Eco-regional Cooperation on the Genetic Resource Market and the Case of the Andean Community

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Abstract

The United Nations *'Convention on Biological Diversity'* codified state sovereignty over genetic resources and subsequently bilateral contracts over genetic resource use evolved. However, countries currently obtain only few benefits from bilateral contracts, largely due to high transaction costs. In this paper, we consider eco-regional cooperation by megadiverse countries in physical genetic resource trade. The main objective is to investigate whether such cooperation can increase benefits for provider countries and *in-situ* conservation of biodiversity. The Andean Community's access legislation serves as a case study. Our main finding is that eco-regional cooperation has the potential to significantly reduce transaction costs for both supplying countries and customers. It can thereby decrease prices for customers and increase demand, conservation levels and providers' benefits. Countries with a relatively higher biodiversity richness and a comparatively better institutional environment are able to appropriate a higher share of cooperation induced benefits. It remains to be seen how the *'Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization'*, which recently entered into force, impacts on these results. In any case, collusion on the physical genetic resource market will not lead to high benefits as market power is limited by substitutes in form of *ex-situ* resources and freely available genetic information. The Andean Community realises few of the potential cooperation advantages.

JEL classification: F53, K23, Q27, Q28, Q57
Key words: genetic resource market; regional cooperation; Andean Community; CBD; institutional analysis

1 Introduction

Genetic resources and their diversity are valuable for R&D in many industries. Numerous discoveries rely on *in-situ* conservation of genetic resources. Countries engage in costly active conservation by setting aside land as protected areas. Genetic resources are also passively conserved *in-situ* if countries lack the capital or human resources to exploit the land or if transaction costs are too high. Active and passive conservation create positive externalities for genetic resource users. A remuneration for passive and especially active conservation can be achieved through payments for the use of genetic resources. Thereby the positive externalities of conservation that accrue to genetic resource users can–at least partly–be internalised.

The *'Convention on Biological Diversity'*[1] (CBD) and its *'Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity'*[2] (NP) are the global institutional framework for payments for genetic resource use. With its entry into force, the CBD codified the sovereignty of states over their genetic resources. Subsequently, countries started to regulate access to their genetic resources in order to receive payments for the use of genetic resource and the associated traditional knowledge from bilateral *'Access and Benefit-Sharing'* (ABS) contracts. The Nagoya Protocol, which came into effect last year, specifies countries' ABS obligations.

As countries within an eco-region share many genetic resources, they may benefit from joint access regulation. The member countries of the Andean Community[3] (*'Comunidad Andina'*, CAN) were the first to opt for such special regulation. They decided to pass community law, *Decisión 391*[4], to govern access to their genetic resources already in 1996.

In this paper we discuss advantages of eco-regional cooperation for the internalisation of positive conservation externalities accruing to genetic resource users. We study the scope of eco-regional cooperation to improve upon the currently common bilateral contracts with a view (a) to achieving payments for physical genetic re-

[1]United Nations (1992): Convention on Biological Diversity, 31 Int'l Leg. Mat. 818, Rio de Janeiro, 05.06.1992.

[2]United Nations (2010): Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity, Nagoya, 29.10.2010.

[3]The Andean states established the Andean Community with the Cartagena Accord in 1969. Chile was a member until 1976, Venezuela from 1973 until 2006.

[4]Decisión 391 on a 'Common Regime on Access to Genetic Resources' (Comision del Acuerdo Cartagena (1996): Decisión 391: Régimen Común sobre Acceso a los Recursos Genéticos, Gaceta Oficial del Acuerdo de Cartagena, Año XII, Numero 213, Lima, 17.06.1996.)

source use and thereby (b) to increasing conservation. In our analysis we consider a continuum of cooperation from loose cooperative behaviour to collusion. In light of transaction cost economics, we study on a generic level how general dimensions of cooperation impact on economies of scale and other institutional factors–and thereby on the volume of trade, the monetary and non-monetary benefits of cooperating countries, and conservation levels. Moreover, we analyse how a country's characteristics influence its share of cooperation induced benefits. We discuss the potential of collusion and its impact on conservation. The CAN serves as case study and adds empirical insights to our theoretical analysis.

Economic and legal research have focused mainly on strong regional cooperation–cartelization on the genetic resource market–to increase the revenues of countries rich in biodiversity. From an economic perspective, Vogel et al. (i.a. 1995, 2000, 2007) have argued since long for an international cartel over genetic resources that also covers natural information[5]. Besides, they propose the conversion of traditional knowledge associated with genetic resources into trade secrets and the formation of local cartels over these, which may merge into regional and subsequently a global cartel. Others have touched upon genetic resource cartels and are more sceptical of their success (Reid et al. (1996, p. 169), Richerzhagen (2011, p. 2254)). Asebey and Kempenaar (1995) and Tilford (1998) provide legal studies of cartelization on the biodiversity market. We differ from the above mentioned cartelization literature in that we explicitly focus on regional cooperation over physical genetic resources, analyse a continuum of loose cooperation to collusion, and additionally consider implication for the level of biodiversity conservation. A related proposition by Winter (2009) are common pools of genetic resources, whereby countries of the same biogeographical region form corporations.

With regard to the CAN, Rosell (1997), Ten Kate (1997), Mariaca (1999), Tafur-Dominguez (2000), Ruiz (2003), and Bucher (2008) review the content of *Decisión 391* from a legal perspective; we add an economic analysis with our case study.

The paper proceeds as follows: In Section 2 we provide a background on the genetic resource market under the CBD and its Nagoya Protocol. In Section 3 we introduce the dimensions of eco-regional cooperation in genetic resource trade. We analyse eco-regional cooperation advantages in Section 4. In Section 5 we study the CAN community access regulation. With Section 6 we conclude.

[5]Natural information is an even wider category than genetic information, including also, for example, biomimicry (Vogel et al. 2011, p. 55).

2 The genetic resource market under the CBD and its Nagoya Protocol

The CBD and its Nagoya Protocol established an *'Access and Benefit-Sharing'* (ABS) mechanism to govern genetic resource use and the fair sharing of the resulting benefits. The CBD defines genetic resources as "genetic material of actual or potential value", whereby "genetic material means any material of plant, animal, microbial or other origin containing functional units of heredity" (*Art. 2*).The predominant, though not uncontested (ref. Schei and Tvedt 2010, p. 18), interpretation is that the CBD applies only to genetic material, not to genetic or natural information. We therefore focus on physical genetic resources in this paper.

The Nagoya Protocol entered into force in October 2014 and specifies the ABS mechanism, which member countries have to implement.[6] It regulates countries access (*Art. 6, 7*), benefit sharing (*Art. 5*), and compliance obligations (*Art. 15 - 18, 30*) with regard to genetic resources and associated traditional knowledge. A user entity has to ask a provider country for access to its genetic resources and/or traditional knowledge associated with genetic resources, i.e. to obtain *'Prior Informed Consent'* (PIC). If granted, user and provider country negotiate the terms of access and benefit sharing, the *'Mutually Agreed Terms'* (MAT). The benefit sharing can take various forms and may include monetary (e.g. up-front payments, royalties) and non-monetary benefits (e.g. joint R&D, technology transfer) (ref. *Annex NP*). The benefits finally agreed upon in bilateral ABS mirror the relative negotiation power of provider and customer, but also costs of providers and benefits for users. Many countries, such as Brazil, are both provider and user countries.

