
Biodiversity conservation and use: Local and global considerations

Josep-Antoni Gari

School of Geography, University of Oxford, Oxford, OX1 3TB, UK.

<mailto:josep.gari@geography.oxford.ac.uk>

Abstract: Leading sustainable development discourses construct biodiversity as a global resource intended to fit into intellectual property systems and world markets. Large biomedical and agricultural research ventures claim a central role in advancing worldwide development and valuing biodiversity. Intellectual property rights over life forms and processes spread as the mechanism to support such large biotechnological endeavours, which promise agricultural and medical development for all humankind. However, field research in the Andes and Amazonia discloses that biodiversity is a crucial local process, rather than a global resource. Local ecological practices construct collective biodiversity flows that care for food security, health care, and ecosystem resilience alike. By constructing biodiversity as a global resource predetermined to both markets and intellectual property systems, the global developmentalism neglects and therefore undermines important local regimes of biodiversity. Many native ecosystems that fulfill a crucial role as spaces of contextualised management and research on biodiversity are just regarded as biodiversity marketplaces. This paper questions the ability of global intellectual property rights over life forms to improve the livelihood and development of the powerless indigenous and peasant people. Instead, the cross-cultural expansion of the public domain over biodiversity flows and biotechnological processes seems a critical task.

Keywords: Biodiversity, intellectual property rights, TRIPs, indigenous people, genetic resources, quinoa, Andes, Amazonia, traditional ecological practices, food security, biotechnology.

Reference to this paper should be made as follows: Garí, J.A. (1999). Biodiversity Conservation and Use: local and global considerations. Science, Technology and Development Discussion Paper No. 7, Center for International Development and Belfer Center for Science and International Affairs, Harvard University, Cambridge, MA, USA. Excerpt from a paper with the same title to be published in a book edited by Peter Drahos and the African Centre for Technology Studies (Kenya).

Biographical notes: Josep A. Garí is Marie Curie Research Fellow at the University of Oxford, working on the political ecology of biodiversity. He has recently conducted field research on indigenous agroecology, food security, and development struggles in both Amazonia and the Andes. He has been awarded the Planetary Garden Prize for Young Research Scholars (1999).

You take my life, when you do take the means whereby I live.
William Shakespeare, *The Merchant of Venice*, IV:1.

1. The biodiversity issue

The mainstream approach

The notion of *biodiversity* emerged in the 1980s to pursue a conservationist agenda on biological diversity. Meanwhile, biotechnology research expanded, while intensifying both its search for native biodiversity and its releasing of new living forms. Two mainstream discourses emerged and, at some degree, they have joined each other: the *conservation* of biodiversity and the global biotechnological *transformation* of life's forms.

Biodiversity reached international attention in the Earth Summit of 1992 with the signature of the *Convention on Biological Diversity*. Then, the sustainable development movement spread to promote the reconciliation of biodiversity with mainstream development [63]. Natural parks, biotechnology, markets, and intellectual property systems become key institutions for the valuation of biodiversity.

The leading trend of the sustainable development discourse proposes to capture the market values of biodiversity to ensure its conservation [44]. In particular, large biomedical and biotechnological research endeavours have become the leading means to allocate market values to biodiversity [36][53][64]. Biodiversity is regarded as source of materials and information for biotechnology [55]. The US National Institutes of Health state that the discovery of pharmaceuticals from natural products will both promote sustained economic growth in developing countries and conserve biological resources [39]. The reasoning of the sustainable developmentalism enters a new dimension when these proposals around the global valuation of biodiversity require a parallel granting of intellectual property rights over the biological forms that are used and manipulated. In the globalisation of biodiversity, the issue of intellectual property rights over life forms and processes has acquired a prominent role. Intellectual property systems are encouraged to support the market and biotechnological values of genetic resources and biodiversity [23][53][54]. Intellectual property is promoted as the fourth pillar that the modern world is adding to Adam Smith's trilogy of labour, capital and natural resources [38]. Private biotechnology is expected to improve human welfare on the basis of market processes; in particular, in the two major areas of biomedicine and agriculture.

