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Biodiversity conservation: How can the regulation of bioprospecting under the Nagoya Protocol make a difference?

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THE REGULATION OF BIOPROSPECTING: WHAT IS IT? AND WHY IS IT IMPORTANT?

The need to protect biodiversity and to promote fairness in the use of genetic resources and associated traditional knowledge has engendered one of the most contentious debates of the 21st century between developed and developing countries. This debate has fundamental implications for the way in which basic and applied research on genetic resources and biodiversity is conducted and its results are made available between and within peoples and societies. Therefore, the regulation of bioprospecting –i.e. "the search for plant and animal species from which medicinal drugs and other commercially valuable compounds can be obtained"– not only tells stories about biodiversity conservation, but also about food security, global health, intellectual property, indigenous peoples, equity, justice and human rights.

NEW PERSPECTIVES: BIOPROSPECTING CONTRACTS AS MARKET-BASED INSTRUMENTS

In a context of financial constraint, MBIs are seen as a potential tool to help foster biodiversity conservation. As private contracts between two (or more) parties (theoretically Coasean agreements), bioprospecting contracts could be more efficient than command-and-control regulations aimed at biodiversity conservation. Aiming to regulate bioprospecting, the Nagoya Protocol on Access to Genetic Resources and Benefit Sharing (ABS), adopted in 2010, should help to stop the misappropriation of genetic resources and associated traditional knowledge (known as 'biopiracy'), while providing legal certainty for public and private users of such resources.

MONETARY AND NON-MONETARY BENEFITS, AND BIODIVERSITY CONSERVATION

The appropriate regulation of bioprospecting activities holds potential for generating additional resources and incentives for biodiversity conservation, including at the local level, which could counterbalance the monetary gains arising from activities degrading biodiversity. However, the total value arising from the utilization of genetic resources through bioprospecting can be relatively low and uncertain, with important differences between sectors. Thus, its conservation potential might be limited, though not entirely negligible. Key ABS-related drivers in the interest of biodiversity conservation include: decreasing transaction costs through model contracts; increasing the bargaining power of Southern countries and stakeholders through capacity development; the application of ABS-related certification standards in BioTrade; and the recognition of the rights of indigenous and local communities.

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LIST OF ACRONYMS

ABNJ	areas beyond national jurisdiction
ABS	access to genetic resources and benefit sharing
ALBA	Bolivarian Alliance for the Peoples of Our America
CBD	Convention on Biological Diversity
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture
COP	Conference of the Parties to the Convention on Biological Diversity
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
ICNP	Intergovernmental Committee for the Nagoya Protocol
IFM	innovative financial mechanism
ILCs	Indigenous local communities
IP	intellectual property
IPR	intellectual property rights
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
IUCN	International Union for the Conservation of Nature
LMMC	like-minded megadiverse countries
MA	Millennium Ecosystem Assessment
MAT	mutually agreed terms
MBIs	market-based instruments
MGR	marine genetic resources
MLS	Multilateral System of Access and Benefit Sharing of the ITPGRFA
NGO	non-governmental organisation
ODA	overseas development assistance
PCT	Patent Cooperation Treaty
PGRFA	plant genetic resources for food and agriculture
PIC	prior informed consent
PVP	plant variety protection
SMTA	Standard Material Transfer Agreement
TK	traditional knowledge
TRIPS Agreement	Agreement on Trade-Related Aspects of Intellectual Property Rights of The WTO
UEBT	Union for Ethical BioTrade
UNCTAD	United Nations Conference on Trade and Development
UPOV	Union internationale pour la protection des obtentions végétales (International Union for the Protection of New Varieties of Plants)
USPTO	United States Patent and Trademark Office
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

1. INTRODUCTION: CONTEXT AND RESEARCH QUESTION

1.1. The rapid loss of biodiversity…

Biological diversity is defined by the UN Convention on Biological Diversity (CBD) as "the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."[1] Therefore, in essence, biological diversity underpins all life on earth. However, due to anthropogenic causes, such diversity is in danger of erosion and extinction more than ever before.

The Millennium Ecosystem Assessment [(MA)] (2005) shows that degradation of biodiversity is still very significant: over half of the 14 biomes that the MA assessed have experienced a 20–50% conversion to human use between 1960 and 2000. Similarly, according to WWF in its Living Planet Report (WWF, 2012), the Living Planet Index, based on trends in the size of 9,014 populations of 2,688 species of birds, mammals, amphibians, reptiles and fish has globally declined 28% from 1970 to 2008, especially in tropical areas (61%), where most poor people reside. This eventually led the UN Millennium Development Goals Report 2010 (UNDESA, 2010) to recognize unequivocally that "the world has missed the 2010 target for biodiversity conservation, with potentially grave consequences" (Billé *et al.*, 2012a).

1. CBD Article 2.

1.2. … needs to be tackled in a context of financial crisis and decreasing overseas development assistance (ODA)

The 11th Conference of the Parties (COP) to the Convention on Biological Diversity (CBD), which was held from 8 to 19 October in Hyderabad (India), was presented as a return to normalcy (Billé *et al.*, 2012b) after the somewhat unusual publicity surrounding the previous conference in Nagoya in 2010 (IDDRI, 2012). If it was presented by some as a success (which is debatable), this was primarily because of the last minute agreement reached on the weakest component of the Nagoya deal: the Strategy for Resource Mobilization. This Strategy was adopted at the 10th COP in Nagoya in 2010, and is directly connected to the Strategic Plan for 2011-2020 and its 20 "Aichi Targets". During COP 11 negotiations, developing countries have shown high expectations that the commitment to increase funding for meeting the 20 Aichi biodiversity targets be taken by developed countries (especially through ODA). While some funding needs' estimations are already available—e.g. the US$ 15 to 38 billion per year for the developing countries and countries with economies in transition (155 countries) (CBD, 2012a),—these are rough estimates, which fully acknowledge the presence of complex methodological challenges. Besides, estimates of biodiversity-related funding needs were supposed to be provided by CBD Parties, but only a few of them had actually submitted their estimates before the COP.

Eventually, it was agreed that international financial flows for biodiversity protection would be doubled by 2015 relative to the 2006-2010 average. In an economic context that is increasingly challenging for most traditional donors, a controversial issue is the optimal share of "innovative financial mechanisms" that will have to be devised in

order to increase the potential contribution of the private sector to biodiversity conservation. However, under the pressure of the countries of the Bolivarian Alliance for the Peoples of Our America (ALBA), this debate has so far resulted in the "black-listing" of possible references to "markets" (CBD, 2012b). Against this backdrop, the need for increased conservation funding has brought actors to discuss the relevance of "innovative financial mechanisms" (IFMs), which is another way to discuss market-based instruments (MBIs) for biodiversity conservation.[2]

Indeed, command-and-control policies are often assumed to have largely failed to protect biodiversity because monitoring is very costly and States' capacity to do so is limited (Turner and Hulme, 1997). On the contrary, the necessity to value biodiversity with the view to providing incentives for its conservation is increasingly recognized. As Myers and Reichert (1997; p. XIX) put it, "we don't conserve what we don't value." As we shall see below, giving a value could indeed both leverage more private money for biodiversity conservation and provide private investors with right incentives to conserve valuable resources. It is in this context that many countries and international institutions have called for the emergence of IFMs, based on market-based instruments. For example, Article 8.32 of the Agenda 21 states that:

> Governments should consider gradually *building on experience with economic instruments and market mechanisms by undertaking to reorient their policies*, keeping in mind national plans, priorities and objectives, in order to: (a) establish effective combinations of economic, regulatory and voluntary (self-regulatory) approaches; […] (d) *establish a policy framework that encourages the creation of new markets* in pollution control and environmentally sounder resource management; [and] (e) move towards pricing consistent with sustainable development objectives. (*Emphasis added*)

Building on the above, Europe is very strong in its support for these instruments as it is reflected in key policy documents. For instance, the Green paper on market-based instruments for environment and related policy purposes (EC, 2007) notes that "the EU has increasingly favoured economic or market-based instruments—such as indirect taxation, targeted subsidies or tradable emission rights." Another example is the EU Biodiversity Strategy to 2020, which states that "[Europe] will promote the development and use of innovative financing mechanisms, including market-based instruments" (EC, 2011). At the international scale, the OECD Report 2003, entitled "Harnessing Markets for Biodiversity" contends that "private markets show particular promise in the management of agriculture, forestry, and genetic resources" (OECD, 2003).

1.3. Bioprospecting and biodiversity conservation

In this context, bioprospecting contracting—hence bioprospecting activities through their contractual regulation[3]—can be considered as a tool that potentially contributes to reducing biodiversity loss by providing incentives for its conservation. This is at least the hypothesis that we endeavor to assess in this study.

Aiming to regulate bioprospecting activities and implement the third objective of the CBD (i.e. benefits sharing),[4] the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of the Benefits Arising from their Utilization (ABS) was adopted in Nagoya after eight years of negotiations. Opened for signature on February 2011, it has only been ratified by 18 countries as of 29th May 2013, whereas 50 ratifications are required for it to enter into force.

Central to the relations between countries of the "North" and the "South" within the CBD, this Protocol should help to stop the misappropriation of genetic resources and associated traditional knowledge (known as 'biopiracy'), while providing legal certainty for public and private users of such resources (Chiarolla, 2012). Ardently supported by the megadiverse countries (those endowed with very rich biological diversity) such as Brazil and India, the Nagoya Protocol provides an international framework to ensure that the benefits arising from

2. Whether market-based and economic instruments differ from one another is a question that is not considered in this paper. Both terms are often used indifferently to allude to the same concept: using transactions and exchanges of goods and services to provide incentives to make decisions that account for the non-market values.

3. While there is no legal definition of "bioprospecting" a working definition of this term may be necessary. The English Oxford dictionary defines bioprospecting as "the search for plant and animal species from which medicinal drugs and other commercially valuable compounds can be obtained." See: http://oxforddictionaries.com/definition/english/bioprospecting. Besides, a study by UNU-IAS highlights that: "A common distinction is made between scientific research undertaken for noncommercial purposes, also called 'pure scientific research', and commercially–orientated research, also called 'applied scientific research.' Bioprospecting […] could also be considered as a form of *applied scientific research*." Emphasis added. See Arico and Salpin (2005).

4. The CBD objectives are: 1) conservation of biological resources; 2) sustainable use of its components; and 3) fair and equitable sharing of the benefits arising from the utilization of genetic resources.

the use of genetic resources by industries and researchers are shared in a fair and equitable manner with the country providing such resources,[5] based on its prior informed consent and a contract (i.e. the mutually agreed terms).[6]

Historically, ABS issues are hotly debated between biodiversity-rich developing countries—often with the support of NGOs and grassroots groups that are vocal about the need to defend also the rights of Indigenous Local Communities (ILCs)—and developed countries whose discourses focus primarily on biodiversity conservation, and improving investment environments and incentive mechanisms.

Following the adoption of the Nagoya Protocol, this study considers the current evolution of the legal framework applicable to bioprospecting activities in the context of the ongoing trend towards the development of market-based instruments for biodiversity conservation. In particular, it aims at investigating the potential contribution of bioprospecting activities, and of the benefits arising thereof, to biodiversity conservation, in accordance with the CBD and its Nagoya Protocol.

This study first presents the potential role and advantages of different market-based instruments for biodiversity conservation (section 2). In this context, it shows that bioprospecting contracts can theoretically be characterized as a "Coasean agreement", which is a potentially efficient MBI to regulate bioprospecting activities and foster conservation (section 3). Thereafter, the study considers some interactions between bioprospecting legislation under the CBD and IPR protection of genetic resources. In particular, it focused on their respective implications for benefit sharing and biodiversity conservation, especially in light of the forthcoming entry into effect of the Nagoya Protocol on ABS. It further explains the key innovative features of the Nagoya Protocol and how they may improve existing ABS mechanisms with a focus on its links to biodiversity conservation (section 4). However, it also shows the limitations of such mechanisms, in particular, with the view to reducing biodiversity loss (section 5), and it highlights some possible solutions and ways forward (section 6). The study finally concludes by providing an assessment of the extent to which bioprospecting under the Nagoya Protocol may contribute to biodiversity conservation by providing for the recognition of enabling rights, and additional incentives and funding for such purpose (section 7).