The Nagoya Protocol foresees the creation of a *'National Focal Point'* with international information and cooperation duties and a *'Competent National Authority'* for granting access in member countries (*Art. 13*). A global *'Access and Benefit-sharing Clearing-House'* shall facilitate the information sharing (*Art. 14*). Moreover, the Nagoya Protocol provides for the development of model contractual clauses (*Art. 19*), codes of conduct, guidelines, and best practices and/or standards (*Art. 20*), as well as awareness-rising (*Art. 21*), capacity building (*Art. 22*), and technology transfer, collaboration, and cooperation (*Art. 23*).

The Nagoya Protocol explicitly encourages transboundary cooperation (*Art. 11*)

[6]The Nagoya Protocol is based on the 2002 *'Bonn Guidelines on Access to Genetic Resources and Fair and Equitable Sharing of the Benefits Arising out of their Utilization'* (UNEP/CBD/COP/6/24).

and prompts a discussion on a *'Global Multilateral Benefit-Sharing Mechanism'* for shared genetic resources or for resources for which PIC is not possible (*Art. 10*).

Genetic resources are important production factors for many industries, i.a. pharmaceutical and cosmetic firms, biotechnology, and food and beverage industries (Ten Kate and Laird 1999, p. 9). Physical genetic resources are, for example, accessed to be exported into another country for proliferation. They may also be accessed because of the genetic or natural information contained within them. Mostly, it is the information that is commercially used (Stone (1994, p. 597); Schei and Tvedt (2010)). Richerzhagen (2011, p. 2248) describes the current genetic resource market as oligopsonistic. Ten Kate and Laird (2000, p. 245) explain that "life science titans such as Monsanto, Novartis and Aventis evolve alongside a host of small research biotechnology companies". The supply-side concentration on the market for physical genetic resources depends on the type of screening. Only for random screening do all countries with reasonable biodiversity richness compete against each other. Most screening, though, is knowledge-based, be it 'biorational', 'chemotaxonomic' or 'ethnobotanical' (Ten Kate and Laird 2000, p. 249 f.). Users search for specific genetic resources–which reduces the number of suppliers beforehand. Hence, we describe the market for physical genetic resources as a bilateral oligopoly.

So far, bilateral bioprospecting falls behind expectations in terms of contract numbers and magnitude of realised benefits (Boisvert and Vivien (2005, p. 466 f.); Pastor and Ruiz (2009, p. 8)). Currently difficult access regulations from provider countries raise transaction costs for users, which reduces the demand for access to genetic resources (Fernández Ugalde 2007, p. 7). Also for providers, bilateral contractual ABS involves–so far–considerable transaction costs for administration, monitoring, and enforcement (Vogel 2007, p. 59 ff.). For most resource-rich countries, especially monitoring of contract compliance is a challenge (Ten Kate and Laird 2000, p. 244). They face asymmetric information regarding the commercial research process in the purchasing country and the sources of a final product's components. Detection of genetic resources taken without prior consent of the host country or of resources acquired through illegal trade is similarly difficult. In addition, many countries implemented national legislation ineffectively and inefficiently (Kamau et al. 2010, p. 248). Besides, the bilateral approach covers access to physical genetic resources and may also be applied to genetic information not yet in the public domain. It cannot, however, capture the bulk of intangible genetic and natural information in the (semi-)public domain.

It has to be seen, whether and how far the Nagoya Protocol which came into force recently changes bilateral contractual ABS and whether and how *Art. 11*, NP, on transboundary cooperation and *Art. 10*, NP, on a *'Global Multilateral Benefit-Sharing Mechanism'* are implemented.

It is in this setting that we study the scope of eco-regional cooperation to improve upon the currently common bilateral contracts with a view to achieving payments for physical genetic resource use and thereby to increasing conservation.

3 Dimensions of eco-regional cooperation

In the following we introduce different elements of eco-regional cooperation in physical genetic resource trade. Megadiverse countries can cooperate rather loosely by, for example, coordinating information they reveal to third parties. Or in the other extreme, they may collude in prices and reallocate benefits and thereby be close to maximising their joint benefit. In the following we present general degrees of cooperative behaviour from cooperation ((i)-(v)) to collusion (vi):

(i) Public notification of all bioprospecting processes.

(ii) A public register of genetic resources within the eco-region.

(iii) Coordination of access to genetic resources.

(iv) A regional competent authority.

(v) Reallocation of benefits according to a pre-defined rule.

(vi) Coordination in prices.

Public notification of bioprospecting processes (i) and a public register of biological or genetic resources within the eco-region (ii) are forms of loose cooperation between countries. They can vary in their set-up and comprehensiveness. The register might be similar to or make use of existing genetic barcode databases[7].

A stronger form of cooperation is the coordination of access to physical genetic resources within the eco-region or even a joint access regulation (iii). Besides the CAN's *Decisión 391*, there are other regional frameworks of more or less coordinated access: The *'African Union'* has developed a non-binding *'Model Legislation for the Protection of the Rights of Local Communities, Farmers and Breeders, and for the*

[7]For example: GenBank of the National Library of Medicine of the United States of America (www.ncbi.nlm.nih.gov/ genbank/, last 19.09.2014), European Nucleotide Archive ENA (www.ebi.ac.uk/ena, last 19.09.2014), DNA Data Bank of Japan (www.ddbj.nig.ac.jp, last 19.09.2014).

Regulation of Access to Biological Resources' in 2001 to assist its members in drafting their national legislation (Munyi and Jonas 2013, p. 219 f.). The *'Association of South East Asian Nations'* has developed a *'Framework Agreement'* on ABS, which "leaves each Member State to determine the nature of the country's access instrument" (Cabrera Medaglia et al. 2012, p. 25) and is still a draft (ASEAN Centre for Biodiversity 2013). The *'Central American Commission on Environment and Development'* has drafted a *'Central American Protocol on Access to Genetic and Biochemical Resources and the associated Traditional Knowledge'*, which has been signed but not ratified by its member countries (Cabrera Medaglia et al. 2012, p. 80).[8]

A regional authority (iv) may coordinate joint action and represent the group of cooperating countries. The member countries decide upon the range and depth of its competencies; it might be responsible for or merely streamline information, communication, negotiation and/or trade.

An even more intense form of cooperation is the redistribution of monetary and possibly non-monetary benefits from genetic resource trade among members sharing the same genetic resources within their eco-region (v). Monetary benefits might, for example, be shared through a fund and non-monetary benefits through joint training workshops or cooperation in R&D.

Cooperation merges into a collusion if countries agree on and are able to enforce higher prices for physical genetic resources (vi). There are parallels to the industrial economics literature, which we transfer and adapt to eco-regional state-run collusion[9]. Most industrial cartels coordinate both in prices and market shares (Harrington 2006, p. 5).[10] Coordinating market shares typically implies agreeing on trade volumes (quota) or allocating bioprospecting agents (e.g. per industry sector) according to a pre-defined rule. Considering genetic resource collusions, such rule could prohibit undercutting prices of another member country that is already negotiating with a customer. A quota, however, is not feasible because physical genetic

[8]The Himalayan Region might develop a regional framework as well (Prasad Oli and Das Gupta 2008). The *'Group of Like-Minded Megadiverse Countries'* is not (yet) a cooperation in the sense of this paper as it does not (yet) comprise entire eco-regions.

[9]State-run cartels are not identical to industrial cartels. Levenstein and Suslow (2006, p. 49) stress that "their goals are more complex than private cartels, including not only the maximization of joint profits, but national economic stability and international political influence as well".