Intellectual property rights over life drive the privatisation of biodiversity and agricultural resources. As the *Agreement on Trade-Related Aspects of Intellectual Property Rights* (TRIPs Agreement), one of the leading international documents on the field, states in its preamble, "intellectual property rights are private rights". In fact, the whole point of patenting, which is a mainstream form of intellectual property, is to exclude others from access to informational resources [14]. Therefore, intellectual property rights enforce the privatisation of resources, research, knowledge, and technology on a wide scale. By supporting these trends, the global green developmentalism is actually proposing to privatise and sell nature to preserve it [34].

The expansion of both biotechnology and intellectual property rights has decisive effects on biodiversity. The biotechnology industry needs biodiversity, and, in the case of agriculture, it also affects biodiversity through releasing new agricultural forms. The controversies around genetically-modified organisms disclose the multifaceted dimension of biodiversity under mainstream biotechnology. Some argue that biotechnology and intellectual property rights will ensure the global conservation of biodiversity by generating added value on biodiversity. Others argue that the transformation of biodiversity by releasing new agricultural and microbial forms will improve development. Others fear that biotechnology is producing "genetic pollution".

In consequence, the mainstream advances around the biodiversity issue have focused on either its strict conservation in natural parks, or its use for large biotechnological projects. Biodiversity has become constructed as a global resource. Spreading green developmentalist discourses support the full integration of biodiversity into international markets, into global property systems, and into the globalisation process. The ambitious biotechnology proposes to bring both value to biodiversity and wealth to people. However, intellectual property rights encourage particular systems of managing both biodiversity and biotechnological processes at a global scale.

The political ecology of biodiversity

The concerns about global biodiversity, the expansion of intellectual property rights, and the growth of biotechnology are causing conflicts worldwide. Indigenous peoples claim that both their native plants and their knowledge become privatised by biotechnological corporations. Peasants accuse some agricultural research of privatising crucial seeds and plant processes.

I will investigate the biodiversity issue and the related controversies around intellectual property rights on the basis of some field research studies and experiences, both local and international, conducted in 1998-1999. They comprise a study on the biodiversity of the Andean crop quinoa, a research on biodiversity among the indigenous peoples of Pastaza in Amazonia, some experiences from the IV meeting of the Conference of the Parties to the *Convention on Biological Diversity*, and an evaluation of the increasing geographical and material expansion of intellectual property rights.

The research adopts a political ecology perspective, regarding the political dimension of ecological conflicts, and addressing the cross-boundary dynamism of ecological-social issues. Development will be investigated beyond increasing market relations, but as the coevolution of ecosystems and societies [41]. From the contextualist paradigm [27], local knowledge systems, traditional ecological practices, and cultural meanings are inextricable from the native ecology, and therefore are relevant for both biodiversity conservation and local development. In essence, the research aims to address the following issues: a) whether biodiversity is *only* valuable as a resource for large biomedical and agricultural research ventures; b) whether there is a socio-political approach to biodiversity beyond the market [33]; c) the conflict between biodiversity as a global resource versus biodiversity as a local process; d) the relevance of both biodiversity and biological research for local development; e) whether biodiversity and ecological knowledge are shifting from the public domain to the private sector; f) the processes around the conservation, use, and control of biodiversity; and g) the crucial relevance of *who* controls biodiversity, biotechnology, and ecological knowledge.

2. The Andean crop quinoa

Quinoa (*Chenopodium quinoa*) is a food plant cultivated in the Andes for at least 3,000 years [57]. It is an annual plant that produces a grain very rich in protein, thus being essential for the nutrition of many indigenous peasant communities in the Andes. Next, I examine two aspects of quinoa. First, the biodiversity of quinoa throughout the Andes, particularly in the Altiplano, based on field research in 1999. Secondly, the international struggles around the case of a quinoa patent granted in 1994 in the USA.

The biodiversity of quinoa

Quinoa comprises a unique biodiversity. In the Andes, both wild and cultivated varieties coexist. There are at least 45 cultivated varieties, which can be classified under five main ecotypes: Valle [valley], Altiplano [high plateau], Yungas [warm valleys], Salares [salt flats], and Nivel del Mar [sea-level] [57]. These ecotypes and their incorporated biodiversity ensure the wide agroecological adaptation of quinoa in the Andes. Thanks to its biodiversity, quinoa is cultivated in high altitudes, around 4,000 metres of altitude in the Titicaca plateau, and in the dry salt flats of the Southern Bolivian Altiplano. Quinoa is the only crop that grows in the Bolivian salt flats, where drought, salinity and altitude are extreme.

