developed new administrative, financial, and institutional procedures. For instance, it took over and decentralized the administration of protected land with the new National System of Conserved Areas (SINAC) and removed perverse incentives, for instance the Forest Payment Title, a subsidy to promote reforestation, which allowed landowners to make money twice, at first by cutting and selling primary forest, secondly by reforesting the open areas (Miranda et al., 2002, p. 5). Furthermore, it designed the National Conservation Strategy for Sustainable Development in Costa Rica and came up with new innovative financing mechanisms for conservation activities (Gámez et al., 1993, p. 55).

In 1989, the National Institute for Biodiversity (INBio) was created as a private, but non-profit institution to coordinate the different activities of universities, private organizations, and government and to become a national focal point in the field of biodiversity. The institute’s mission is to raise awareness of the value of biodiversity and thereby promote its conservation and economic development in Costa Rica. INBio’s different programs such as the biodiversity inventory, search for sustainable uses, accumulation of information, and dissemination of knowledge, complement one another and help to document the state of Costa Rica’s biodiversity and to identify bioprospecting potential.

Except for some initial funding, INBio is a self-supporting institution allowed to receive grants and enjoying tax-free status but responsible for its own funds and personnel. In 2001, the bioprospecting budget represented 11% of the total institutional budget having fluctuated between 11 and 17% in previous years (Gámez, 2003, p. 8). A cooperation agreement concluded between MINAE and INBio provides the legal framework for all of the institute’s inventory and bioprospecting activities. Authorized through single research permits, INBio collects samples for its own inventory and bioprospecting

divisions or interested parties. Based on this agreement, INBio bioprospects only within the country's protected wild areas. Monetary benefits, arising are shared with MINAE (ex ante 10% of the research budget and ex post 50% of any further royalties or milestone payments from bioprospecting contracts), and are used for the support of the management and the protection of conservation areas (MINAE, 1994, *Clausulas 12*; Sittenfeld and Lovejoy, 1999, p. 95).

Until the adoption of the Biodiversity Law, INBio worked based on an agreement with the ministry and concluded more than 20 investigation contracts with many life science companies, international research institutions, and universities in the meantime. At the request of companies the concrete contractual contents according to royalties are not published. Taking the number of contracts with estimated royalty percentage as an indicator for expectable benefits contracts – the more contracts the more research and the higher the possibility of discovering a substance for commercialization – the result turns out relatively satisfactory. By receiving an eventual royalty payment of 1 to 5% for one highly successful drug Costa Rica could generate as much national net income during the life of the patent as a major crop does (Sittenfeld and Gámez, 1993, p. 75).

Only in 1998 Costa Rica implemented the CBD by the Law of Biodiversity, No. 7788. Before that date ABS was regulated in the framework of the Law of Wildlife Conservation and corresponding regulations and actually still is. It is obvious that the experiences with INBio which attracted worldwide attention had a decisive influence on the CBD. Nevertheless, the new Biodiversity Law will introduce new procedures and institutions. Regulating the use and management of biodiversity, associated knowledge, institutional authorities, the basic requirements, and procedure for ABS and IPRs, the new law offers the basic framework for access permits and bioprospecting contracts. It establishes the National Commission for the Management of Biodiversity (CONAGEBIO) as the responsible institution for ABS and defines its functions. CONAGEBIO is an intersectoral coordination body. It consists of ministers or representatives from the ministry of Environment and Energy, Agriculture, Health and Foreign Trade, the Institute for Agricultural and Fishing, the Small Farmers Board, the Indigenous People Board, the National

Council of Rectors, the Federation for the Conservation of the environment, and the Union of Chambers of Commerce. The national law and especially the ABS part are completed via a by-law, having still a draft status. In addition, the implementation process was delayed due to a claim of unconstitutionality concerning the extensive competencies of CONAGEBIO. Recently, the commission has been appointed. Up to now, bioprospecting in Costa Rica is only regulated by the Law of Wildlife Conservation and the MINAE-INBio agreement.

5.2. *Evaluation of the critical factors in Costa Rica's ABS*

5.2.1. *Assigning property rights and intellectual property rights*

Costa Rica has implemented the sovereignty principle as follows: the Biodiversity Law applies to all components of biodiversity found under the state's sovereignty, as well as to the processes and activities carried out under its jurisdiction or control (Ley de Biodiversidad art. 3); biochemical and genetic properties of components of biodiversity within the Costa Rican territory belong to the public domain, but the state has the responsibility to authorize the exploration, research, bioprospecting, and use (Ley de Biodiversidad art. 6). In this way, a second property right regime is created in addition to the private property for the tangible biological material which can be held by the landowner (individuals, communities, state). This second regime for the genetic and biochemical information of the resources is held by the public domain and executed by the state or the commission.