2. THE EMERGENCE OF MARKET-BASED INSTRUMENTS (MBIs) FOR BIODIVERSITY

2.1. Three assumed strengths of MBIs: incentivization, better resource allocation, enhanced funding

Market-based instruments are most often alleged to exhibit three main advantages as compared with alternative instruments for biodiversity conservation that are based on prescriptive legislation. Such advantages provide three levels of justification to the former, namely: the provision of incentives for biodiversity conservation, a more optimal allocation of resources—or better efficiency, and their expected capacity to fill the biodiversity funding gap.

First, the theory of incentives refers to the fact that agents receive price signals and make decisions accordingly. Decisions are not imposed through coercive or prescriptive means, and agents have the opportunity to balance the costs and benefits of going one way or another. An optimum level is assumed to be easier to achieve due to the higher flexibility of incentives; in addition, incentives are considered more effective than coercion in inducing the right decisions by agents—especially in contexts with poor law enforcement. In other words, MBIs purportedly focus on achieving results through the self-interest of private entities (Jack *et al.*, 2008).

Second, MBIs allow buyers of ecosystem services to more efficiently find and choose providers with the greatest and most cost-effective contribution. Moreover, the market approach is temporally and spatially more flexible and allows biodiversity

5. In accordance with CBD Article 15, the Nagoya Protocol reiterates that, as a general rule, ABS shall be subject to the prior informed consent (PIC) of the provider country "*that is the country of origin of such resources or a Party that has acquired the genetic resources in accordance with the Convention, unless otherwise determined by that Party.*" See: Article 6.1 of the Nagoya Protocol. This formulation conveys the idea that the provider country shall be a "qualified" or "legitimate" provider. Therefore, the prior informed consent is the permission given by the competent national authority of a "legitimate" provider country to a user prior to accessing genetic resources, in accordance with the applicable national legal and institutional framework. See Chiarolla (2012).

6. The Protocol also reiterates that the "benefits arising from the utilization of genetic resources as well as subsequent applications and commercialization" shall be shared with the provider country "upon mutually agreed terms." Article 5.1 of the Nagoya Protocol. Therefore, mutually agreed terms (MAT) are the agreement reached between the provider of genetic resources and the user of such resources on their conditions of access and use, and on the benefits to be shared between both parties. See Chiarolla (2012).

projects to periodically adapt and change their geographical location based on locally changing ecosystem services' values and opportunity costs to produce services (Wissel and Wätzold, 2010).

Third, MBIs are alleged to be an innovative approach to fill the existing funding gap for biodiversity conservation. As already said, a "funding gap" between the cost of achieving the biodiversity conservation targets and the funding available has been identified, although the quantitative figures remain debated, and in this context the Strategy for Resource Mobilization was adopted and stipulate that Parties should "substantially increase resources […] from all sources, including innovative financial mechanisms". In other words, public funding is far from sufficient and new sources must be sought (Ring *et al.*, 2010).

Of course, such alleged advantages from MBIs cannot be analysed independently from more traditional approaches, such as protected areas. Policies and instruments for biodiversity conservation, either public, private or hybrid, should be seen as complementary rather than substitute, and should thus be designed and implemented in combination rather than competition. For conciseness reasons, we nevertheless focus here on MBIs and their potential for biodiversity conservation.

2.2. A diversity of market-based instruments (MBIs)

Based on alleged advantages analysed above, many so-called market instruments have been designed and implemented in the field of biodiversity conservation. While the wide spectrum of possible market-based mechanisms as well as the clarification and definition of the concept of MBIs are analyzed elsewhere (Pirard, 2012), this section provides an overview of categories of MBIs with the view to assessing where bioprospecting lies within the landscape of such instruments.

There are many ways to approach MBIs and their diversity, and many typologies are possible as long as the criteria for creating distinct categories are clearly stated. These typologies are complementary, and we decide to present here a very recent attempt by one of the authors. It is based on a theoretical reasoning that pays special attention to the economic characteristics—and the nature of the "market" that is considered for implementation—of various policy instruments labeled as MBIs in the literature and discourses.

Table 1 is intended to provide the reader with a sense of the diversity of approaches that are classified under the banner of MBIs. In this report, devoted to bioprospecting contracts, only one category is directly concerned as we will see in the next section. It means that bioprospecting contracting represents a specific way to rely on "markets" for the management of biodiversity resources.

Table 1. Categories of market-based instruments

Category	Description	Illustrations
Direct markets	A market where an environmental product is directly traded with the explicit intention to conserve or sustainably manage biodiversity	Non-timber forest products (NTFP), eco-tourism, argan oil
Tradable permits	An ad-hoc market designed to serve a clear environmental objective, where users of an environmental resource need to purchase "permits" (notion of policy-induced scarcity) that are exchanged among resource users	Mitigation banking, Individual Transferable Quotas for fisheries, tradable development rights for land
Auctions	A mechanism whereby candidates to ecosystem service provision set the level of payment as a result of competition. Usually part of governmental programs but also applied in local experiments	BushTender in Australia, Conservation Reserve Program in the US
Coasean-type agreements	Consists in contracts resulting from negotiations between a limited number of stakeholders to exchange rights in response to a common interest (ideally free of public intervention)	Direct payment schemes (payments for environmental services-PES), conservation easements, conservation concessions
Regulatory price changes	Consists in regulatory measures that lead to higher or lower relative prices or production costs, e.g. as part of a fiscal policy	Eco-tax, agro-environmental measures
Voluntary price signals	Consists in schemes whereby producers signal positive environmental impacts to consumers, and get price premiums and/or increased market shares	Forest certification, labels for organic agriculture, voluntary codes of conduct

Source: Pirard, 2012

3. BIOPROSPECTING FROM THE MARKET PERSPECTIVE: THE DESIGN OF COASEAN-TYPE AGREEMENT

3.1. Negotiated contracts with bilateral governance

Bioprospecting, under the current regime is best governed as a Coasean-type agreement (Simpson and Sedjo (1998a) and Lerch (1998); see category 4 in our typology, Table 1).

According to Coase (1960), the internalisation of negative (e.g. biodiversity erosion) or positive (social gains from private biodiversity

conservation) externalities is indeed most efficiently achieved by private bargaining among affected parties over the allocation of rights. By exchanging well-defined property rights and compensating for this exchange, actors can maximize the total value created.

Problems might arise in provision of genetic resource because provider countries and local resource stewards fail to account for social benefits from genetic resources (e.g. value added from pharmaceutical products) when taking their decisions about economic strategies (e.g. deforestation versus conservation); indeed, without clear property rights over the scientific and commercial use of genetic resources, they cannot be compensated for the cost of conserving these. As a result, local communities without clear rights only compare the costs of conserving a certain stock of genetic resources (the foregone economic opportunities of intensive agriculture or tropical deforestation and timber industries) with private benefits (e.g. non-timber forest products, tourism, but excluding social gains from pharmaceutical uses of genetic resources). They fail to internalize the positive externalities of conserving genetic resources, leading to under-provision of the latter (socially sub-optimal).

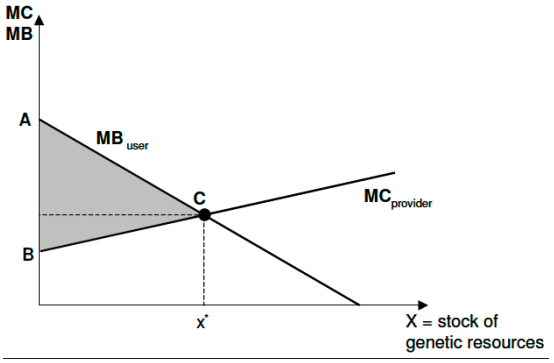
On the contrary, with well-defined property rights over genetic resources devolved to provider countries and local communities, the possibility of an agreement (financial compensation) would allow accounting for social gains (the marginal benefits (MB) of the user). In that situation, the provider would now compare its marginal cost (MC) of conservation (e.g. opportunity cost of deforestation) with these marginal social returns to the user.

Graphically, Richerzhagen (2007) shows that the bargaining between the provider and the user of genetic resources would end in a Pareto-optimal provision of the stock of protected biodiversity (X*) where the marginal benefits (MB) of the user equals the marginal costs (MC) for biodiversity protection of the provider. The outcome of such a negotiation is a social surplus (ABC), which can be shared between the participating parties (see figure 1 below). As we shall see later, the sharing of such surplus remains however problematic.

In order to achieve such Coasean Pareto-optimum, one has to craft an institutional arrangement. Building on Williamson (1979), we characterize bioprospecting arrangements as "bilateral governance", as opposed to "market governance."

The latter is "the classic nonspecific governance structure within which faceless buyers and sellers meet for an instant to exchange standardized goods at equilibrium prices." (Williamson 1979, p. 247-248); here the medium in the exchange remains the 'sale' rather than the 'contract' and the identity of parties is almost of negligible importance. At the opposite, the "bilateral governance" applies to transactions with rather specific, non-transferable investments in physical and human assets. In this case, the non-standard and ill-defined nature of the good and service concerned makes market governance hazardous and recurrent transactions justify the costs of additional governance mechanisms (more complex contracts with direct and recurrent payments).

Figure 1. The Coase theorem applied to the trade of genetic resources



Source: Richerzhagen (2007, p.101)

Contracts for bioprospecting, based on high uncertainty, very specific assets (endemic genetic resources in a very isolated place for one partner, highly skilled human assets as well as specific screening technologies for the other) and relatively recurrent interactions, are thus well characterized as bilateral contracts.

In this bilateral governance, actors in the sector negotiate the transfer of initial access and utilization rights (sovereign rights of the provider countries) and the sharing of the resulting created value between partners. They also agree on rules to coordinate, control and monitor each partner's strategy, and finally agree on a conflict resolution procedure. This eventually leads to institutional stability, as well as social welfare through the maximization and sharing of the value created. In the words of Richerzhagen (2007), "contracts on bioprospecting seem to be a perfect solution because externalities are internalized, a social welfare benefit accrues, and—as joint product—biodiversity conservation is realized. Therefore, from an incentive point of view, a fee-for access regime provides an effective system" (p. 101).

3.2. Practical specificities and limitations of bioprospecting deals

Empirically, bioprospecting contracts do however not strictly resemble the ideal bilateral governance structure as theoretically thought in Williamson (1979) and in our typology above.

On the one side, Harvey and Gericke (2011) practically detail all potential benefits which could arise from bioprospecting bilateral contracts, both monetary and non-monetary, as shown in Table 2.

On the other side, significant uncertainty and opportunistic behaviours from respective partners constitute specific impediments which prevent bilateral contracts to practically thrive in the bioprospecting sector:

(i) Information gaps are key and genetic resources' users may not know what is the potential of a given site although this might improve with efforts to increase scientific knowledge and inventories. Risks are related to these information gaps.

(ii) Ex-ante transaction costs (information costs to search for a site, for a partner; then costs for bargaining, contracting and decision-making so as to reach a deal) as well as ex-post transactions costs (during the operational phase, recurrent annual costs to take decisions, implement contractual clauses, monitor compliance and potentially solve conflicts)

(iii) Mistrust; and

(iv) Unequal bargaining power.

In total, depending on contextual variables, bilateral governance might prove very costly and inefficient, currently limiting the multiplication of bioprospecting agreements.