[10]For example, the lysine cartel coordinated on one price, the citric acid cartel on two, and the electrical and mechanical carbon and graphite products cartel had many prices. The citric acid cartel additionally introduced a global sales quota for each firm, the lysine cartel a minimum sales target differentiated between the global and the European market, and the chlorine-chloride cartel followed the home-market-principle (Harrington 2006, p. 6, 24-26, 33).

resources accessed to obtain the contained information can only be sold once as the information is then likely to enter the public domain (Vogel et al. 2000, p. 105 f.). Hence, genetic resource collusions are likely to coordinate in prices. Fixing explicit prices is easier if the collusion can focus on comparable goods like several endemic species[11]. When a collusion's product is too heterogeneous, internal compliance control is difficult (Carlton and Perloff 2005, p. 135). Prices can be monetary or non-monetary benefits (ref. Section 2). Besides coordination in prices (vi), collusion may as well include all or some of the above described elements (i)-(v). It might facilitate public notification (i) and a resource register (ii). If a collusion enjoys cartel power and trust among its members exists, it might have an incentive to increase bioprospecting rates via pro-active genetic resource advertising. Benefit reallocation (v) among collusion members may include all or only collusion induced benefits. In contrast to the latter, the former implies that countries obtain benefit shares which would otherwise accrue exclusively to a neighbouring country. Such total benefit redistribution is the strongest collusion type.

4 Eco-regional cooperation advantages

In this section we discuss eco-regional cooperation advantages arising from different degrees of cooperation. We analyse on a generic level how the different design elements (i)-(vi) contribute to economies of scale (Section 4.1) and other institutional factors (Section 4.2) as well as market power and bargaining strength (Section 4.3). To address the entire amplitude of cooperation advantages in our analysis, we refer in the following to a far-reaching eco-regional cooperation covering the elements (i) to (vi). Table 1 summarises these impacts at the end of these three sections.

Once we have shown the impact of eco-regional collaboration elements on economies of scale, transparency, communal spirit, and market power and bargaining strength, we then discuss their impact on transaction costs as well as monetary and non-monetary benefits–and thereby on profits of cooperating countries (Section 4.4) and on the level of biodiversity conservation (Section 4.5).

4.1 Economies of scale

Economies of scale in administration, *monitoring*, and *enforcement* may arise from cooperation and mutual exchange of information, especially if facilitated by a re-

[11] Endemic species are species with are unique to a confined geographic location.

gional competent authority (iv). The information complexity can be distributed over all cooperating countries. Besides, knowledge spillovers occur, which lessen each country's information burden share even further. This includes information on the CBD, the Nagoya Protocol, international negotiations, national ABS regulations, the reliability of customers, as well as information on genetic resources and related knowledge. Public notification of ABS processes (i) further contributes to economies of scale in monitoring a customer's usage of genetic material and information as well as products developed thereof. Especially with advancing technologies, economies of scale in monitoring are increasingly important. Public notification additionally generates economies of scale in enforcement by increasing transparency about customers (ref. Section 4.2). A regional authority also lowers the enforcement costs by discouraging non-compliance by customers via a higher threat of detection. Coordination of access regulation (iii) will facilitate the work of a regional competent authority and raise the described economies of scale.

Economies of scale in advertising may arise if a regional competent authority (iv) increases the visibility and effectiveness of marketing campaigns; a public resource register (ii) will support these activities. Coordination in access (iii) generates economies of scale in advertising as other countries will communicate identical or similar access conditions to customers–even in absence of a regional authority.

Economies of scale in biotechnological development may result from exchange of information through a regional authority (iv) as well. Cooperation increases the chance that the worldwide unevenly distributed information on genetic resources and biotechnological knowledge reaches a country. It also reduces the degree of uncertainty inherent in this information as it can be verified with cooperating countries. A public resource register (ii), public notification of ABS processes and the genetic resources involved (i), and benefit reallocation of non-monetary benefits in form of joint R&D (v) contribute to economies of scale in biotechnological development. They may occur even for the most developed country; it will gain from a wider research network with an increased rate of innovations.

Additional side-benefits from a regional authority (iv) are possible regarding the management of 'cross-border affairs' such as invasive alien species and effectiveness of regional policies such as nature conservation zones.[12]

[12] We thank a reviewer from the 2nd International Conference on Environment and Natural Resources Management in Developing and Transition Economies (enrmdte), Clermont-Ferrand, 17. – 19.10.2012, for mentioning these additional side-benefits.

4.2 Other institutional advantages

Eco-regional cooperation influences institutional aspects within the member countries. Neighbouring countries that build comparable institutions enable institutional learning and adaptation and thereby enhance institutional functioning. A regional authority (iv) is likely to reinforce institutional capacity. Joint action–in whichever form–may create communal spirit and trust. Trust among cooperating countries might enable pro-active resource advertising to increase bioprospecting rates. Moreover, a country's property rights over genetic resources will enjoy a stronger enforcement as other cooperating countries have an incentive to respect them in expectation of reciprocal enforcement of their property rights over genetic resources.

Cooperation reduces the information asymmetry problem on both resource demand and supply side. A genetic resource supply country has higher chances to dispose over knowledge about the bioprospecting firm from other countries, especially in case of public announcement of ABS processes (i). This diminishes the principal-agent-problem of moral hazard, i.e. the threat that a prospecting firm undermines a contract by, for example, using the genetic material for R&D other than agreed upon. In turn, a prospecting firm enjoys access to detailed public information on a countries' genetic resources and access requests by competitors. Moreover, a genetic resource register (ii) eases the identification of one or several countries of origin. Coordination of access (iii) lowers information costs on access requirements of different potential supply countries. A regional competent authority (iv) further increases transparency for customers and suppliers. Transparency in genetic resource trade lowers transaction costs in form of monitoring and enforcement costs for the host countries and in form of search costs for the prospecting firms.

Countries belonging to an eco-regional cooperation may build up reputation. As it is a transaction-specific expenditure and much dependent on the customer's perception, the return–becoming a preferable trading partner–is incalculable. Reputation generates "idiosyncratic exchange relations" that withstand trade disruptions better (Williamson 1979, p. 240 f.).

Eco-regional cooperation in physical genetic resource trade can influence some, although probably not the most important components of the institutional environment. The institutional environment refers to a country's political and economic setting, which is simultaneously dependent on many factors such as corruption, delinquency, unemployment, and trust (Davis and North 1970, p. 133). More specifically, eco-regional cooperation cannot, for example, provide remedy for poor statal enforcement such as control of illegal trade in genetic resources or even stealing of resources. Similarly, eco-regional cooperation does not have a direct impact on the deficiencies of national biodiversity governance institutions (e.g. those referred to by Kamau et al. (2010, p. 248)). It might give an additional (needed) stimulus, though, and reduce transaction costs of implementing these institutions.

4.3 Market power and bargaining strength

Collusion in prices of physical genetic resources (vi) may generate cartel profits, an economic rent besides the remuneration of provision costs of a resource. Economic rents are only possible in case of endemic resources, imperfect competition, or search costs. Achieving economic rents through collusion requires cartel power. Cartel power consists of the two related components 'market power' which is defined by "the ability to price profitably above the competitive level" (Carlton and Perloff 2005, p. 8) and 'bargaining strength'[13] which describes the cartels ability to speak with one voice, act as one, and commit credibly (Komorita 1977, p. 68).