But even if the state has the authority over biodiversity according to the Biodiversity Law, an important part of the benefits (apart from other benefits at least 10% of the research budget, 50% of later bonuses) flow back to the National System of Conservation Areas, indigenous communities, or to the private owner depending on the land property rights. Thus, by establishing a benefit sharing scheme allowing those economic agents who decide over the use of the biological resources to participate in the benefits, conservation incentives are instituted.

Until now bioprospecting has only been undertaken in conservation areas on state property, thus property rights are defined and assigned. The majority of

protected areas in Costa Rica especially the areas, where bioprospecting takes place, are scarcely inhabited. Consequently, the PIC is granted by the state. At the same time, mainly the government benefited from the bioprospecting activities and channeled the benefits directly to the conservation areas. The distribution of the benefits arising out of INBio's contracts is transparent. Between 1991 and 2000 the total amount of 512,148 US\$ has been received by MINAE due to the 10% research budget regulation and 790,649 US\$ directly by the conservation areas (Cabrera Medaglia, 2002, p. 25). But compared to revenues gained by selected agricultural and forest products and tourism, this contribution is small. The foreign exchange generated during the same period (1991–2000) by timber was 2,613,000 US\$ by bananas 57,051,000, by coffee 32,659,000 US\$, and by tourism, one of the most important economic activities of the country, 71,986,000 US\$ (Gámez, 2003, p. 3).

Costa Rica is a member of the WTO and therefore is obliged to implement IPR protection to comply with the TRIPs agreement. By its very wide scope the Biodiversity Law takes up Costa Rica's TRIPs obligations in the area of biodiversity. Apart from the issues directly connected with biodiversity conservation, it addresses IPR issues very explicitly, especially the scope of application. Before granting some kind of IPR for biodiversity components the "National Seed Office" and "Registers of Intellectual and Industrial Property" have to consult the technical office of CONAGEBIO and provide a certificate of origin and prior informed consent in order to ensure exceptions of patentability (DNA sequences, plants and animals, not genetic modified micro-organisms, etc.). The objection of the technical office forecloses the registration of patent or another IPR (Ley de Biodiversidad art. 80). With the exception of the IPR law of the Andean Community (Decision 486, Art. 26h) neither international nor other national IPR laws require such a certificate. Thus, the control and prevention mechanism only takes effect in Costa Rica and not in important locations as the European Union or the United States of America.

According to the contractual commitments Costa Rica and INBio as providers usually do not participate in a patent, because they are not regarded as inventors of the final product. If INBio contributes to the invention, a joint patent is possible, but this has not

yet been the case. Through PIC and benefit sharing, the contributions of the country and the biodiversity institute are considered and acknowledged.

ABS is more or less accepted in Costa Rica as the implementation of international obligations. Nevertheless, there exists environmental, farmer, and indigenous groups objecting the concept. Most of the groups do not try to prevent bioprospecting but try to increase their influence and realize their ideas through the participation in CONAGEBIO or as observers and consultants during the negotiations about the drafted by-law for ABS. The new by-law will guarantee the participation of the local level by establishing clear regulation on access application and benefit sharing.

Costa Rica established property rights on all levels of stakeholders, thus allowing rent capture from the commercialization of genetic resources and institutes conservation incentives. By assigning rights and realizing participation in the Costa Rican case, the critical factor of property rights assignment is positively addressed.

5.2.2. *Accounting for time lags*

The bioprospecting contracts, which INBio have negotiated, include regulations for milestone payments and royalties, but apart from minor up-front payments, no monetary benefits have been received by Costa Rica or INBio so far. In the years 1991 to 2000 the total contributions of bioprospecting activities to biodiversity conservation and education add up to US\$ 2,768,407. For a 10 year period the monetary contributions, raised out of direct payments, payments for specific samples, and the coverage of research budgets, are relative small. Due to the long and insecure development, until now no product has reached the market and no royalties have been paid, but there are some products under development, especially related to herbal areas (Cabrera Medaglia, 2002, p. 19). Consequently, the substantial part of benefits in form of future royalties and milestone payments is still waited for. Around 50% of the total revenues of bioprospecting activities went directly to the conservation areas; the rest has been received by groups within INBio and national public universities. Until now, non-monetary benefits dominate the ABS process, playing a major role for sustainable development. Costa Rica and INBio benefited in different

ways. Transfer of important technology has improved the infrastructure within INBio and public universities and enables the institute to do research and develop own products or at least more processed, value-added samples. The biodiversity inventory has been expanded by the collected material financed by bioprospecting partners. Scientists and technicians could build up scientific capacity in relation to state-of-the-art technologies, joint research, and received acknowledgement in publications. INBio and Costa Rica benefit through development of negotiation expertise and spill-over effects on other economic activities like ecotourism and improvement of local legislation according to conservation issues (Cabrera Medaglia, 2002, p. 26).