4. BIOPROSPECTING LEGISLATION AND IPR PROTECTION OF GENETIC RESOURCES

4.1. Patents, plant breeder's rights and bioprospecting

Regardless of the important differences that exist between (a) ABS systems, on the one hand, and (b) patents and plant variety protection (PVP), on the other, they all present a functional similarity. All of them are legal mechanisms, which are used—with different degrees of success—to

Table 2. Types of "Monetary and Non-monetary Benefits"

1. Monetary benefits may include, but not be limited to:	2. Non-monetary benefits may include, but not be limited to:
(a) Access fees/fee per sample collected or otherwise acquired; (b) Up-front payments; (c) Milestone payments; (d) Payment of royalties; (e) Licence fees in case of commercialization; (f) Special fees to be paid to trust funds supporting conservation and sustainable use of biodiversity; (g) Salaries and preferential terms where mutually agreed; (h) Research funding; (i) Joint ventures; (j) Joint ownership of relevant intellectual property rights.	(a) Sharing of research and development results; (b) Collaboration, cooperation and contribution in scientific research and development programmes, particularly biotechnological research activities, where possible in the Party providing genetic resources; (c) Participation in product development; (d) Collaboration, cooperation and contribution in education and training; (e) Admittance to ex situ facilities of genetic resources and to databases; (f) Transfer to the provider of the genetic resources of knowledge and technology under fair and most favourable terms, including on concessional and preferential terms where agreed, in particular, knowledge and technology that make use of genetic resources, including biotechnology, or that are relevant to the conservation and sustainable utilization of biological diversity; (g) Strengthening capacities for technology transfer; (h) Institutional capacity-building; (i) Human and material resources to strengthen the capacities for the administration and enforcement of access regulations; (j) Training related to genetic resources with the full participation of countries providing genetic resources, and where possible, in such countries; (k) Access to scientific information relevant to conservation and sustainable use of biological diversity, including biological inventories and taxonomic studies; (l) Contributions to the local economy; (m) Research directed towards priority needs, such as health and food security, taking into account domestic uses of genetic resources in the Party providing genetic resources; (n) Institutional and professional relationships that can arise from an access and benefit-sharing agreement and subsequent collaborative activities; (o) Food and livelihood security benefits; (p) Social recognition; (q) Joint ownership of relevant intellectual property rights.

Source: Nagoya Protocol on ABS, Annex

create (or regulate) markets for genetic resources (and plant varieties, in the specific case of PVP). They are designed to do so by restricting access to self-replicating biological materials through the establishment of legal rights and obligations at the national level.

The history of the progressive commodification[7] of genetic resources, including both sovereign rights-based and IPR-based systems of ownership (Safrin, 2004), reflects the development of what Raustiala and Victor (2004) have termed the '*Regime Complex*' for genetic resources. At the international level, various instruments contribute to the commodification of genetic resources. They can be distinguished between biodiversity-related instruments and IPR-related instruments, in accordance with their principal subject matter. On the one hand, the UN Convention on Biological Diversity and its Nagoya Protocol, among others,[8] can be included in the first category. Both types of legal instruments contribute to define and establish rights over genetic resources (Chiarolla, 2011: 29-30). On the other, the second category of legal instruments includes, *inter alia*, the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS)[9] and the UPOV Convention (International Union for the Protection of New Varieties of Plants).[10]

Under the CBD, domestic access and benefit sharing legislation or regulatory requirements normally establish obligations that concern (a) the way in which genetic resources and associated traditional knowledge may be accessed, and (b) how the benefits that result from their use are shared between the individuals or organisations using such resources and knowledge, including commercial use, and the peoples, communities and countries that provide them. However, in the absence of domestic ABS obligations, bioprospecting (including the collection, transfer and use of genetic resources) would potentially be free from additional costs or requirements other than the cost of their material acquisition.

The intellectual property system also has important implications for bioprospecting activities. This is because various types of IPRs can protect the results issued from bioprospecting research. For instance, plant variety rights and patents are legal tools devised to allow the private sector to appropriate returns from investments in plant breeding and biotechnology. Therefore, the expectation to acquire exclusive rights over proprietary products and processes provides powerful incentives for private-sector investment in bioprospecting. For example, genetic resources, including seeds and other propagating materials, which fulfil the relevant statutory requirements (e.g. novelty, inventive step and industrial application under patent law) can be protected under the IPR system. If an application is successful, the applicant is rewarded with the grant of the exclusive right to exploit a gene-base invention (under patent law) or a novel plant variety (under plant variety rights protection) for a limited period of time. Such period of exclusivity is normally 20 years for patents and 20 to 25 years for PVP depending on the concerned species.

In the United States of America, in Europe and in other industrialized countries, the strengthening of IPR protection has slowly occurred over the twentieth century. On the one hand, the establishment and allocation of IPRs matched the expectations of emerging private actors. On the other, these actors were eager to exploit the augmented technological opportunities initially created by public research with public funds (Pardley et al, 2003). Genetic resources can be modified by human intervention and take on characteristics that do not exist in nature. When these modifications result in a *new* biotechnological invention that involves an *inventive step* and is capable of *industrial application*, the invention may qualify for patent protection. TRIPs Article 27 calls on WTO Members to provide patent protection for both products and processes, and forbids discrimination among different fields of technology.[11] This provision allows (but does not require) the patenting of plants

7. By commodification we mean the privatization of the rights to access and use genetic resources, as well as their subsequent commercialization.

8. Another fundamental legal instrument that belongs to this category is the FAO International Treaty on Plant Genetic resources for Food and Agriculture.

9. The TRIPs Agreement introduces intellectual property rules into the multilateral trading system by requiring all WTO members to provide minimum standards of protection for a wide range of intellectual property rights (IPRs). The TRIPs Agreement was negotiated during the 1986–94 Uruguay Round and entered into effect on 1 January 1995. It covers four fundamental strategic areas for the protection of IPRs, in particular: it establishes international substantive minimum standards for IP protection; it provides detailed international criteria for national enforcement of IPRs; it subjects any controversy as to compliance with minimum standards and enforcement to the WTO dispute settlement system; and it establishes common procedural requirements concerning the administration and maintenance of IPRs at the national level.

10. UPOV is the French acronym that stands for Union internationale pour la protection des obtentions végétales.

11. Article 27.1 of the TRIPs Agreement states: 'Patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application.'

and plant varieties as well as their genetic components, while providing flexibility in the way in which it can be implemented at the national level (Correa, 2012).

Under Article 27.3(b) of the TRIPs Agreement, countries are free to choose their own effective *sui generis* system for the protection of new plant varieties. Besides, the UPOV Convention provides a ready-to-use legislative model for *sui generis* plant variety protection (PVP). PVP under UPOV provides breeders with exclusive rights on the propagating material (such as seeds and other propagating materials) of new plant varieties. Unlike the patent system, a breeder's exemption allows access to PVP-protected material for research, for further breeding, and for non-commercial use by farmers without authorisation (Dutfield, 2011). In addition, the farmers' privilege allows farmers to retain seeds for their own use and for non-commercial exchange. Under UPOV 1991-type legislation, the holder of a PVP certificate has *inter alia* the right to exclude others from producing or reproducing, conditioning for the purpose propagation, offering for sale, selling, exporting, importing and stocking propagating material of the protected variety for any of the above mentioned purposes.[12]

In conclusion, companies interested in bioprospecting and screening for potential useful applications of genetic resources can obtain patent rights over inventions derived from such resources (or, in the case of plant breeders, plant variety protection over new varieties). For instance, following the grant of a patent for a gene-based invention, the right holder has exclusive rights to use and commercialize the claimed invention and its embodiments, including those comprising or consisting of genetic resources. Thus, the right holder would be able to exclude all other actors from capturing revenues from the commercialisation of the invention, including communities or individuals from the provider country where the genetic resource (on which the invention is based) was collected (see Box 1).

4.2. Missing links and limitations of the IPR system in terms of its potential contribution to benefit sharing and biodiversity conservation

Most user countries do not provide for patent disclosure requirements. This means that in such countries national authorities, which are responsible for granting patents (and plant breeders' rights), do not require applicants to disclose:

- the origin or source of the genetic resources used in the claimed invention (or plant variety); and
- whether such resources were legally acquired following the grant of the prior informed consent (PIC) by the country providing them as well as the establishment of mutually agreed terms (MAT) for the sharing of benefits.

Hence, at present, the intellectual property system in most (developed) countries is not designed to support compliance with access and benefit sharing (ABS) requirements under the CBD,[13] by ensuring that PIC and MAT are established between the user and the provider country. Besides, only a relatively limited number of countries has adopted and implemented functional ABS legislation and/or regulatory requirements for bioprospecting (see below). This is an important reason that explains why only a few patents that involve genetic resources are granted with the prior informed consent and following the establishment of an ABS agreement with the provider country (and the other legitimate resource holders). In addition, provider countries have limited possibilities and capacity to seek legal recourse against companies, which may have allegedly misappropriated their genetic resources, in each country where the latter may have filed a patent application. This is

Box 1. The Enola Bean Case

Amongst the few well-publicized cases of biopiracy, the *Enola bean case* clearly shows the dangerous effects of erroneously granted patents, especially in the context of international trade. In 1999, US national Larry Proctor obtained utility patent 5,894,079 from the US Patent and Trademark Office (Barba, 2008).

In its patent, Proctor claimed to have developed a new bean variety, obtained from a Mexican variety known as *Phaseolus vulgaris*, which "produces distinctly colored yellow seeds which remain relatively unchanged by season." Then, Proctor threatened Mexican farmers, who traditionally exported these beans to the US, to pay him royalties, if they did not want to be sued for patent infringement. This resulted in considerable economic losses by these farmers, who suddenly saw their produce seized at the frontier with the US.

The International Center for Tropical Agriculture (CIAT), alerted by Mexican farmers who had been prevented from exporting their produce to the US, found out that the patented variety was identical to at least six well-known bean varieties. In 2000, CIAT requested the USPTO to re-examine the patent. It took more than seven years for the patent to be revoked for lack of novelty, with remarkable economic losses for the Mexican bean producers.

12. Article 14(1) of the 1991 UPOV Convention.

13. See above section 1.3.

because the ABS legislation of provider countries is not extraterritorially applicable under the jurisdiction of (other) user countries.

Because of the above reasons, provider countries and indigenous and local communities often find it difficult to obtain some direct benefits from technological and other applications that involve the use of their genetic resources and associated traditional knowledge. This situation is exemplified by some well-known cases of "biopiracy" (e.g. Basmati rice in India, the Camu Camu plant in Peru, the hoodia plant or the Rooibos tea in South Africa, see Box 2 for more details) (Robinson, 2012).

The **Camu Camu plant**, native to the Peruvian Amazon, provides fruits with high levels of vitamin C. Whereas prior art and research documenting the use of the Camu Camu was available, the Japanese Patent Office has granted a series of patents for cosmetic extracts and food additives derived from this plant. Peruvian researchers indicated that "there [was] lack of evidence of an inventive step" (one of the requirements for the grant of a patent) *inter alia* because vitamin C is already known as a compound that can prevent skin-ageing. Moreover, apart from the problem of the failed recognition of orally transmitted knowledge as prior art that can challenge patent novelty, Peruvian researchers noted that the lack of clarity in the English translation of Japanese patent documents and the lack of precision of what was actually claimed limited patent transparency and thus prevented them to efficiently challenge these patents. Finally, it appeared that the Camu Camu plants were initially exported to Japan as commodities (without PIC) and subsequently used for research and development on their genetic makeup.

In such cases, indigenous and local communities have faced difficulties in claiming their right over genetic resources collected in their territories and over associated traditional knowledge. Indigenous and local communities have sometimes had recourse to the support from NGOs to compel concerned companies to negotiate *ex-post* an ABS agreement, as in the case of the Hoodia plant, where an ABS agreement was eventually concluded with San People (Robinson, 2012: 61-62).[14]

Box 2. Examples of "biopiracy" cases

Basmati rice has been grown across India for centuries during which time it has been improved by local farmers through seed selection and conventional breeding practices. Controversy arose in the late 1990's when the US Patent and Trademark Office (USPTO) granted a patent on "Basmati rice lines and grains" to RiceTec Inc., a Texas-based company, in 1997. Shortly after the patent was granted, Indian and international NGOs and the Agricultural and Processed Food Products Export Development Authority, took legal action against this patent because it would legally impose restrictions on Indian exports to the US where the patent was granted. Subsequently, while most patent claims were cancelled or abandoned, three claims were eventually maintained.[1] Activists have continued to argue that these claims should also be stroked because prior art already existed in India concerning the Basmati rice's qualities. However, most of the times such knowledge in India was only orally transmitted and not patented in the country, while the USPTO does not recognize 'foreign' prior art unless it is documented *in written form* and accessible in order to prove lack of novelty.
Source: Robinson (2012)

1. See Berne Declaration, 'Basmati rice «biopiracy» patent struck down by US patent office', http://www.evb.ch/en/p25000429.html accessed on 8 March 2013.