Market power depends on the market share and the demand elasticity. The market share for physical genetic resources rises in the share of global biodiversity, the estimated share of unknown species, and the number of endemic species represented by the eco-regional genetic resource cartel. The effectiveness of the cartel's power in rising prices hinges on the demand elasticity, i.e. it being inelastic. Empirically estimated demand elasticities can currently not be obtained; the amount of available prices for and quantities of genetic resources is insufficient due to few and often confidential bioprospecting contracts. Reid et al. (1996, p. 168 f.) assume an elastic demand for biochemical resources for the pharmaceutical industry and a less elastic one for genetic resources for agricultural use. The demand elasticity rests upon the ease of substituting physical genetic resources as well as random or specific screening. The most important substitute is the increasing importance of genetic and natural information (ref. Section 2). It is a very imminent external factor threatening eco-reginal collusion in physical genetic resource trade. Besides, genetic resources that have been obtained prior to the entry into force of the Nagoya Protocol are substitutes as the obligations under the Protocol do not apply to them. In combination, these substitutes challenge the benefits and thus the impact of eco-regional collusion. Hence, there might, if at all, only be a short window of opportunity for colluding in prices of physical genetic resources before the continuously increasing stock of sub-

[13] Also termed 'tactical advantage' by Komorita (1977, p. 68).

stitutes in form of freely available genetic and natural information as well as *ex-situ* resources nullifies market power. However, if any, market power, is likely to be weak due to already existing substitutes.

The lower the market share the more important is bargaining strength. Cartel members acting credibly as one may be able to appropriate a higher percentage of a potential price differential between the buyers willingness-to-pay and the own willingness-to-sell. Credibly implemented joint access regulation (iii) and a regional authority (iv), which is equipped with competences to negotiate binding trade agreements, are important elements for establishing bargaining strength. The cooperating countries will have to find a way of assuring the regional authority's credibility, for example, by agreeing on guidelines that balance freedom of authority and own sovereignty. This balancing act is tricky. The competent authority will negotiate every deal anew as there are no standardised products and prices, and will thereby accumulate considerable knowledge. This knowledge lead may erode the power of the countries and make them dependent on the regional authority.

For successful collusion, potential rents have to outweigh transaction costs of collusion. The latter include notification, coordination, and negotiation costs among collusion members, costs for enforcing the collusive agreement internally, as well as costs for commitment devices. Moreover, there are costs of compromises as the agreement might deviate from the individual optimum.

4.4 Impacts on the profits of cooperating countries

The profits of cooperating countries depend on the level of transaction costs and the amount of monetary and non-monetary benefits. Economies of scale (ref. Section 4.1) and other institutional advantages such as transparency and mutual trust (ref. Section 4.2) reduce transaction costs for biodiversity rich provider countries. New transaction costs associated with cooperation, e.g. coordination costs, attenuate the transaction cost reduction, but are arguably by far smaller than the transaction cost reductions from cooperation advantages. Thus, there is most likely a net transaction cost reduction for supply countries under eco-regional cooperation–raising profits.

Profits may also rise due to benefits induced by cooperation through an increase in the volume of trade. The reduction in transaction costs that arises for customers (ref. Section 4.2) is likely to increase the eco-region's attractiveness for bioprospecting agents and, thus, to raise demand for physical genetic resources and thereby benefits for supply countries. In addition, collusion induced benefits are theoret-

Table 1: Eco-regional cooperation advantages from cooperation elements (i) - (vi)

Benefit type	**Public notification**	**Public resource register**	**Access coordination**	**Regional authority***	**Benefit reallocation**	**Price coordination**
Economies of scale						
Administration			x†	x		
Monitoring	x		x†	x		
Enforcement	x		x†	x		
Advertising		x	x	x		
Biotechnological development	x	x		x	x•	
Cross boarder affairs				x		
Other institutional advantages						
Communal spirit/trust◇	x	x	x	x	x	
Transparency for suppliers	x			x		
Transparency for customers	x	x	x	x		
Reputation▷	x	x				
Market power and bargaining strength vis-à-vis customers						
Better trade conditions			x	x		x

* The benefits realised through creating a regional authority are conditional on its institutional competencies. We consider a regional authority with far-reaching competencies.
† Indirect through facilitating economies of scale from a regional competent authority.
• In case of non-monetary benefits.
◇ Communal spirit manifests itself inter alia in the mutual recognition of property rights.
▷ Much dependent on the behaviour of the suppliers and expectations of the customers.

ically possible (ref. Section 4.3). In both cases, benefits may be monetary and non-monetary.

Cooperating countries profit to different degrees from the increase in benefits. In the following, we analyse factors that largely determine the distribution of potential cooperation induced benefits. The benefit distribution is influenced by the countries' characteristics and cooperation design. We first consider eco-regional cooperation without benefit redistribution. Once the eco-region has attracted a trading partner, countries within the eco-region compete against each other in the process of finalising the contract between the customer and one of themselves. A country is the more attractive the higher its relative biodiversity share and the lower the transaction costs for the customer, i.e. the better the institutional environment.[14] If countries decide to redistribute benefits (v) as part of eco-regional cooperation, the relative distribution of the total benefit among these countries depends on the respective allocation rule. A more in-depth analysis of a rule for the redistribution of

[14]We consider customers from CBD Parties who have an interest in complying with the CBD. 194 countries are Parties to the CBD. (Online: www.cbd.int/convention/parties/list, last 11.07.2014).

benefits and internal benefit spillovers or of market share allocation regulations is beyond the scope of this paper. In the end, though, these rules mirror the relative negotiation power of countries as they are the result of a negotiation process. The relative negotiation power assumably depends on the countries' relative biodiversity richness and relative political power, which tends to be correlated with the relative institutional environment.

A cooperating country's benefit share thus, arguably, generally depends on the country's (a) respective institutional environment and (b) relative level of biodiversity and number of species endemic in its territory as compared to the other countries of the eco-region. We give an an overview of relative benefit shares in Table 2. Ceteris

Table 2: Cooperating countries' relative benefit shares

		Relative biodiversity richness	
		low	high
Relative institutional environment	unfavourable	+	++
	favourable	+++	++++

paribus, a relatively favourable institutional environment in comparison to other countries leads to higher benefits. The same applies to a ceteris paribus relatively higher biodiversity richness. The country with an institutional trade advantage or an Hecksher-Ohlin comparative advantage relating to biodiversity endowments will thus obtain the contract. Richerzhagen and Holm-Müller (2005) emphasize the importance of the institutional environment for attracting genetic resource trade. A cooperating country with the comparatively best institutional environment and the highest biodiversity richness will reap the highest benefits (++++). It can appropriate the largest share of cooperation induced benefits. Considering eco-regional cooperation among several biodiversity rich countries, we assume that a relatively favourable institutional environment is more decisive for the magnitude of the benefit share. Hence, a country characterised by a relatively good institutional environment and a relatively low biodiversity richness (+++) will, arguably, gain (slightly) more from eco-regional cooperation than a country with a relatively high biodiversity richness and a relatively unfavourable institutional environment (++). If biodiversity richness differs much among countries of the same eco-region, this ordering is likely to reverse. The country with the poorest institutional environment and the relatively lowest biodiversity richness will hardly obtain any benefits from eco-regional cooperation (+).