In monetary terms, time lags remain a problem, even if milestone payments are planned. These payments are relatively small. The main benefits accruing to the country without any delay are non-monetary benefits, especially concerning the research capacity. For Costa Rica this fact is acceptable, as management of biodiversity is placed in the hands of the state, the dominant land-owner of collection sites. But it shows that even in this relatively successful case payments would rarely be able to change the decision of local agents.

5.2.3. *Political and legal security in supplier countries*

There is a relatively high interest of international companies or research institutions to bioprospect in Costa Rica and the country seems to be very attractive for bioprospecting. Costa Rica and INBio have concluded many more contracts than other countries. Legal security provided in the country and by the biodiversity institute is an important reason for companies to choose this research location and partner (Cabrera Medaglia, 2002, p. 37). The legal security guarantees that contractual commitments are fulfilled by the Costa Rican partner. By offering a stable democratic, political system, Costa Rica is a very interesting partner for bioprospecting activities. The country has a comprehensive Biodiversity Law and developed a by-law for ABS recently, ensuring the legal framework for ABS.

INBio is not the only intermediary in Costa Rica bioprospecting and assisting interested party. Private persons as well as other organizations try to work in this field, but not on the same scale as INBio does.

These intermediaries do not have an agreement with MINAE, so their activities take place in a grey area. No significant number of contracts has been concluded with those intermediaries, supporting the argument that missing legal security deters companies from undertaking bioprospecting activities.

Political and legal security is one point explaining the high number of bioprospecting contracts with Costa Rica. Beside the political stability not too often found in biodiversity-rich countries it is the clear cut legislation concerning INBio that seems to be valued highly by companies.

5.2.4. *Information asymmetry concerning the behavior of the investor*

Costa Rica tried to protect itself against biopiracy quite early. Interested parties do not collect bioprospecting material; they receive it directly from INBio. The bioprospecting contracts are concluded for a certain amount of samples from specified areas. INBio keeps an identical sample in its inventory and delivers the material coded. If the contractual partner is interested in more of the collected material they have to turn to INBio. By this way INBio keeps important information about the material and controls its export. The new Biodiversity Law also regulates the patenting process for bio-products in Costa-Rica. The provision of a PIC certificate is an obligation within the patent application process. Thus the legal origin of the biological material used for the patent is guaranteed. This does not hinder patenting with illegal material outside Costa Rica though. The only asset Costa Rica has in this respect is the interest of companies to continue cooperation with INBio.

5.2.5. *Administrative complexity*

INBio was founded with international support and with the objective to support the country's responsibilities in the area of biodiversity inventory, search for sustainable uses, accumulation of information, and dissemination of knowledge. The biodiversity institute is the national focal point for bioprospecting. This leads to short timeframes for the negotiations of contracts and thus lowers the transaction costs for companies. Within 1 year a bioprospecting contract can be concluded with INBio, in other countries this process takes much longer (see for example Liebig et al., 2002, p. 42 on the Philippines). The experiences

seem to prove that a specialized probably private, but non-profit organization is in a better position to fulfill this function in an efficient manner especially related to the process of applying for access than governmental institutions. The Biodiversity Institute is not part of the complex governmental administration, but operates as a consultant in biodiversity issues. The condition of not being a profit organization prevents INBio from abusing its standing out position related to bioprospecting. By forming an independent institution with expertise in the decisive fields and embedded in a stable political system Costa Rica succeeds in getting a leading position in bioprospecting.

The expected changes in processing by the creation of CONAGEBIO as the new governmental national focal point related to biodiversity policy and management are evaluated differently. The demand side is very content with the existing regulations. Even if the Biodiversity Law is advertised by some experts as the most ambitious and elaborate national law of its kind, bioprospectors and intermediaries assume that the new regulation will complicate the application and execution process and that the competitive advantage of Costa Rica in the bioprospecting market will vanish. Under the new by-law INBio can still work as an intermediary, but CONAGEBIO also participates in and supervises the negotiations with the bioprospectors and approve the MAT and PIC. The composition of CONAGEBIO representing the major concerned stakeholders can lead to longer negotiations and decision-making processes due to differences in opinions. The transaction costs on both the provider and the user side are expected to increase, which will restrict the efficiency of ABS.

It seems that the construction of one independent agency was one of the assets for Costa Rica. The resulting short decision processes were especially interesting for the demand side. The new processes will presumably be more time-consuming, integrating the interests of different stakeholders that formerly remained outside the process. This could result in fewer contracts and there exist doubts about whether the net benefits staying in Costa Rica will increase.