In certain cases, they may seek the revocation of patents, which may not be valid because they lack novelty or the inventive step (or the revocation of plant breeder rights, for instance, because the protected variety is not distinct from already known varieties). However, the limited administrative, legal and technical capacity of those seeking the revocation of a patent, especially stakeholders in developing countries, as well as the time and elevated costs of such proceedings often make these remedies unfit for purpose (see, for instance, the case of the Peruvian Maca).[15] More importantly,

14. In 1995, the South African Council for Scientific and Industrial Research (SACSIR) filed a patent application on Hoodia plant for the use of the active components of the Hoodia plant that were responsible for suppressing appetite. In 1998, SACSIR signed an exclusive licensing agreement with the UK Company Phytopharm for related products (functional weight-loss foods). Both organisations were heavily criticized by local and international NGOs, including the Working Group on Indigenous Minorities in Southern Africa. The latter eventually argued that Phytopharm and SACSIR had not contacted the San people to seek their prior informed consent. Besides, the patent was also sublicensed to Pfizer, a U.S. drug company, and to the food multinational Unilever in the Netherlands. A "bad naming" campaign eventually led SACSIR to negotiate a memorandum of understanding with San local communities (through the Working Group) in 2001 and to establish a "San Hoodia Benefit-Sharing Trust" where ultimately royalties would be paid for socio-economic development of the San people.

15. The government of Peru has actively pursued a number of patents filed in the US and the EU on Maca roots for their use in therapy for sexual potency. The government submitted a report to WIPO and argued that the patents were not inventive or novel since several pieces of literature already documented relevant prior art. Moreover, the report expressed concerns about the impact of these patents on Peruvian Maca exports to the US. Despite these robust findings, which could contribute to the revocation of these patents, Peru indicated that it had encountered difficulties in challenging such patents in the US and the EU because of "administrative, legal, technical capacities, cost and time issues" (see Robinson, 2012: 67-68).

if the concerned patents or plant breeders' rights meet the statutory requirements for their grant, they may not be revoked solely because they are not in compliance with PIC and MAT requirements under CBD. Therefore, the legitimate right holders would have no recourse at all against misappropriation.

Against this background social scientists forecast a situation where indigenous and local communities have no incentives to invest in biodiversity conservation as they cannot claim and defend rights over genetic resources (Swanson and Göschl, 2000; Lawson, 2010). Here private and public incentives are misaligned and this leads to under provision of biodiversity conservation efforts.[16]

4.3. Considerations on the nature and functions of domestic ABS legislations

Aside from patents and plant variety protection, some governments have implemented ABS-related restrictions on access to genetic resources to regulate the transfer and use of (often unimproved) genetic materials and prevent their misappropriation. The legal basis of these laws is the principle, reaffirmed by the UN Convention on Biological Diversity and its Nagoya Protocol, that states have sovereign rights over all natural resources within their national jurisdiction, including genetic resources.

A key objective of ABS laws is to promote the fair and equitable sharing of the benefits arising from the use of genetic resources. Many developing countries, which are rich in biodiversity but do not have advanced biotechnology capacity, have claimed that equity concerns are important, because foreign companies have historically obtained profits from products derived from their genetic resources and associated traditional knowledge, without paying anything back to the countries of origin and/or to indigenous and local communities (ILCs), which contribute to conserving biodiversity *in situ*.

Aside from ABS competent national authorities of the provider country, traditional knowledge (TK) holders and other groups of individuals belonging to an indigenous or local community, which have direct links with the concerned genetic resources, may be given the right to:

i) share the benefits arising from their utilization;

ii) give their prior informed consent as a necessary condition for the legal taking of such resources and knowledge; and

iii) negotiate mutually agreed terms (MAT) that will apply to the transfer of genetic resources and their subsequent use (CBD Article 15.7 and Nagoya protocol Article 5.1 & 2).

The formal recognition under national ABS legislation of indigenous and local communities' customary rights and responsibilities aims to empower these resource providers by ensuring that they have granted their prior informed consent and participate in benefits sharing, including research, development and conservation activities concerning the resources of which they are the source.

In sum, ABS-related restrictions on access to genetic resources could be understood as a tool used by some governments to internalise (and capture) positive externalities that would otherwise be more broadly distributed, including by foreign nationals, in the form of benefits arising from unfettered access to genetic resources. Thus, ABS systems are government-led forms of commodification in the sense that genetic resources and associated traditional knowledge covered by such systems are not in the public domain (Chiarolla, 2001: 144). Besides, the benefits arising from their utilization are shared bilaterally between transacting parties (e.g. the country of origin and the user) and/or trilaterally in the case of the involvement of ILCs. In accordance with the CBD database on ABS measures, seven regional organisations and 57 countries have reported to have adopted measures concerning genetic resources and ABS.[17]

4.4. The Nagoya Protocol on ABS

In October 2010, the adoption of Nagoya Protocol on ABS reaffirms that genetic resources are subject to national sovereignty and offers the opportunity to recognize the rights of indigenous and local communities over their genetic resources and associated traditional knowledge. Besides, the Protocol aims at providing increased legal certainty and transparency by defining minimum standards concerning access to genetic resources as well as the right to benefit sharing, which will benefit respectively user and provider countries.

16. Swanson and Göschl (2000) for instance show that the existing IPR regime in the plant breeding sector has not provided incentives to farmers in the developing world to conserve agricultural biodiversity. This is because, the authors argue, "[…] the farmers in the developing world receive no return from the use of their varieties in the plant breeding industry (because the farmers have no recognized property rights in their genetic resources) and hence they have no direct incentive to invest in diversity" (p. 85).

17. Source: http://www.cbd.int/abs/measures/, accessed on 4 March 2013.

Thus, all Parties are required to implement minimum benefit-sharing obligations by adopting appropriate legal, administrative and policy measures for the utilization, within their jurisdiction, of genetic resources taken from another Party (Article 5). Besides, Parties (in the exercise of their sovereign rights as provider countries) *may* require users to seek their prior informed consent (Article 6.1) and to sign mutually agreed terms (Article 6.3 e) for benefit sharing, as a precondition for the grant of a bioprospecting permit.[18] Finally, Articles 15 to 17 of the Protocol set out crucial obligations for user countries. Namely, the latter shall ensure that users within their jurisdiction comply with the applicable ABS requirements of the provider country from where the genetic resources and associated traditional knowledge were accessed.

While the Nagoya Protocol to the CBD is meant to increase transparency about the utilization of genetic resources through an internationally recognised certificate of compliance (Article 17.2) and the establishment of one or more relevant checkpoints (Article 17.1.a), it neither mentions nor does it require Parties to implement mandatory patent disclosure requirements. Thus, the relationship between the Nagoya Protocol and the IPR system appears to privilege the principle of non-interference.

At the local level, PIC and MAT requirements, as set out in the Nagoya Protocol, also provide the basis to define ILCs' rights to grant access to genetic resources and allows for benefit sharing at the community level. In particular, Article 6.2 of the Protocol states that: "In accordance with domestic law, each Party shall take measures, as appropriate, with the aim of ensuring that the prior informed consent or approval and involvement of indigenous and local communities is obtained for access to genetic resources where they have the established right to grant access to such resources." In parallel, Article 7 on access to traditional knowledge further states that: "In accordance with domestic law, each Party shall take measures, as appropriate, with the aim of ensuring that traditional knowledge associated with genetic resources that is held by indigenous and local communities is accessed with the prior and informed consent or approval and involvement of these indigenous and local communities, and that mutually agreed terms have been established." These two provisions, jointly with Article 12 on "traditional knowledge associated with genetic resources," provide the basis for the recognition the rights of indigenous and local communities to their genetic resources and traditional knowledge. Indeed, this is one of the most innovative aspects of the Nagoya Protocol in comparison with the Convention on Biological Diversity and its Article 8(j) on the protection of traditional knowledge, innovations and practices.

4.5. The potential contribution of the Nagoya Protocol to biodiversity conservation

With the introduction of new obligations on compliance with domestic ABS legislation, the Nagoya Protocol has raised expectations that countries will be better able to capture the benefits arising from the use of their genetic resources and/or their biochemical composition,[19] while conserving and sustainably utilizing biodiversity.

Empirically, Ten Kate and Laird (1999) estimate that markets for various products derived from genetic resources could range from 500 to 800 billion USD annually, while Rausser and Small (2000) found that marginal values of species from bioprospecting can be large (over US$9,000/hectare). Rausser and Small (2000) assume that prospectors can use information to carry out more efficient searches. By using scientific information and traditional knowledge, one could search for bioprospecting leads in a more efficient order instead of carrying out random searches[20]. This targeting raises the value of new searches at the margin. In such cases, private bioprospecting contracts could thus create significant incentives

18. Under Article 6.3, a Party that decides to pass access legislation by requiring the grant of PIC and the establishment of MAT shall implement minimum conditions concerning such access, including inter alia: legal certainty, clarity and transparency; fair and non-arbitrary rules and procedures on accessing genetic resources; a clear and transparent written decision by a competent national authority, in a cost-effective manner and within a reasonable period of time; the issuance of a permit as evidence of the decision to grant PIC and of the establishment of MAT; where applicable, criteria and/or processes for obtaining PIC or approval and involvement of ILCs for access to genetic resources; and rules and procedures for requiring and establishing MAT. The above minimum access standards are expected to promote bioprospecting and were included into the Protocol at the request of (developed) user countries.

19. Dutfield (1999) already emphasized that: "in theory creating property rights over biogenetic resources would lead to their more efficient utilization. It would do this by strengthening the bargaining position of developing country suppliers enabling them to capture greater benefits. Consequently there would be stronger incentives to conserve and sustainably exploit the resource base since the enhanced benefits would help meet the opportunity costs of conserving species and biodiverse ecosystems while securing long-term benefits from their industrial application" (p.3).

20. Simpson et al. (1996) assume a random search process.

to conserve biological diversity as bioprospecting companies and provider countries might realize the high value of such genetic biodiversity. Conserving the latter, in order to safeguard the probability of future searches and commercial applications may become profitable. Going further, Polasky and Solow (1995) point out that species, which share the same beneficial trait, may not be perfect substitutes. Therefore, relevant research may not necessarily terminate upon the discovery of the first species with the trait (the one-hit assumption). In a "multiple-hit" model with imperfect substitution, value of the marginal species can reach significant value.[21]

At the national level, ABS requirements to share such potential value may contribute to generating funds for national governments, which could be used to foster biodiversity conservation. In particular, Article 9 of the Nagoya Protocol provides that: "The Parties shall encourage users and providers to direct benefits arising from the utilization of genetic resources towards the conservation of biological diversity and the sustainable use of its components". In this context, bioprospecting activities as well as the subsequent commercial exploitation of genetic resources and derived biochemical compounds, as regulated by the Nagoya Protocol, could help filling the funding gap for biodiversity conservation. Such gap was estimated at US$ 17 to 47 billion per year for developing countries and transition economies (155 countries).[22]

The implementation of domestic PIC and MAT requirements of the countries providing genetic resources (whose compliance by users should now be ensured by all parties, including user countries, through Articles 15 to 17 of the Protocol) could also provide incentives to better conserve biodiversity, since part of the revenues from the use of genetic resources will be captured at the local level. This would increase private returns to investment in conservation. In other words, biodiversity conservation could be promoted if at the local level the private benefit of conserving biodiversity (in this case, as potential benefits from bioprospecting contracts) exceeds the private benefits of cultivating land or of any other biodiversity damaging activity (e.g., commercial logging). However, this favorable situation may not often materialize in practice.

For instance, access to genetic resources may no longer be needed if an active compound can be extracted and reproduced in a laboratory. Therefore, in such cases, the incentives to conserve biodiversity *in situ* could be lower than expected. This is because there would be no direct long-lasting factual connection between benefit sharing and *in situ* biodiversity conservation. On the other hand, while such factual connection could be maintained over time when the repeated harvesting of specimens is required, some potential threats to biodiversity may arise from these activities.[23] Therefore, negative externalities potentially associated with bioprospecting should also be considered and carefully managed.