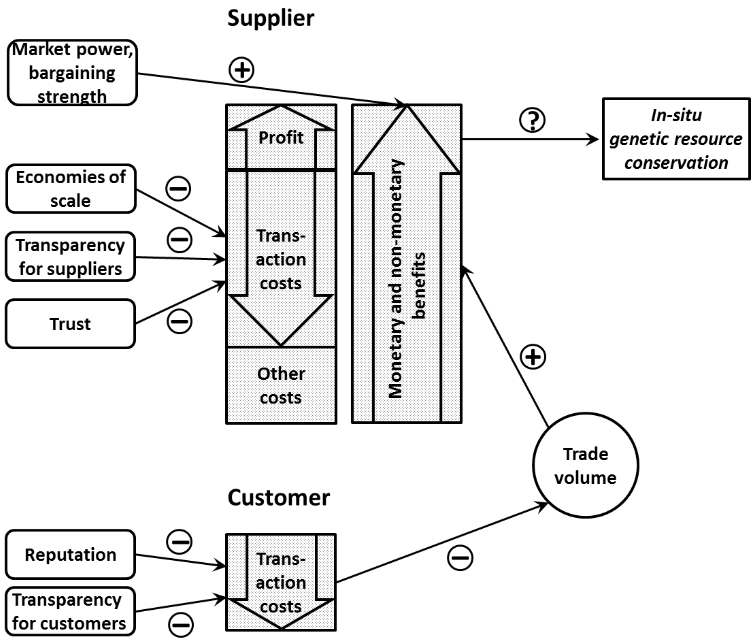
4.5 Indirect effects on the level of biodiversity conservation

The level of active and passive *in-situ* conservation of genetic resources depends on many factors. Passive conservation results from the inability to exploit the land cost-efficiently. Pressure on undeveloped land rises with increasing economic development and human capital. Active conservation efforts may be grounded in intrinsic motives. Besides, they may be induced by the prospect of income and job creation trough eco-tourism and other direct benefits from conservation. Payments for access to physical genetic resources are another factor that provides *in-situ* conservation incentives. The payments internalise positive conservation externalities accruing to users of physical genetic resources and thus increase *in-situ* conservation: Compared to the bilateral contractual approach, demand is higher in case of eco-regional cooperation of megadiverse countries as prices for customers are lower (ref. Section 4.2). A higher demand for physical genetic resources should lead to an increase in conservation of physical genetic resources and especially be an incentive for *in-situ* biodiversity conservation through its option value for future bioprospecting contracts.

The case of strong cooperation in form of collusion (vi), though, is special. Successful collusion would reduce demand for genetic resources compared to an ABS mechanism with equal levels of transaction costs. Higher prices, though, might create an incentive for *in-situ* conservation through the option value of profitable bioprospecting contracts. Moreover, compared to the status-quo ABS successful collusion does not necessarily reduce demand as the total access price might not increase if collusion simultaneously leads to a reduction in a customer's transaction costs. If access is much more streamlined, explicit and transparent after collusion, this reduction in transaction costs might overcompensate the rise in access price. Thus, the effect of collusion on the level of biodiversity conservation might also be positive, but is at least unclear.

A summary of this Section is provided by Figure 1, which illustrates the described interlinkages: the impact of eco-regional cooperation on economies of economies of scale (ref. Section 4.1), other institutional factors such as transparency and communal spirit (ref. Section 4.2), and market power and bargaining strength (ref. Section 4.3), and their impact on transaction costs as well as monetary and non-monetary benefits–and thereby on profits of cooperating countries (ref. Section 4.4) and on the level of biodiversity conservation (ref. Section 4.5).

Figure 1: Eco-regional cooperation advantages



5 Case Study: The Andean Community's cooperation in genetic resource trade

The Andean Community[15] (CAN) was the first eco-region that decided to regulate access to its genetic resources by community law. In 1996 it passed *Decisión 391*[16] on a *'Régimen Común sobre Acceso a los Recursos Genéticos'*. The Andean countries' motivation to collectively regulate access to genetic resources might be of monetary and non-monetary nature. Ruiz (2003, p. 11) reports that perceptions of excessive biopiracy and the related expectation of high potential commercial gains from genetic resource trade largely influenced the drafting of *Decisión 391*; those involved thought of bioprospecting as a "fountain of considerable richness". This might also explain the–as we will expound–restrictiveness of the framework. But the CAN does not refer to itself as a collusion. It intends with *Decisión 391* to "establish the conditions for just and equitable participation in the benefits of the access" (*Art. 2a*) and to "strengthen the negotiating capacity of the Member Countries" (*Art. 2e*).

In this section we analyse the CAN's *Decisión 391* together with *Resoluciónes*

[15] For information on the Andean Community ref. footnote 3.
[16] Ref. footnote 4.

414[17] and *415*[18] detailing an application form and a model contract in light of the previously discussed advantages of eco-regional cooperation in physical genetic resource trade. In Section 5.1 we describe the characteristics of *Decisión 391* and in Section 5.2 we evaluate the cooperation advantages for the CAN members.

5.1 The Andean Community's access regulation

Decisión 391 is embedded in the political-institutional environment of the CBD and the Cartagena Agreement[19]. It directly applies in Colombia; Peru, Ecuador, and Bolivia drafted special national legislation (Díaz 2000, p. 10). Access regulation is thus streamlined, but not uniform. In the following, we analyse *Decisión 391* in light of the cooperation characteristics introduced in Section 3.

Public notification of all bioprospecting processes. Decisión 391 includes the notification of all other *'Competent National Authorities'* (*Art. 48, 49*) and the public of ABS processes (*Art. 18, 21, 27, 28*). It stipulates short time limits for the Competent National Authorities to notify the public after application entry (5 days, *Art. 28*), to evaluate the application after registration (30 days, *Art. 29*), and to inform the applicant after the evaluation has been completed (5 days, *Art. 30*).

Public genetic resource register. Art. 50n calls upon the Competent National Authorities to keep a national genetic resource register. Columbia created such inventory (Law 99, Art. 5). Yet *Art. 50n* neither requires additional screening and collecting activities nor public access to the inventory.

Coordination of access to genetic resources. Decisión 391 provides detailed genetic resource access regulation (*Art. 16 - Art. 47* as well as *Resolución 414* and *Resolución 415*). It includes access to *in-situ* and *ex-situ* resources as well as their by-products and intangible components[20] (*Art. 1, 3*). The CAN requires that: CAN nationals have to be part of the research, research in the country of origin has to be supported, knowledge transfer mechanisms have to be established, state of the art knowledge about the resource and method in question have to be transferred, and

[17] Comision del Acuerdo Cartagena (1996): Resolución 414: Adopción del modelo referencial de solicitud de acceso a recursos genéticos, Gaceta Oficial del Acuerdo de Cartagena, Año XIII, Numero 217, Lima, 05.08.1996.

[18] Comision del Acuerdo Cartagena (1996): Resolución 415: Adopción del modelo referencial de contrato de acceso a resursos genéticos, Gaceta Oficial del Acuerdo de Cartagena, Año XIII, Numero 217, Lima, 05.08.1996.

[19] The CAN is based on the Cartagena Agreement signed in 1969.

[20] Intangible components refer to "all individual or collective knowledge, innovations and practices associated with a particular genetic resource or its derived products, whether or not protected by intellectual property regimes" (Glowka 1997, p. 250).

the institutional development in the country of origin as well as the competencies of local communities have to be supported (*Art. 17a-f*). Moreover, prospectors have to supply duplicates of collected resources, the research results, and the conditions of material transfer contracts signed with other parties to the Competent National Authority (*Art. 17g-i*). Only if the prospector provides the state of art information about the resource, its uses, and the associated risks, access will be granted (*Art. 22*). *Art. 35* requires a benefit sharing agreement as annex to the access contract.

Regional competent authority. Decisión 391 inaugurates the *'Andean Committee on Genetic Resources'* with *Art. 51.* Alongside general coordination and recommendation tasks, it is responsible for proposing an outline of a joint database for access applications and contracts (*Art. 51c*) as well as a joint warning system for access problems (*Art. 51g*), for promoting joint research and technology transfer (*Art. 51d*), and for management and control of access to shared resources (*Art. 51f*). The Andean Committee functions as umbrella organisation of the Competent National Authorities. The latter keep their sovereignty over granting access and draft national access regulation subject to the CBD and CAN *Decisión 391* (*Art. 5*)[21].

Benefit reallocation. The CAN members do not redistribute benefits. The Competent National Authority that attracts a bioprospector enters into contract with the agent and obtains–if existent–the entire benefits.