5.2.6. Market structure

In principle the bargaining position of Costa Rica is relatively weak due to the oligopsonistic competition. Despite the ongoing loss of biodiversity the total

supply of diverse genetic material still satisfies the demand. It is still easy to obtain samples. In many countries the access is not regulated and free to obtain. Therefore, the degree of competition among buyers is much lower than on the supplier side. The diverse biological resources within the mesoamerican biological corridor from Mexico to Colombia are similar and an interested company is able to substitute one country for another. In fact INBio and Costa Rica succeeded in attracting many interested parties, more than any other country within the mesoamerican biological corridor even though there was unregulated access in competing countries. This success can be ascribed to the scientific capacity of INBio, the National System of Conserved Areas, and other institutions (for example the Organization of Tropical Studies) which is a result of a long-time research by international biodiversity scientists in the country and the transfer of technology, knowledge, and human capacity.

As transaction costs are much lower in Costa Rica than in other countries firms have a great interest in bioprospecting in Costa Rica and INBio's bargaining position is considerably improved. By working successfully and reliably in this field for more than 10 years INBio gained experiences and developed procedures, resulting in long-lasting partnerships with industry and research institutions.

Since 2002 a group of megadiverse countries has been established with Costa Rica as one of its members. The group was formed as a mechanism of consultation and cooperation to promote common interests related to the conservation and sustainable use of biodiversity. It can be expected that such a coalition will strengthen the market position of supplier countries. But the bargaining position is still weakened by the existence of ex-situ collections. Within Costa Rica the Biodiversity Law applies and bioprospecting samples, existing in situ or ex situ, can only be obtained through an access permit. But the access to ex-situ collections in other countries and the access to material stored pre-CBD adoption are not regulated and companies still can recourse to these collections. This selection is limited though and the expectations of finding promising genetic material within these collections are not as high as from samples, obtained from in-situ sites or ex-situ collections, created after the adoption of the CBD.

Hence, industry continues to have a high interest in bioprospecting contracts.

6. Conclusions

Costa Rica is generally taken as an example for a relatively successful strategy of access and benefit sharing. The number of contracts with companies in the life science industry is high and there are considerable non-monetary benefits accruing to Costa Rica. The ecological data on Costa Rica also show a favorable development. The monetary benefits are small though. This is one important indicator for the fact that the ecological success in Costa Rica is not only and perhaps not even mainly due to the commercialization of biodiversity associated with bioprospecting. In Costa Rica this is only part of a comprehensive strategy. Nevertheless, there are reasons to take Costa Rica as a model country for designing ABS procedures. Many of the critical factors analyzed in this paper are handled in an outstanding way. With the introduction of one single authority in the bioprospecting process Costa Rica lowered transaction costs (in contract preparation and enforcement) for demanding companies thus greatly improving its bargaining position. The bioprospecting procedure alleviates the country's informational deficiencies about the use of the biological material and thus its own enforcement costs. INBio as the agent being responsible for the management of biodiversity in the country is also in charge of the bioprospecting process. In this respect incentives are set correctly.

It has to be acknowledged though that this happened in a very favorable environment. Political stability greatly helped INBio to win its good reputation for bioprospecting. Costa Rica is a small and not too densely populated country. Property rights over the biological resources are defined and assigned. This all helped in designing an efficient institutional setting. But there are problems not yet solved in the Costa Rican case. Payments come late and they are insecure. The efficient decision process goes together with little influence of other stakeholders. Here it is the status of INBio as a non-profit and non-governmental organization that may help gain acceptance with stakeholders not formally participating in the bargaining-process.

In conclusion it seems that by the establishment of an intermediate organization as INBio, providing technical and scientific capacity and assisting partners in bioprospecting activities, countries can greatly enhance their chances to participate in the benefits of bioprospecting. This may help to change the attitude towards the sustainable use of natural resources and thus have a positive impact on the ecological situation. It should not be hoped though that with future and insecure payments ABS alone can hinder deforestation processes. A comprehensive strategy is the minimum requirement to make any progress in this field.

In many countries the situation related to ABS is not as favorable as the one in Costa Rica. However other countries should take into consideration the experiences of Costa Rica especially related to institution building when drafting and implementing an ABS regime. In the international context especially industrialized nations have to acknowledge provider countries' interests in the patenting process. In this way the most favorable conditions for an effective ABS regime can be created to the benefit of provider countries as well as of industrialized nations.

Acknowledgment

We thank the "Schaumann Foundation" for financial support of this research. We also thank the numerous officials from governmental, scientific, academic, and non-governmental organizations who provided timely and invaluable information for this project and three anonymous reviewers for helpful comments.

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