Observations on the ground of such theoretical argument, on the positive link between bioprospecting activities regulated under ABS mechanism (through the ratification of the Nagoya Protocol) and biodiversity conservation, depend on the degree to which new rights to resources, including genetic resources and the associated benefits, will be assigned to the primary resource stewards, e.g. provider countries, indigenous and local communities, to cover the opportunity costs of biodiversity conservation. In this context, various reasons have led scientists and stakeholders to be relatively cautious about the potential contribution of bioprospecting to biodiversity conservation under the Nagoya Protocol. Such reasons are further considered in the below sections.

5. EMERGING CHALLENGES IN ABS IMPLEMENTATION: MOBILIZING FINANCIAL RESOURCES AND OTHER INCENTIVES FOR BIODIVERSITY CONSERVATION

The legal and economic literature which was presented so far has prospected the possibility to harness bioprospecting activities so that ABS requirements under the Nagoya Protocol could generate financial resources and other incentives for biodiversity conservation both at the local and national levels. However, in practice, the links between ABS implementation and the conservation of biodiversity are not obvious ones and a number of preconditions need to be in place for bioprospecting to simultaneously deliver on its promises in terms of international equity and biodiversity conservation.

21. However, study results remain sensitive to assumptions (about the searching process) and thus might be mobilized in the opposite direction (see below).

22. See above section 1.2.

23. See below section 5.4. on "Bioprospecting and biodiversity loss."

5.1. Uncertain economic value from bioprospecting and the "size of the pie" issue

Part of the literature shows that the biodiversity used in bioprospecting appears to have an uncertain economic value and that such value greatly differs across sectors of economic activities. Therefore, the value which can be captured through ABS mechanisms to fill the funding gap for biodiversity conservation (see paragraph 4.5 above) is still highly uncertain.

Several studies have shown that the total economic value from bioprospecting is relatively low. For example, analyses by Simpson *et al.* (1996) and Simpson and Sedjo (1998b), Craft and Simpson (2001) find that the expected value from searching natural lands for pharmaceutical discoveries amount to less than a cent per hectare.[24] Simpson *et al.* (1996) estimate that the marginal value of habitat will be low (e.g. US$21/hectare). They emphasize that when several species produce the same chemical compound, the probability of discovering the compound's value is high, but discovery in one species will render other species redundant as a source of that compound. Examining the role of information and search processes on marginal values of biodiversity-rich habitat,[25] and comparing the models and results of Simpson *et al.* (1996) and Rausser and Small (2000),[26] Costello and Ward (2006) found that the use of information in the search process raises marginal values, but that increase accounted for only 4% of the difference in the results of the two studies. In total, Costello and Ward's (2006) results support Simpson *et al.*'s (1996) assertion that the marginal value of land from a bioprospecting perspective would not be enough to counter farmers' incentives to change their land patterns of production.[27] Hence, in many cases, bioprospecting activities are unlikely to overcome the opportunity costs of biodiversity conservation and as a result, limited additional incentives can be generated for habitat protection (Barbier and Aylward, 1996: 173).

However, recent studies have also shown that biodiversity in particular technology sectors can be highly valuable. For example, in the case of marine biotechnology, estimates predict that "undiscovered cancer treatments from marine organisms could be worth between US$563 billion (€428.5 billion) and US$5.69 trillion (€4.33 trillion) […] there may be as many as 594,232 novel compounds waiting to be discovered in unstudied marine species, and that these could lead to between 55 and 214 new anti-cancer drugs. The study only accounted for anti-cancer drug revenues." (Erwin *et al.*, 2010)[28]. Another study highlights that "the global market for Marine Biotechnology products and processes is currently estimated at € 2.8 billion (2010) with a cumulative annual growth rate of 4-5%. Less conservative estimates predict an annual growth in the sector of up to 10-12% in the coming years, revealing the huge potential and high expectations for further development of the Marine Biotechnology sector at a global scale"(Querellou et al, 2010).

These figures should nevertheless be taken with much caution. First, any of the above predictions is hardly reliable, because of the necessarily strong methodological assumptions on which they are based; second, the economic value arising from marine bioprospecting also concerns marine genetic resources collected beyond national jurisdiction,[29] while those which may be covered by domestic ABS mechanisms, in accordance with the CBD Nagoya Protocol, shall be limited to marine genetic resources collected from areas within national jurisdiction.

In total, there appear to be an important mismatch between the low or uncertain value from the use of biodiversity as a raw input into commercial R&D, on the one hand, and the growing importance of biotechnology products and processes, in terms of global market value, on the other.[30] In conclusion, the provision of ABS-re-

24. These measures are questionable since they depend on various assumptions.

25. Costello and Ward (2006) compare both random searches (as in Simpson et al., 1996) and optimal searches (as in Rausser and Small, 2000).

26. See also section 4.5 of this study on the economic theories and incentives to conserve biodiversity. Besides, Rausser and Small (2000) calculate that the economic value from bioprospecting could reach over 9,000US$ per hectare.

27. The authors argue that allowing for more efficient, information-based searches increases the marginal value of land, but not enough to change this result qualitatively.

28. See also: "Science for Environment Policy", European Commission DG Environment News Alert Service, edited by SCU, The University of the West of England, Bristol.

29. On benefit sharing from marine genetic resources in areas beyond national jurisdiction. See Vierros et al. (2013).

30. One possible proxy for such market value and the growing economic interest in marine bioprospecting is given by the number of biotechnology patents that cover marine organisms. For instance, P. Oldham et al. (2013) have recently "identified 767,955 patent documents originating from 354,003 patent families (first filings) that contain references to [Latin] species [names. The authors also] identified 25,495 species names in the claims section of 136,880 patent documents." On the share of PCT patent applications by countries, see below figure 2.

lated incentives for biodiversity conservation will in part depend on the private sector's capacity to transform row inputs with relative low value into products and processes with high commercial value, and to fairly and equitably share the contribution of genetic resources with provider countries and concerned ILCs.

5.2. Bargaining power, compliance and the "piece of the pie" problem

The majority of developing countries have limited capacity and bargaining power to fully engage in biotechnology research and negotiate fair bioprospecting deals. In other terms, most provider countries in the developing world only capture a small share of the economic value that arises from bioprospecting activities.[31] For example, figure 2 shows the share of countries in biotechnology patents filed through the WIPO Patent Cooperation Treaty (PCT) between 2008 and 2010.

The bargaining and the conclusion of an ABS agreement may also prove complicated for provider countries which share the same genetic resources in transboundary situations.[32] In such cases, the competition among countries endowed with the same genetic resources could lead to a 'race to the bottom', where some countries may not require PIC or may demand lower benefits from the deal (favourable MAT). The assets owned by the provider country (i.e. genetic resources under sovereign rights) may not be specific because substitutes in other countries may exist. Thus, in accordance with Williamson (1979), the value flowing to an individual country might be low.

Under the Nagoya Protocol, the unclear possibilities to seek recourse, in the jurisdiction of user countries, against the violation of the domestic ABS legislation of the provider country, do not help the latter gaining greater bargaining power.[33] NP Article 15 stipulates that user countries shall take measures to provide that users under their jurisdiction respect ABS legislation or regulatory requirements of the provider country from which the concerned genetic resources were taken. However, Article 15 is relatively vague and thus there exist important grey areas.[34] Thus, developed user countries, including the EU and its Member States,[35] may deliberately pass relatively 'weak' compliance measures in their national (or regional) ABS legislation. However, this would probably fall short of monitoring, in an *effective* manner, the utilization of genetic resources throughout the research, development, innovation, pre-commercialization and commercialization chain, as prescribed by NP Article 17.1(a)(iv).

Besides, it also remains unclear whether and how a Party to the NP will be allowed to file a complaint against another Party, which allegedly does not duly implement its obligations under the Protocol. This particular problem concerns primarily compliance by Parties with the Protocol, which is distinct from—but related to—compliance by users with the domestic ABS measures referred to in Articles 15 and 16.[36]

Finally, a large number of genetic resources are already conserved *ex situ,* such as those in the genebanks that are held by Centers of Consultative Group on International Agricultural Research (CGIAR). These genetic resource collections, which were initially assembled under the principle of "common

31. According to Dutfield (1999), "There has been a concentration of high-value IPR protected technologies and products in the hands of a small number of conglomerates with annual turnovers higher than the GNPs of several developing countries. Given the economic power of these companies it may be more difficult than ever for developing countries to negotiate favorable terms for technology acquisition" (p. 6-7).

32. These situations may potentially be covered by the Global Multilateral ABS Mechanism that may be established under NP Article 10 as well as by the obligations concerning transboundary cooperation under NP Article 11.

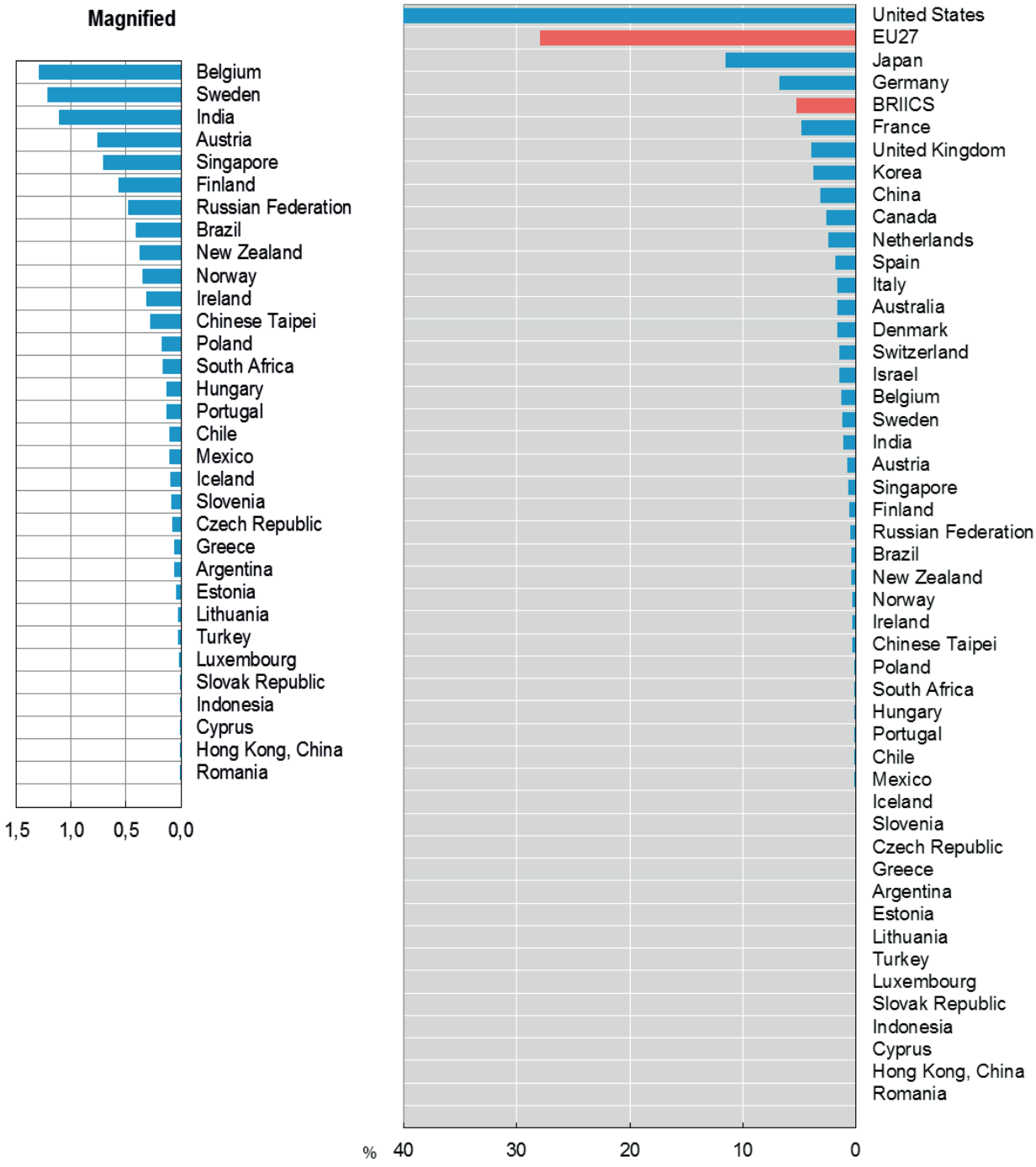
33. In particular, "access to justice" measures are mandatory only with regard to compliance with mutually agreed terms (NP Article 18.2 & 18.3.a). This situation concerns the violation of contractual obligations established in the MATs. Such violation can be classified under the heading of "misuse of genetic resources." By contrast, it is unclear the extent to which the opportunity to seek recourse should be made available, under the legal system of user countries, in the case of disputes concerning the violation of non-contractual obligations that arise from provider countries' domestic ABS legislation or regulatory requirements. Such violations can be properly described in terms of "misappropriation," which can be used as a synonym for "biopiracy." See Chiarolla (2012).