Coordination in prices. Neither *Decisión 391* nor the model contract contained in *Resolución 415* specify a classification and assignment of genetic resources to benefit-sharing requirements.

5.2 Analysis of the Andean Community's cooperation advantages

We analyse the CAN's theoretical advantages from jointly regulating access by *Decisión 391* in form of transaction cost reductions and of an increase in benefits due to additional demand (Section 5.2.1) as well as the distribution of cooperation induced benefits among CAN members (Section 5.2.2). Subsequently, we contrast them with realised cooperation advantages (Section 5.2.3).

5.2.1 Potential cooperation advantages for the Andean Community

In the following we discuss advantages, which the CAN members could theoretically realise through eco-regional cooperation as set out in *Decisión 391* as well as associated indirect impacts on conservation.

[21] *Decisión 391* has precedence over national law (Bucher 2008, p. 112).

Economies of scale. CAN collusion members are to inform each other about all ABS related aspects including in cases of defraud (*Art. 48, 49*). Thereby they profit from a reduction in information costs regarding monitoring and enforcement activities. The CAN may achieve economies of scale in administration with *Resolución 414* specifying a model application form and *Resolución 415* outlining a model contract. Besides, the CAN is likely to realise economies of scale in biotechnological development. It aims to foster exchange and development of technologies and scientific and technological knowledge (*Art. 2d, 8, 9*). To this end CAN members are to organise subregional trainings (*Art. 10*), coordinated by the Andean Committee (*Art. 51d*). *Art. 17c* requires mechanisms to transfer state of the art knowledge about resources, which customers demand, and the methods they use. Moreover, economies of scale may arise from cooperation in conservation (*Art. 10*).

Other institutional advantages. The CAN stipulates "national, and not discriminatory, treatment" among members regarding access (*Art. 11*). *Decisión 391* acknowledges the property rights of "the native, Afro-American and local communities" (*Art. 7*) and requires the recognition of suppliers in access contracts (*Art. 34*). If implemented, these regulations have the potential to ease national as well as regional societal distress. However, there is also a risk that indigenous communities generally refuse the marketing of genetic resources they perceive as sacred. Besides, *Decisión 391* is likely to increase transparency in genetic resource trade on the demand and the supply side. A CAN member country should know about prospecting activities of, compliance by, and sanctions for an agent by other CAN members (*Art. 48, 49*). Information on all ABS processes and contracts has to be made public (*Art. 18, 21, 27*)–access applications and approvals are published in the newspaper (Art. 28, 38)–and hence the CAN members can possibly count on additional information about a customer from the public domain. The prospecting firm has to inform the CAN contract party about the requested genetic resource (*Art. 22*). The high discovering probability created by joint CAN action and strict disclosure provisions has the potential to reduce the threat of moral hazard. Similarly, the prospecting firm is supposed to enjoy transparency about the access procedure, the terms of the model contract (*Resolución 415*), and potential rival applicants[22] (*Art. 18, 21, 27, 28, 38*). *Art. 15* calls for "clear, effective, well-grounded and lawful" access processes and *Art. 28, 29, 30* ensure timewise procedural certainty. Furthermore, *Decisión 391* includes a "national inventory of genetic resources and their by-products"(*Art.*

[22] *Art. 19* allows for confidential treatment of information that "could be put to unfair commercial use by third parties" subject to restrictive conditions.

50n), however does not mention whether bioprospectors can obtain access to it.

Market power and bargaining strength. The Andean countries host two biodiversity hotspots, the '*Tropical Andes Hotspot*' and the '*Tumbes-Chocó-Magdalena Hotspot*' (Mittermeier et al. 2004), as well as important wilderness areas. The Tropical Andes Hotspot is acknowledged in the community's name and the leading of the 35 world biodiversity hotspots[23] (Mittermeier et al. (2004); Williams et al. (2011)). It has the highest estimated number of endemic plant and vertebrate species and the second largest remaining primary vegetation area (Mittermeier et al. 2004, p. 32 f.). The current CAN members and Venezuela[24] cover 25% of global biodiversity (CAN 2002, p. 13). The CAN's high share of global biodiversity together with joint access regulation in form of *Decisión 391* and the *'Andean Committee on Genetic Resources'* as a regional authority are promising cooperation characteristics for building up market power and bargaining strength. However, substitutes for genetic resources qualify the high market share and reduce market power (ref. Section 4.3). Moreover, the Andean Committee is equipped with only few competences. It lacks, for example, the authorization to negotiate binding trade agreements (*Art. 5*). CAN member countries continue to negotiate unilaterally, not as a block with the other countries of the eoc-region. *Decisión 391* is therefore also unlikely to improve much upon the bargaining strength of the CAN countries.

Impacts on the CAN's profits. The profits of the CAN member countries have the potential to be higher than without cooperation due to transaction cost reductions and cooperation induced benefits. Considerable economies of scale and other institutional advantages can theoretically be realised; these would lead to transaction cost reductions and thereby increase the CAN's profits. As described above, transaction cost reductions also arise for customers. These are likely to increase demand for genetic resources of the Andean eco-region. Thereby the CAN is able to appropriate cooperation induced monetary and non-monetary benefits. Market power and bargaining strength, however, are unlikely to be pronounced enough to raise benefits much beyond the effect of the increase in the demand.

Indirect effects on conservation. The theoretically potential increase in profits is likely to provide an incentive for continued and increased *in-situ* conservation of genetic resources. Moreover, economies of scale may arise from the cooperation mechanism on conservation matters of common interest (*Art. 10*).

[23] Biodiversity hotspots are areas hosting at least 0.5% of global plant species as endemic ones and that have diminished to 30% of its original size (Myers et al. 2000).

[24] Venezuela was part of the CAN from 1973 until 2006 (ref. footnote 3).

Table 3: Andean countries' biodiversity richness and endemism[*]

Country[△]	Diversity Index [◇]	Deviation from expected richness[†]	Mammals			Birds			Plants	
			total	endemic	threatened no. (%)	total	endemic	threatened no. (%)	total	endemic
Argentina	0.196	0.423	320	49	32 (10)	897	19	38 (4)	9,372	1,100
Bolivia	0.239	0.882	316	16	23 (7)	–	18	27 (–)	17,367	4,000
Chile	0.112	0.229	91	16	21 (23)	296	16	15 (5)	5,284	2,698
Colombia	0.538	1.685	359	34	36 (10)	1,695	67	77 (5)	51,220	15,000
Ecuador	0.353	1.519	302	25	31 (10)	1,388	37	60 (4)	19,362	4,000
Peru	0.369	1.344	460	49	47 (10)	1,538	112	71 (5)	17,144	5,356
Venezuela	0.379	1.398	323	19	25 (8)	1340	40	24 (2)	21,073	8,000

[*] Endemism refers here to species endemic to one particular Andean country.
[△] Andean countries which are not part of the CAN are written in italics.
[◇] The diversity index is the mean of biodiversity richness and endemism. It ranges from 0 - 1. Globally, Brazil has the highest index value (0.74). Colombia ranks fifth. The calculation is given in Groombridge and Jenkins (2002, p. 295).
[†] The relative biodiversity richness with regard to a country's territorial size. Groombridge and Jenkins (2002, p. 296) use the Arrhenius equation for this calculation. Globally, Indonesia has the highest relative biodiversity richness with a value of 1.844. Colombia ranks second, Ecuador third, and Brazil forth with a value of 1.436.

Source: Data from the *'World Atlas of Biodiversity'* (Groombridge and Jenkins 2002, p. 295 ff.).