34. Ibid.

35. See the European Commission's proposal submitted to the European Parliament and to the Council (4 October 2012), "Proposal for a regulation on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization in the Union", COM(2012) 576 final. For more details consider, in particular, the "due diligence approached" enshrined in Article 4 of the draft regulation, as well as the presumptions of compliance envisaged for transfer of genetic resources held by the "Union trusted collections" under Article 5.Commission's proposal formally submitted to EP and to Council after adoption on 4 October 2012Commission's proposal formally submitted to EP and to Council after adoption on 4 October 2012

36. At the first meeting of the Conference of the Parties serving as the meeting of the Parties to the Nagoya Protocol (COP-MOP) to be held in the Republic of Korea in October 2014, eventually such issue will be addressed with the possible adoption of set of "procedures and mechanisms to promote compliance" with the Protocol in accordance with the mandate provided in its Article 30.

Figure 2. Share of countries in biotechnology patents filed under PCT, 2008-10



Source: OECD, Patent Database, December 2012.

heritage of mankind,"[37] are now exchanged within the so called Multilateral System of ABS established by the FAO International Treaty on Plant Genetic Resources.[38] However, many developing countries have called into question the legitimacy of the above exchange practices, which may allow users to access plant genetic resources (*per se* outside the scope of the FAO International Treaty) without respecting domestic ABS obligations, in particular, by making recourse to intermediaries such as the CGIAR and others genebanks. On the other hand, in accordance with principle of non-retroactivity, most developed countries are strongly opposed to the applicability of obligations under the Nagoya Protocol to genetic resources collected before its entry into effect. All the above further limits the provider countries' bargaining power *vis-à-vis* prospective users, which may prefer to obtain genetic resources from intermediaries without respecting domestic PIC requirements or negotiating MATs.

5.3. Local level rights and incentives: a key challenge for biodiversity conservation

While sovereign rights over genetic resources have been recognized to provider countries and are normally vested primarily at the *central government level*, it remains unclear and case-specific how resource stewards, such as indigenous and local communities, will be empowered to exercise their rights over genetic resources at the *local level*. The legal provisions of the Protocol that concern Indigenous and local communities rights (see above section 4.4) are relatively weak and, in practice, states are free to decide on the practical ways, if ever there is political will, to involve indigenous and local communities in PIC procedures and in the negotiation of MATs and associated benefit sharing.

In this context, there is a risk that benefits from bioprospecting deals might be captured only at the government level, providing local stewards with little incentives to sustainably use and conserve resources whose economic rights are not recognized. Defining and allocating rights over valuable resources gives incentives for their owners to sustainably use them as they capture all or part of the generated revenues and support costs (externalities are internalized).[39] Against this backdrop, the Nagoya Protocol does not define the instances in which Parties are called to take measure to recognize the "established rights" of Indigenous and local communities at the local level. It rather appears to delegate such task to domestic legislation. Therefore, it leaves provider states as the main gatekeepers.

Barrett and Lybbert (2000) show the difficulties of transferring bioprospecting gains to the poor in developing countries so as to modify their land-clearing decisions. However, the centralization and neglect of indigenous and local communities' rights over genetic resources might prove counterproductive. In the words of Dutfield (1999, p. 4):

> Emphasising property rights at the nation state-level may even encourage counterproductive conservation and sustainability policies including mercantilist and overly-centralised approaches that may be both inefficient and undemocratic. It is true that governments are in a far stronger position to bargain with transnational corporations than domestic non-governmental institutions and local communities, yet a statist approach that assigns the gatekeeper role exclusively to government entities may not be the most efficient way to monitor the erosion of the country's biological diversity, especially in areas inhabited by indigenous and local communities.

In order to create a link between the benefits generated through bioprospecting, biodiversity conservation and the sustainable use of its components, Article 9 of the Nagoya Protocol requires Parties to encourage users and providers to direct relevant benefits towards the conservation of biological diversity. However, this Article is relatively weak since Parties shall only "encourage" users and providers to do so. Besides, the employed wording hides the reality that in many cases the provider country is one of the parties to the ABS agreement. Therefore, Parties should have the duty to direct relevant benefits to biodiversity conservation, especially if they are the direct beneficiaries under an ABS agreement.

This presents two main challenges. On the one hand, there is no obligation for providers to redirect the shared benefits towards biodiversity conservation at the local level, in particular, where the concerned genetic resources were collected *in situ*. Hence, there is no clear connection between the stream of benefits potentially captured from a genetic resource through ABS and the availability of additional resources for its conservation. On the

37. Such principle was provided for by the 1983 FAO International Undertaking on Plant Genetic Resources.

38. This was established in accordance with the Agreements concluded between the Governing Body of the FAO International Treaty and the Centers of CGIAR. See Chiarolla et al. (2012).

39. As stated by Richerzhagen (2007), "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 landowner or local community in charge of the resource management and bearing the conservation costs." (p. 100).

other, based on Article 9, users and providers can decide to allocate the benefits arising from the use of a genetic resource in any manner they feel appropriate, even in a totally different location and for totally different purposes. The issue of doubtful ecological equivalence[40] is a very salient one since it contributes to determine the environmental effectiveness of bioprospecting regulation (through ABS) as a market-based instrument for biodiversity conservation.[41]

Finally, the possible devolution of rights at the local level would not necessarily foster biodiversity conservation as the nature of incentives for indigenous and local communities and stakeholders to engage in conservation may also depend on the modalities of their involvement in bioprospecting arrangements. These arrangements can be diverse and propose benefits such as up-front payments, joint ventures, salaries, royalties, and many others (see Table 2). For instance, there might well be cases where such arrangements result in payments for biodiversity conservation *a posteriori*, with no guarantee that biodiversity conservation would continue in the long-term.[42]

5.4. Bioprospecting and biodiversity loss

As anticipated in section 4.5, bioprospecting, whether regulated under an ABS regime or not, could also present some potential threats to biodiversity.

First, whereas the Nagoya protocol could foster the use and valorization of valuable biodiversity, there is however a legitimate risk that "ordinary biodiversity" would be negatively affected through leakage effects. Indeed, provider countries and local communities could be incited to protect areas with high commercial value biodiversity and thus overexploit neighbouring areas, with lower commercial biodiversity value, in order to keep on sustaining their livelihoods.

Second, when the repeated access to genetic resources is required, for instance, because of their non-replicability in the lab or the lower bioactivity of their synthetic equivalents, then the repeated harvesting of specimens from the wild may lead to resources depletion and biodiversity degradation. In the case of cultivated species, their intensive cultivation may have negative effects in terms of habitat changes. Frisvold and Day-Rubenstein (2008) show that, in the case of the discovery and commercial development of the anti-cancer drug Taxol from the Pacific yew tree, this has led to habitat conversion, as well as the decline and near extinction of the Asian yew in Pakistan, India, Nepal and China. Authors thus conclude that "the discovery of Taxol and the search for Taxol-like compounds [has] illustrate[d] how bioprospecting can substitute threats to biodiversity from over-harvesting for threats to biodiversity from habitat conversion."

In the case of agricultural biodiversity, the "replacement of complex, diverse agro-ecosystems, with monocultures of single 'improved' varieties" protected by plant breeders rights and/or patents has often led to greater crop vulnerability to diseases and climatic shocks (Dutfield, 1999, p. 6-7; Chiarolla, 2011), as well as to an overall reduction of biodiversity in agro-ecosystems. Swanson and Göschl (2000) show that during the period 1960–1990, parallel to the increasing number of improved plant varieties protected by plant-breeder rights, plant diversity in agriculture has been also in decline throughout the developing world. In 1992, 74% of all rice varieties in Indonesia descended from only one maternal parent, while in Sri Lanka there were 2000 varieties in 1959 down to five major varieties in 1992 (WCMC, 1992). More recently a study undertaken for the USDA has highlighted that "crop genetic diversity may decline with reductions in total numbers of varieties [and] concentration of area planted in a few favored varieties" (Rubenstein *et al.*, 2005).

6. POSSIBLE WAYS FORWARD

6.1. Standardization of ABS contracts to boost bioprospecting deals and increase resources for biodiversity conservation

One way to scale-up the amount of resources potentially arising from bioprospecting deals is to increase the level of standardization of bioprospecting agreements to make them closer to what would be named a "commodity" in economics (i.e. a standard good produced for sale). This is because transactions are expected to multiply if the good is

40. Ecological equivalence is attained when species or ecosystems are deemed to have enough similarities so that they could replace one other with no resulting net loss from an ecological point of view.

41. For instance, if a provider country were to redirect funds arising from an ABS agreement, which concerns genetic resources collected from a tropical forest, toward the creation of a national park in a semi-arid area, there would be no automatic equivalence in terms of the conserved biodiversity.

42. As stated by Laird and Wynberg (2007), "ABS relationships have emerged as most common model to access genetic resources… but manifest as a gradient of arrangements from superficial to long-term.

easier to exchange and transaction costs are low. A certain degree of standardization would then enable bioprospecting deals to move from «bilateral governance» towards «market governance» (see sub-section 3.1 above). However, the achievement of a relatively high degree of standardization across all relevant sectors of activity seems unfeasible, because high uncertainty, asset specificities and relatively recurrent interactions between the transacting parties—not to mention the variability of ABS requirements under the domestic legal system of different countries—force parties into the paradigm of bilateral governance.

Nagoya Protocol Article 19.1 expressly provides that: "Each Party shall encourage, as appropriate, the development, update and use of sectoral and cross-sectoral model contractual clauses for mutually agreed terms."[43] The IUCN Explanatory Guide (p. 194) thus highlights that "[…] optional model clauses could … provide a useful starting point and help identify best practices, as well as being an important capacity-building tool for those with less experience and saving time and resources when in many cases contracts can be very similar." An informal meeting for the implementation of Articles 19 (Model Contractual Closes) and 20 (Codes of Conduct, Guidelines, and Best Practices and/or Standards) of the Nagoya Protocol, was recently held on 25—26 March 2013 in Tokyo, Japan, with the viewto facilitating discussions on ways to support efforts of Parties to implement the above Articles (UNU-IAS, 2013).[44]

In order to reduce transaction costs, enable the conclusion of ABS deals and promote transparency and fairness, one possible option is to standardize contracts based on asset and/or context characteristics and to develop a number of model contractual closes. Several initiatives have been undertaken to produce model clauses for access and benefit-sharing agreements, most of which at the national level.[45] For instance, the Australian Government has proposed a 'Model ABS Agreement between Access Provider and Access Party' concerning access to biological resources in commonwealth areas, as well as a 'Model ABS Agreement between Australian Government and Access Party' in relation to access to biological resources in these areas. Both documents aim at standardizing bioprospecting contracts with regard to the ABS conditions for the commercial utilization of such resources. For instance, they define monetary benefits for the provider by setting payment percentages (% of gross Exploitation Revenue) based on the "purpose of the product" and the "Gross Exploitation Revenue" received by the access party from the product in one calendar year ($AUD).[46] (See Figure 3).

Figure 3. Australian Government, "Model ABS Agreement between Access Provider and Access Party" concerning access to biological resources in commonwealth areas[47]

SCHEDULE 3. BENEFIT-SHARING WITH THE COMMONWEALTH

A.1. Where the gross Exploitation Revenue received by the Access Party in a calendar year falls within the relevant range specified in column 1 of the table below, the Access Party will pay to the Commonwealth the corresponding percentage of gross Exploitation Revenue specified in column 2 of the table.