5.2.2 The distribution of potential cooperation induced benefits

Potential cooperation induced benefits vary between CAN members. Colombia, Ecuador, Peru, and Bolivia are all megadiverse countries, but differ in their relative biodiversity richness and number of endemic species. They also vary in their institutional environment. The two factors in combination determine the share each country can obtain from total cooperation induced benefits (ref. Section 4.4).

Relative biodiversity richness. Colombia, Ecuador, and Peru share the *'Tumbes-Chocó-Magdalena Hotspot'* in addition to the *'Tropical Andes Hotspot'*, which also stretches across Bolivia. Table 3 presents Groombridge and Jenkins's (2002) *'World Atlas of Biodiversity'* figures for biodiversity richness and endemism of the Andean countries. Not surprisingly, Bolivia has the comparatively lowest diversity in terms of biodiversity richness and endemism (0.239). Colombia scores highest (0.538), followed by Peru (0.369) and Ecuador (0.353). Biodiversity richness per area is important for the screening costs bioprospectors face. Here again, Colombia ranks first (1.685) and Bolivia last (0.882). Ecuador (1.519), though, has a higher per area biodiversity richness than Peru (1.344).

Relative institutional environment. We use selected indicators of the *'Worldwide Governance Indicators'*[25] (WGI) of the World Bank (Kaufmann et al. 2010) to compare the institutional environment of the Andean countries. Table 4 presents the WGI 2013 values for the indicators 'regulatory quality' (RQ), 'government effectiveness' (GE) and 'rule of law' (RL) for these countries. Regulatory quality captures

Table 4: Relative institutional environment of the Andean countries

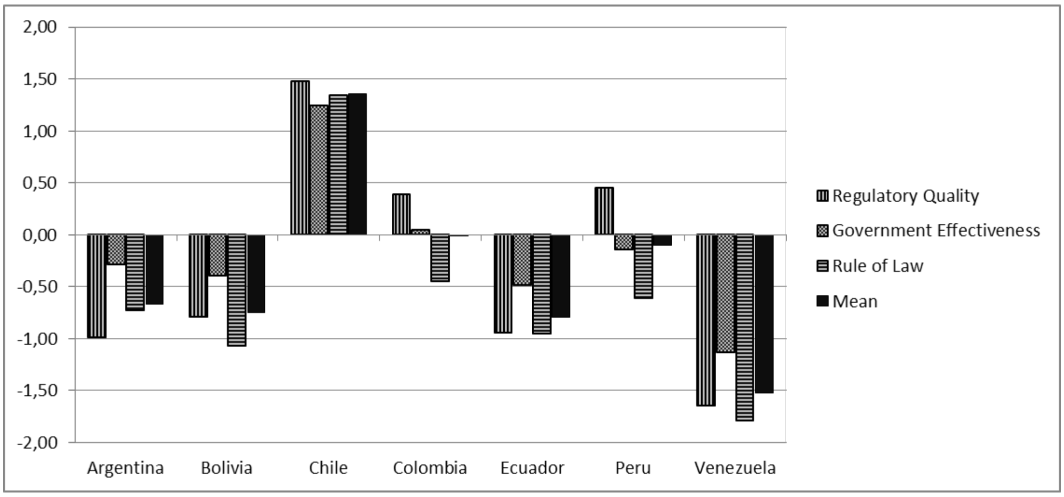
Country*	Regulatory quality (RQ)	Government effectiveness (GE)	Rule of law (RL)	Mean
Argentina	-0.99	-0.29	-0.73	-0.67
Bolivia	-0.79	-0.40	-1.07	-0.75
Chile	1.48	1.25	1.34	1.35
Colombia	0.39	0.04	-0.45	-0.01
Ecuador	-0.94	-0.49	-0.95	-0.79
Peru	0.45	-0.14	-0.61	-0.10
Venezuela	-1.64	-1.14	-1.79	-1.52

* Andean countries which are not part of the CAN are written in italics.

Source: Data from WGI 2013 (ref. footnote 25). The indicator range is -2.5 to 2.5, with higher values corresponding to better performance.

[25] Online: http://info.worldbank.org/governance/wgi/index.aspx, last accessed on 29.11.2014.

Figure 2: Correlation of WGI 2013 indicator values for the Andean Countries



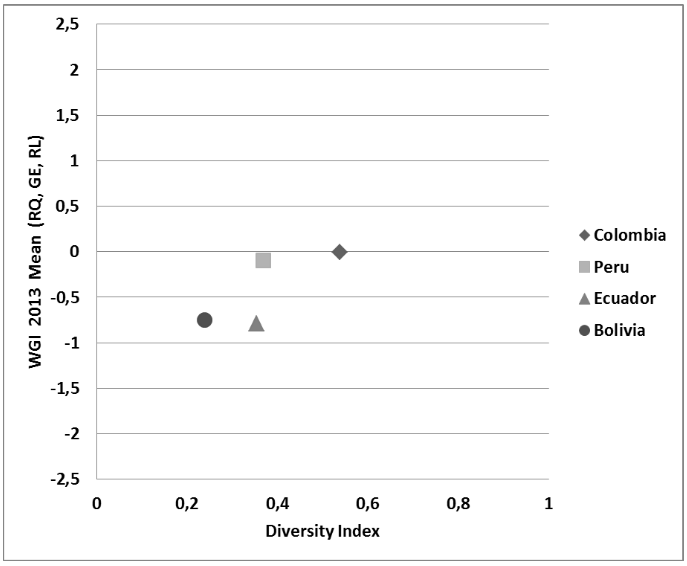
Source: Own diagram based on WGI 2013 data of the World Bank, ref. footnote 25.

"perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development", government effectiveness "perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies", and rule of law "perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence"[26]. The three indicators are correlated in case of the Andean countries as can be seen in Figure 2. We therefore use the mean to compare the Andean Countries' institutional environment. Colombia achieves the relatively highest mean of the three indicator values (-0.01), closely followed by Peru (-0.10). Bolivia ranks third (-0.75), closely followed by Ecuador (-0.79). The ranking should, however, be interpreted cautiously, because the values lie close to one another, the aggregation level is high, and thresholds are likely regarding the importance of the relative institutional environment for benefit appropriability.

Relative benefit share. Combining the scores in relative institutional environment and biodiversity richness, we can deduce a very tentative ranking in benefit shares. Figure 3 shows the CAN members' performance in these two dimensions. A clear

[26]Online: http://info.worldbank.org/governance/wgi/rq.pdf, http://info.worldbank.org/

Figure 3: Relative institutional environment and biodiversity richness of the Andean Community member countries



Source: Own diagram based on WGI 2013 data (ref. footnote 25) and data from the 'World Atlas of Biodiversity' (Groombridge and Jenkins 2002, p. 295 ff.).

ranking in benefit shares is not possible. Colombia and Peru have a strict dominance in benefit share appropriability over Bolivia and Ecuador. A ranking between Colombia and Peru as well as between Bolivia and Ecuador is speculative.

Following our assessment, Chile, Argentina, and Venezuela, which belong to the same eco-region, but not to the CAN, have lower chances to appropriate benefits induced by eco-regional cooperation than the current CAN members. In the considered WGI 2013 indicators (ref. Table 4), Venezuela performs worst among the Andean countries (mean: -1.52). The mean of the three WGI indicator values is higher for Argentina (-0.67) and Chile has the by far highest mean (1.35), but they have comparatively very low diversity index scores (Chile 0.122, Argentina 0.196; ref. Table 3). The vast majority of the Tropical Andes is in effect located in the current CAN member states, and the Andes make up only a relatively small part of Venezuela's, Chile's, and Argentina's total land size. With in comparison relatively low biodiversity richness and endemism (Chile, Argentina) or an comparably unfavourable institutional environment (Venezuela), the three Andean non-member countries of the CAN have little chance of attracting numerous bioprospectors. An Andean

governance/wgi/ge.pdf, http://info.worldbank.org/governance/wgi/rl.pdf, last 29.11.2014.

country with a low probability to act as contracting party will over-proportionally shoulder cooperation costs, possibly to the extend that it has no incentive for regional cooperation. Hence, we are able to explain the actual composition of the CAN with our determinants.