Purpose of the product	Gross Exploitation Revenue received in one calendar year ($AUD)	Payment (% of gross Exploitation Revenue)
Pharmaceutical, Neutraceutical or Agricultural	< 500,000 500,000 – 5,000,000 5,000,000	0 2.5 5.0
Chemical and diagnostic	> 200,000 or < 100,000 100,000 – 3,000,000 > 3,000,000	1.5 0 1.0 2.0
Other research	> 200,000 or < 100,000 100,000 – 3,000,000 > 3,000,000	2.5 0 1.0 3.0

Source: Australian Government

An example of an international user-led initiative to provide standardized ABS clauses in the field of marine microbiology concerns the draft Micro B3 model agreement on ABS.[48] In particular, the project consortium is developing a standard MTA whose features include, *inter alia*: 1)

43. The second paragraph further states that the COP "[…] serving as the meeting of the Parties to this Protocol shall periodically take stock of the use of sectoral and cross-sectoral model contractual clauses."

44. The outcome of this meeting will be made available to the ICNP3 as an information document.

45. Several models can be found on the World Intellectual Property Organization (WIPO) website databases at http://www.wipo.int/tk/en/databases/contracts accessed on 10 March 2013.

46. Both model agreements set out non-monetary benefits in schedule 4.

47. World Intellectual Property Organization (WIPO) website database at: http://www.wipo.int/tk/en/databases/contracts/texts/australiaprovider.html accessed on 8 March 2012.

48. The EU FP7 project Micro B3 (Biodiversity, Bioinformatics, Biotechnology, available at: www.microb3.eu) aims at developing innovative bioinformatic approaches and a legal framework to make large-scale data on marine viral, bacterial, archaeal and protists genomes and metagenomes accessible for marine ecosystems biology and to define new targets for biotechnological applications. The research target includes marine microbial metagenomes sourced within as well as beyond national jurisdiction. See Broggiato (2013).

no distinction between commercial and non-commercial research and development (R&D) but an innovative distinction between R&D for the public domain and proprietary R&D; 2) a viral license clause, which allows the transfer of the material to third parties under an MTA that includes the same standard conditions of use and dissemination; and 3) some elements of an *ex post* compensatory liability are specified *ex ante* (e.g. free use for all uses, but accompanied by a liability that is triggered in case of commercialization). The Micro B3 consortium also suggests that the range or amount of benefits to be shared should be agreed in advance to avoid or minimize case-by-case *ex post* negotiations.[49]

However, with very specific assets (genetic resources) and uncertainty about their potential utilization, a high degree of standardization may not often be feasible or economically efficient since it can prevent partners from designing customized contractual solutions. In the context of the food and agriculture sector, access to plant genetic resources (PGRFA) included into the Multilateral System (MLS) of the FAO International Treaty is done on the basis of its Standard Material Transfer Agreement (SMTA).[50] Hence, it does not require ad hoc negotiations between providers and recipients of PGRFA. This reduces transaction costs as "access shall be accorded expeditiously, without the need to track individual accessions and free of charge, or, when a fee is charged, it shall not exceed the minimal cost involved."[51] However, some private sector seed companies appear to prefer avoiding the use of materials coming from the Multilateral System whenever they can access such materials from other sources. This is allegedly due to the lack of flexibility of the Standard Material Transfer Agreement as well as the mandatory inclusion of benefit-sharing and reporting obligations.[52]

Further, biodiversity-wise, there might be a trade-off between more transactions (standardized, but with little guarantees for returns to biodiversity conservation *in situ*) and fewer but customized and higher-quality transactions (adapted, with more targeted incentives directed towards long-term conservation of biodiversity). Yet, according to estimates of the bioprospectors' willingness to pay, which are based on their expected returns from bioprospecting, standardization might not live up to expectations in terms of their capacity to generate new funding. For instance, Costello & Ward (2006) and Harvey & Gericke (2011) have reached relatively pessimistic conclusions.

Finally, it is fundamental to stress the importance of facilitated access to genetic resources for non-commercial research,[53] which is critical for increasing knowledge that can be useful for biodiversity conservation. Thus, the use of model or standard contractual closes should be considered an important tool to implement simplified access measures under the Nagoya Protocol. In conclusion, while it appears that a higher degree of standardization would be desirable for the non-commercial use of genetic resources, there is the need to envisage possible changes of intent with the subsequent negotiations of benefit sharing terms for commercial applications.

6.2. Increasing the share of value captured by provider countries: alliances, cartels and tenders

Some economists call for the emergence of cartels between provider countries (see below, for instance: Vogel *et al.*, 2011). According to Dutfield (1999, p.5), this would help rebalance the weak

49. Ibid.

50. The International Treaty on plant genetic resources for food and agriculture (PGRFA) provides an internationally agreed legally-binding framework for the conservation and sustainable use of crop diversity and the fair and equitable sharing of benefits, in harmony with the CBD. Within biodiversity, the Treaty defines a subset of genetic resources of particular importance for agriculture and food security—i.e., PGRFA—and it limits the scope of application of its norms to them. See Chiarolla et al. (2012). The FAO International Treaty also establishes a Multilateral System of ABS (MLS) that consists in pooling selected crop and forage genetic resources from various countries. In particular, Annex I of the FAO International Treaty I lists the 64 crops and forages that are part of the MLS to ensure worldwide food security. These pooled resources are available under the facilitated access mechanism of the MLS only if access is requested for the purpose of utilisation and conservation for research, breeding and training for food and agriculture. The material pooled in the MLS is governed by a set of common rules of access and benefit-sharing that States agreed upon and were formalised in a standard contract called Standard Material Transfer Agreement (SMTA). See Chiarolla (2008).

51. See FAO International Treaty Article 12.3.b.

52. The International Treaty does not require a burdensome mechanism to track individual accessions, as providers of PGRFA do not have the obligation to keep track of all subsequent transfers of the material. However, reporting obligations for both providers and recipient are included in the SMTA in order to ensure that: 1) some benefits flow back to the MLS when a product based on MLS materials is commercialised on the market; and 2) to enable the functioning of dispute settlement procedures (e.g. in accordance with SMTA Article 8, the SMTA contains procedures for the settlement of any dispute that may arise between a provider and a recipient of PGRFA). Through these reporting obligations, in conjunction with the obligation to use the SMTA for any subsequent third-party transfer of PGRFA, the SMTA enables following the chain of transfers between individual providers and recipients of PGRFA at reduced costs.

53. See: Nagoya Protocol Article 8.a.

bargaining position of biodiversity-rich countries when acting alone, especially in cases where the same genetic resources can be found in several neighbouring countries. In such cases, bioprospectors could seek cross-boundary resources in the country that charges the lowest prices (or applies the less burdensome benefit sharing conditions), leading to an unfavourable 'race to the bottom' between provider countries.

Such arrangements are being used by some groups of countries. For example, in 1999, the Andean Community of Nations (Bolivia, Colombia, Ecuador, Peru and Venezuela) has agreed on Decision 391, which aims at setting a *Common Regime on Access to Genetic Resources* (Cabrera *et al.*, 2012:10). This legal harmonization has eventually led to reduced competition among neighbouring countries. Thus, it can potentially increase each individual member state's bargaining power *vis-à-vis* companies when negotiating bioprospecting contracts. However, this kind of regional alliances does not make a 'race to the bottom' impossible since neighbouring non-member states like Brazil, Chile and Guyana may share many of the same resources (Dutfield, 1999).

Vogel (2007) and Vogel *et al.* (2011: 52) propose the creation of cartels of provider countries for economic efficiency, equity and biodiversity conservation. In particular, Vogel *et al.* (2011) argue that:

> Genetic resources and associated traditional knowledge are expensive to conserve but cheap to access. To the extent that the rewards to conservation are inappropriable, we would expect conservation efforts to be underfunded […] An international regime governing [ABS] can create oligopoly rights. The purpose is to give the countries of origin and communities special protection against the information's being accessed and used by others without compensation to all the countries and communities, which have conserved the respective habitat and knowledge [...] by creating a cartel over genetic resources and associated traditional knowledge, user countries encourage provider countries and communities to invest time, effort and money in conserving habitats and knowledge. (p. 58)

By providing the example of the Group of Like-Minded Megadiverse Countries (LMMC), Vogel (2007) notes that the latter created a cartel in 2002. While the above alliance in the Andean Community of Nations was formed to stop a 'race to the bottom' and harmonize conditions of ABS between members, the cartels may arguably encourage the pursuit of rents. In figure 4 below, Vogel (2007) shows how countries in the LMMC group would capture rents, while other countries would get competitive prices (i.e. no rent, long-term equilibrium prices due to the 'race to the bottom'). Finally, a third group of countries would get nothing since their genetic resources are placed under an open-access regime. Within the cartel, Vogel advocates for a fixed royalty rate of 13% of sales of products derived from genetic resources that are shared among all countries that possess an identical resource. Besides, a small additional percentage (Vogel suggests 2%) would go to the actual supplier country.

However, the Nagoya Protocol *per se* will not ultimately achieve cartelization. Vogel *et al.* (2011, p. 65) argue that: "The Protocol is not a move toward cartelization that the economics of information would justify but its exact opposite: a move toward perfect competition." This means that provider countries, in individual negotiations, are still far from gaining strong bargaining power *vis-à-vis* companies; this eventually leads to limiting their incentives for biodiversity conservation at the national and local level (see above in sections 5.2 and 5.3).

Within a context of alliances and cartels for genetic resources, provider countries, holding sovereign rights over the latter, could also mobilize a specific market-based instrument with the view to increasing transparency and maximizing benefits from bioprospecting activities, namely auctions (or tenders) between resource users (see: category 3 in our typology, see Table 1).

Implementing such MBI in the bioprospecting sector would help reveal true information about companies' production costs (searching, screening, research, etc.) and expected benefits (future flows of revenues from patented products). Hence, disclosure of private information via competitive tenders and auctions reduces asymmetric information and increases provider countries' bargaining power; *in fine*, it may lead to a more favorable agreement for the provider.

In practice, pharmaceutical or cosmetic companies wishing to undertake bioprospecting activities for a specific genetic resource (exploring and screening for genetic information) would bid against each other in order to be chosen by the provider country (or the alliance or cartel) as the exclusive prospecting partner. Each company's sealed tender could include four components: 1) a technical presentation; 2) an empowerment plan proposal; 3) an environmental plan proposal; and 4) a financial (and non-financial) offer where proposed benefits will be stated. Each component would be evaluated and graded against pre-agreed criteria. The provider country (or the alliance or cartel) would then, based on evaluation of each bid, decide on which partner to deal with

Figure 4. Rents from the LMMC cartel as compared with other tenure situation

Source: Vogel (2007)

Note: The Group of Like-Minded Megadiverse Countries affords the possibility to capture rents (dark-shaded). The biodiverse countries which ratified the CBD but are not members of the Group (medium-shaded) can expect an elimination of rents through competitive bidding for common genetic resources. The biodiverse country that has not ratified the CBD has no expectation of rents and considers genetic resources "open access" (identification of biodiverse countries based on World Atlas of Biodiversity, UNEP/WCMC, 2002).

for exclusive bioprospecting activities. Such tenders are for example already used in the tourism sector in Namibia (Ashley and Jones, 2001; Lapeyre, 2009a) and South Africa (Mahony and Van Zyl, 2001) where rural indigenous communities holding clear use rights over natural resources lease out their land for tourism commercial purposes to a private partner. The latter is selected through an open tender process whereby all interested investors bid to be granted the right to operate tourism on the community land. While some problems still limit efficiency (Lapeyre, 2009b), in fine this competition allows communities to negotiate better deals with the private sector (lease fees, jobs created, training, etc.).

Linking this MBI with the standardization of contracts could help organize and rationalize the auction and thus it could further lead to better transparency and fairer ABS agreements.

6.3. (Ethical) Biotrade's potential to increase incentives to conserve biodiversity at the local level

As shown by the example of the Asian yew (see section 5.4 above), an important threat to biodiversity is the overexploitation of single high-value biological species. The Nagoya Protocol *per se* is not concerned by the exploitation of species. However, biotrade holds potential both for implementing benefit sharing, particularly at the local and community levels, as well as for being an important driver of such exploitation, which can be harmful to biodiversity especially if not properly managed.

Biotrade, which refers to "the utilization of biological resources and the products derived therefrom, but *not necessarily of the genetic information* contained in genetic resources" (see: Correa, 2011, p. 8, emphasize added), may not always be concerned by the provisions of the Nagoya Protocol. This is because the latter defines its scope of application in relation to the concept of "utilization of genetic resources." Such concept is defined as the "conduct [of] research and development on the genetic and/or biochemical composition of genetic resources" (NP Article 2). As a result, activities which can be regulated under the Nagoya Protocol encompass detecting, extracting, testing, pre-marketing and commercialization of substances and products such as pigments, flavoring, antioxidants, etc., as well as other R&D activities concerning any material of plant, animal, or microbial origin that has been accessed with the purpose of exploiting its genetic value (Correa, 2011).

Correa (2011, p. 22) also notes that "when the properties of a biochemical compound contained

in a biological material are already known, access to the relevant materials for subsequent processing (drying, extraction, purification, etc.) and commercialization of the compound would not be subject to the Nagoya Protocol." Thus, the Nagoya Protocol does not apply to trade in commodities. For instance, the supply of Aloe Vera (cosmetics), Shea nut (cosmetics, food), Papain (tenderizer), Warburgia (antimalarial), Pyrethrum (insecticide), and Neem (insecticide, dentifrice, etc.) as raw materials to prepare powders, essential oils, etc., may fall outside the scope of the Nagoya Protocol. In such cases, benefit sharing is still possible primarily through the payment of a fair price to farmers or collectors of relevant biological resources (rather than by establishing a formal ABS agreement with PIC and MAT).

Thus, biotrade is a tool which could help fostering conservation through the sustainable trade of biological resources. While the negotiations of the Nagoya Protocol did not aim at regulating biotrade *per se* (see above), the benefits sharing standards established by such legal instrument clearly will have had a positive impact on the evolution of biotrade governance.

Launched by the United Nations Conference on Trade and Development (UNCTAD) in 1996, the BioTrade Initiative has promoted sustainable BioTrade in support of the objectives of the Convention on Biological Diversity. The UNCTAD BioTrade framework is based on a set of seven core principles and criteria that correspond to, and further develop, the objectives and principles of the CBD, namely:

1) the conservation of biodiversity;

2) the sustainable use of biodiversity;

3) fair and equitable sharing of benefits derived from the use of biodiversity;

4) socio-economic sustainability (productive, financial and market management);

5) compliance with national and international regulations;

6) respect for the rights of actors involved in BioTrade activities; and

7) clarity about land tenure, use and access to natural resources and knowledge.

Several of these principles relate to conditions for fair access and benefit sharing, in line with the third objective of the CBD and its Nagoya protocol. For instance, under "fair and equitable sharing of benefits derived from the use of biodiversity", principle 3 states that "article 15 [of the CBD] requires access to and the distribution of the benefits related to genetic resources to be based on prior informed consent and mutually agreed terms. When BioTrade activities involve the commercialization of genetic resources, this principle [must] support these objectives and requirements" Besides, criterion 3.1 further specifies that "the [concerned] organisation[s] should interact and involve actors along the whole value chain, where possible", while criterion 3.2 provides that "income should be generated at all levels of the value chain […] under transparent conditions."

Principle 7 on "Clarity about land tenure, use and access to natural resources and knowledge" specifically envisages the negotiation of prior informed consent *at all levels* (communities, local authorities, central government, etc.) by biotrade companies when accessing biological and genetic resources for their sustainable utilization (criterion 7.2) or accessing traditional knowledge (criterion 7.3).

In sum, all the above principles and criteria are aimed at promoting the conservation of biodiversity through its sustainable commercial use. Biotrade activities are also expected to recognize and reward the efforts of communities that are responsible for or involved in the conservation and sustainable management of bio-resources.

The Union for Ethical BioTrade (UEBT), a voluntary private-sector initiative that stemmed from efforts initiated by the BioTrade Initiative, was eventually launched in 2007. The UEBT is a non-profit association that "promotes the *'Sourcing with Respect'* of ingredients that come from biodiversity". In this regards, "members commit to gradually ensuring that their sourcing practices promote the conservation of biodiversity, respect traditional knowledge and assure the equitable sharing of benefits all along the supply chain."

Participating companies must adhere to minimum requirements laid out in the Ethical BioTrade Standard (UEBT, 2012). The latter builds on the seven BioTrade Principles and Criteria that were developed by the UNCTAD BioTrade Initiative. Concerned companies must: 1) undergo independent third party verification against the UEBT standard, within 6 months after being granted "Approved Candidate status"; 2) develop and submit to the UEBT Secretariat a work-plan to meet compliance with the UEBT standard within 5 years; 3) commit to implementation of the work-plan, report on the progress made in its implementation, and undergo regular independent third party verification towards completion of the work-plan; and 4) commit to the continuous improvement of their sourcing practices.

The above described mechanism can be characterized as a market-based instrument in category 6 of our typology (see Table 1). In particular, a publicly recognized standard (such as this one) operates though a voluntary price signal, which may contribute to biodiversity-enhancing practices in

biotrade. In conclusion, while such market approach could help improving the sustainability of the cultivation of, and trade in, raw biological resources in the cosmetic sector, its effectiveness (in terms of biodiversity conservation) will also depend on the consumers' willingness to pay for the additional conservation costs.

7. CONCLUSIONS

This study was prepared in a context of declining public resources for biodiversity conservation (Overseas Development Assistance, domestic budgets) and increasing attempts to fill the biodiversity funding gap with alternatives sources. The recent Conferences of the Parties of the CBD in Nagoya (2010) and Hyderabad (2012) emphasized both the need for contributions by the private sector as well as disagreement regarding its potential role in the conservation of biodiversity. In particular, different views clearly emerged during the intense debates, which took place around the concepts of "innovative financial mechanisms" or "market-based instruments" for biodiversity. The CBD Parties eventually agreed that financial flows to be devoted to biodiversity conservation must be doubled by 2015 (Decision XI/4, paragraph 7(a), UNEP/CBD/COP/DEC/XI/4). Against this backdrop, any (good) idea for achieving this target might be welcomed.

This study has set out to consider the potential contribution of bioprospecting (under the Nagoya Protocol) to biodiversity conservation. Bioprospecting, which has been described as "the search for plant and animal species from which medicinal drugs and other commercially valuable compounds can be obtained," can be regulated by legal contracts (i.e. mutually agreed terms) that address, *inter alia*, the distribution of costs and benefits between stakeholders. With the Nagoya Protocol on Access and Benefit Sharing (ABS), bioprospecting is to be better regulated and monitored in order to avoid that foreign users do utilize genetic resources and associated traditional knowledge (and capture profits from such utilization) without the prior informed consent and a fair and equitable sharing of benefits with the provider countries and communities.

This study has endeavoured to answer the question of the extent to which bioprospecting under the Nagoya Protocol may contribute to biodiversity conservation by implementing several sequential steps. We first considered bioprospecting contracting from the standpoint of market-based instruments (MBI). These instruments are currently praised for their alleged capacity to generate new financial resources and provide actors with economic incentives, and they cover a wide range of approaches. Bioprospecting contracting refers more specifically to Coasean-type agreements, according to which a limited number of stakeholders engage in a negotiation and agree on transactions. This is also referred to as bilateral governance, as opposed to market governance, because the deals are *ad hoc* and very specific to a given context. This categorization has particular implications. First, it means that transactions are rather limited in number and entail substantial transaction costs that constrain their multiplication. While tools and mechanisms for boosting the number of possible ABS deals, such as the standardization of contracts (i.e. MAT), are under consideration at the national and international levels, there are trade-offs between a higher degree of standardization and the possibility to adapt MAT to specific contexts and to incorporate biodiversity conservation objectives and safeguard closes.

A worrisome aspect that was highlighted by our study is the following. Whatever the (additional) funds that are made available through bioprospecting contracts under national or regional ABS frameworks, their connection to biodiversity conservation appears rather weak. Indeed, there are few mechanisms and legal obligations, if any, except for the elusive Article 9 of the Nagoya Protocol, for expecting that locally or nationally distributed resources through an ABS mechanism would be actually used for biodiversity conservation.

ABS systems, on the one hand, and patents and plant variety protection (PVP), on the other, are legal mechanisms, which are used—with different degrees of success—to create (or regulate) markets for genetic resources (and plant varieties, in the specific case of PVP). They are designed to do so by restricting access to self-replicating biological materials through the establishment of legal rights and obligations at the national level. A corollary is that they all face implementation and enforcement problems because the allegedly infringing activities (including, in the broad sense of the term, what is referred to as biopiracy) may take place in foreign jurisdictions, where they may not necessarily be regarded as illegal.

Interestingly, the negotiation and the adoption of the Nagoya Protocol have been predominantly motivated by demands to remedy this kind of problems in the context of transnational R&D activities. Therefore, its set objectives are to enable and promote a fairer, more equitable and just sharing of the benefits arising from the utilization of genetic resources, while the conservation of biodiversity is more properly described as a desirable consequence of the former. However,

at present, the intellectual property system in many countries is not designed to support compliance with access and benefit sharing (ABS) requirements and only a relatively limited number of countries has adopted and implemented functional ABS legislation and/or regulatory requirements for bioprospecting. This means that the implementation of the Nagoya Protocol and the enhancement of its synergies with the IPR system, including through the disclosure of origin of genetic resources in patent applications, may help defining and defending the rights of indigenous and local communities over genetic resources and traditional knowledge, thereby providing incentives to invest in biodiversity conservation.

However, we have also presented some of the most important limitations of bioprospecting regulation through ABS under the Nagoya Protocol in terms of its potential contribution to biodiversity conservation. In particular, we have assessed such limitations from the analytical standpoint of market-based mechanisms for biodiversity. It was emphasised that:

1) The total value arising from the utilization of genetic resources through bioprospecting can be relatively low and is in any case uncertain, with important differences between relevant sectors of activity. Its potential to fill the biodiversity funding gap is limited, though not negligible; therefore, the importance of channeling such additional resources towards biodiversity conservation in an appropriate way should not be neglected;

2) In terms of providing incentives to sectors not to deplete biodiversity, provider countries have historically captured only a negligible share of the global value of genetic resources. With the adoption of the Nagoya Protocol, uncertainties still remain on its potential to reverse this situation of historical injustice (e.g. its potential application to new and continuous uses of genetic resources held in ex situ collections). Therefore, incentives for biodiversity conservation might remain relatively modest at the national level;

3) ABS decision- and law-making in provider countries might concentrate the entitlements to exercise rights over genetic resources at the central government level so that indigenous and local communities will not be provided with additional resources and/or economic incentives to conserve biodiversity and genetic resources in situ; and

4) bioprospecting and the possible sourcing of genetic resources and/or the ensuing production activities may, in certain cases, pose a threat to biodiversity; in other cases, the incentives introduced by ABS measures, as well as by IPR protection mechanisms, may per se favour behaviors and commercial practices that are detrimental to biodiversity conservation, as it was exemplified in the context of the management of agro-ecosystems.

This study further highlights the importance of facilitated access to genetic resources for non-commercial research, which is critical for increasing knowledge that can be useful for biodiversity conservation. In particular, it suggests that the use of model or standard contractual clauses is an important tool to implement simplified access measures under the Nagoya Protocol. Finally, it emphasizes the need to envisage (and monitor) possible changes of intent and the subsequent negotiations of benefit-sharing terms for commercial applications.

In sum, the review of the literature and the concrete examples analysed in this paper suggest that the benefits-sharing objectives pursued by national ABS legislation (and by the Nagoya Protocol) have a self-standing legitimacy *vis-à-vis* the other CBD objectives. While biodiversity loss certainly reduces opportunities for bioprospecting and benefit sharing, there is no obvious or automatic link between enhanced benefit sharing and improved conditions for biodiversity conservation. Bioprospecting contracting, however, holds potential for tailoring the stream of possible benefits to respond to specific biodiversity conservation needs at the national and local levels. On the one hand, preconditions for augmenting the reciprocal positive externalities between biodiversity conservation and benefit sharing appear to hinge upon the appropriate definition and recognition of enabling rights, particularly at the local and community levels, in provider countries. On the other hand, such preconditions are also contingent on the appropriate implementation of measures concerning compliance, monitoring the utilization of genetic resources and access to justice in user countries.

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