5.2.3 Realised cooperation advantages

The CAN members admit in their *'Regional Biodiversity Strategy'* (CAN 2002, p. 34) that there only "exist isolated experiences of sharing of benefits arising from access to genetic resources" and that they are "confronted by problems hindering the application of Decisión 391; and this Decision, in spite of its importance, has not so far proven itself to be an effective instrument for achieving the hoped-for sharing of benefits." Ruiz (2008, p. 17) compiles 8 genetic resource access contracts for Colombia and 5 for Bolivia until 2007, whereby we have no information whether these are commercial contracts. Until early 2013 Peru has been involved in two commercial contract negotiations, but could not conclude them successfully[27]; Ecuador records none[28]. Viewed over one decade, these are few–if not none–commercial contracts and benefits compared to initial expectations and other countries: Costa Rica, arguably a benchmark for a successful provider country under the status-quo ABS, has signed about 65 contracts with industries and universities until early 2013[29], from which it realised a number of monetary and non-monetary benefits (G'amez 2007, p. 85 f.); however, so far no royalties[30].

The discrepancy between the potential eco-regional cooperation advantages described in Section 5.2.1 and the limited ones actually realised by the CAN may be explained by several factors. There is no cooperation between the national focal points, no benefit transfer between member countries exists, and the importance of the Andean Committee is limited, because it lacks own finance.[31] The scarce implementation of the provisions of *Decisión 391* implies that economies of scale and improvements in institutional factors will be limited. It is not clear to what extend communal spirit and trust prevail among the CAN members. Missing trust could

[27] Personal communication with the ABS National Focal Point (NFP) under the CBD of Peru on the occasion of the First meeting of the Plenary of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES-1) in Bonn on 23.01.2013.

[28] Personal communication with the ABS NFP of Ecuador on the same occasion and date.

[29] Correspondence with a member of the Biodiversity Commission of the University of Costa Rica on 04.05.2013.

[30] Presentation at the "Informal Meeting for the Implementation of Articles 19 and 20 of the Nagoya Protocol", Tokyo, 25.–26.03.2013.

[31] Personal communication with the ABS NFPs of Peru and Ecuador (ref. footnote 27, 28).

explain why amendments that improve upon the known deficiencies of *Decisión 391* or advancements in its implementation are absent. Ruiz (2003, p. 12) contests the incentives for communitarian action and attests an absence of political will among the member countries to prioritise the functioning of *Decisión 391* (ibid., p. 18). In addition, new transaction costs arise for the CAN members from *Decisión 391* in form of coordination, notification, and communication costs as well as costs of compromises. Ruiz (2003, p. 13) reckons that the CAN states have underestimated the latter ex-ante.

For customers, some reductions in transaction costs may occur due to the time-wise procedural certainty provided by *Decisión 391* as well as the model application form (*Resolución 414*) and the model contract (*Resolución 415*). However, new transaction costs have been created by *Decisión 391*. Especially the requirements related to the involvement of 'subregional nationals', knowledge transfer and institutional development listed in *Art. 17* are costly for customers to deliver. Additionally, shared competencies between the Andean Committee, national authorities, and local communities are perceived as a hindrance (Bucher 2008, p. 147 f.). Taken altogether, the CAN cannot be described as an example of successful eco-regional cooperation in genetic resource trade.

6 Conclusion

In this paper we analysed the scope of eco-regional cooperation in physical genetic resource trade to improve upon the status-quo bilateral approach with a view (a) to achieving payments for physical genetic resource use and thereby (b) to increasing conservation. We considered a continuum of cooperation from loose cooperative behaviour to price determining collusion, but conclude that the benefits of collusion will be low due to limited market power through the availability of substitutes. Especially easily distributable and accessible genetic and natural information are threatening collusion.

We evince eco-regional cooperation advantages on the market for physical genetic resources. Our findings suggest that, compared to the status-quo and dependent on the degree of cooperation, eco-regional coalitions have the potential to significantly reduce transaction costs for both suppliers and customers. Economies of scale in information, administration, monitoring, and enforcement together with other institutional advantages such as transparency and reputation are important advantages of eco-regional cooperation that lower transaction costs for suppliers. In particular transparency also reduces transaction costs for customers. Transaction cost reductions for customers reduce the price for physical genetic resources and thus increase their demand. An increase in demand of physical genetic resources increases the volume of benefits for biodiversity rich countries. Cooperating countries with a relatively higher biodiversity richness and–in case of megadiverse countries even more relevant–a comparatively better institutional environment are able to appropriate a higher share of these cooperation induced benefits. A higher demand for genetic resources should also lead to an increase in conservation of genetic resources. It increases the perceived option value for future bioprospecting contracts and thereby provides an incentive for *in-situ* biodiversity conservation. Our case study of the Andean Community's community access legislation, however, reveals that the CAN members realise few of these potential cooperation advantages.

A successful implementation of the Nagoya Protocol, which came into force recently, might lower transaction costs of bilateral contractual ABS and thereby the advantages of eco-regional collusion. It remains to be seen whether and how far the Nagoya Protocol changes bilateral contractual ABS. Especially an effectively functioning global *'Access and Benefit-sharing Clearing-House'* (NP, *Art. 14*) may facilitate information sharing. So far, albeit highly promising, the implementation of the ABS Clearing-House[32] finds itself at the beginning. Besides, the provisions on model contractual clauses (NP, *Art. 19*), codes of conduct, guidelines, and best practices and/or standards (NP, *Art. 20*), awareness-rising (NP, *Art. 21*), capacity building (NP, *Art. 22*), and technology transfer, collaboration, and cooperation (NP, *Art. 23*) have the potential to reduce transaction costs for both providers and users. Hence, eco-regional cooperation might become less attractive. The Nagoya Protocol might, however, just as well increase the relevance of eco-regional cooperation–depending on whether and how its member countries implement *Art. 11*, NP, on transboundary cooperation. Moreover, the situation might change considerably, if countries agree on the need for and modalities of implementation of a *'Global Multilateral Benefit-Sharing Mechanism'* (NP, *Art. 10*). The latter might even open up the possibility to address genetic or natural information.

Genetic and natural information are of high and growing importance for commercial users of genetic resources. They limit the scope, relevance, and benefits of eco-regional cooperation in trade of physical genetic resources. Genetic or natural information can hardly be included in a regional cooperation agreement due to their non-excludable nature. The prospect for eco-regional cooperation will thus

[32]Ref. online: https://absch.cbd.int/, last 14.03.2015.

be most relevant in the short-run. With technological progress and further growth of new commercial research fields that predominantly rely on genetic and natural information, a global mechanism becomes indispensable if one aims at simultaneously achieving the three goals of the CBD, namely "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising out of the utilisation of genetic resources" (CBD, *Art. 1*). In any case, regional and global mechanisms need to be designed such that they lead to marked reductions in transaction costs and thereby create incentives for countries to continue and deepen cooperation. Moreover, increased transparency for customers is vital for lowering their transaction costs and rising demand. If demand rises, we can expect the importance of *in-situ* conservation among biodiversity rich countries to follow suit.

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