The Altiplano is located around 3,800 metres of altitude. High altitude, low and irregular precipitation, and frequent frosts are the main climatic aspects [24][56]. As a mountain ecosystem, the Altiplano is fragile, being affected by soil erosion and other environmental pressures [59]. Agriculture and food provision are very difficult aims. The cultivation of biodiversity of quinoa is a crucial agroecological practice to ensure food production in the Altiplano (field research, 1999). The different cultivated varieties have ecological, agricultural and cultural differences; for instance, in resisting frosts, in preventing the main quinoa pest kcona-kcona, in maturation time, in productivity, in gastronomical values, in nutritional components, and in resisting the attack of birds, among other aspects. The simultaneous cultivation of diverse varieties ensures production in the variable, unpredictable, and extreme environment of the Altiplano. In every community, each family cultivates around 3-4 varieties of quinoa belonging to two main groups: a) varieties of high productivity in good years, and b) varieties of high resistance to frosts, pests and other environmental pressures that yield a minimum production even in a bad year (field research, 1999). Therefore, the local use of biodiversity is oriented towards food security. The peasant communities ensure agricultural stability through biodiversity. Biodiversity is thus crucial in the risky agroecological conditions of the high Andes.

The quinoa biodiversity is embedded into the whole cultural and ecological context of the Andes. In the Northern Altiplano, around Lake Titicaca, the peasant ecological knowledge feeds the articulation of a set of agricultural strategies, traditional technologies, peasant institutions, and use of agrobiodiversity to ensure food security. The peasants conduct agricultural strategies like crop rotation. They build terraces to cultivate hillsides, which are generally less affected by frosts than many open plateaux. They are recently rescuing traditional infrastructures like the waru-waru, which is an agricultural infrastructure based on water management that creates a micro-ecosystem for agriculture [10]. On the other hand, the Andean peasants have some community lands for agriculture, and a collective regime of plant genetic resources. Finally, they use large agrobiodiversity, at both species and genetic levels, comprising the cultivation of around 8 crops. In essence, biodiversity is linked to a whole agroecological context, where the peasant knowledge is crucial.

Besides, the conservation and cultivation of quinoa biodiversity is linked to particular peasant processes. Andean peasants have traditionally maintained, accelerated and directed the genetic

and evolutionary flow of quinoa biodiversity. In every community, there are what I call *research peasants*. They are peasants who have particular interests in looking at new emerging varieties, in purchasing new varieties from other peasants, and in exchanging quinoa varieties in local markets and seed fairs. The mainstream view of traditional peasants as farmers that are frozen in the past is completely misplaced, because the traditional ecological practices comprise very active processes of in-situ research, conservation, and innovation over biodiversity. Besides, the peasant society encourages a free flow of biodiversity and the associated knowledge, based on a common regime of plant genetic resources. Knowledge and resources are exchanged among communities, neglecting monetary terms because the peasants are poor, while encouraging farmer-to-farmer cooperation to innovate and spread knowledge.

The peasant ecological practices keep the coevolution of quinoa biodiversity, as indicated by diverse studies [49] [61]. These studies illustrate that, both historically and at present, Andean peasants shape the biodiversity of quinoa. In particular, the peasant practices keep open genetic flows of biodiversity, thus becoming small in-situ biotechnologists.

In conclusion, Andean peasants conserve, manage, transform, and advance local "biotechnology" on agrobiodiversity to ensure food security. These biodiversity processes are deeply embedded into the agroecological context of the Andes, where peasant ecological knowledge and collective management of plant genetic resources are leading tools. There is a whole peasant ecological knowledge system that ensures both food security and ecosystem resilience in the Andes.

The quinoa patent

Throughout the twentieth century, quinoa remains a very local crop in the highest and most extreme regions of the Andes. Production remains for self-consumption, while wheat imports since the 1950s had pushed quinoa off the markets in the Andean countries. In the 1990s, however, quinoa demands in regional, national and international markets grow [19]. At the same time, quinoa becomes of some interest for international agricultural research, which led to the first patent of quinoa in 1994, granting property rights over some quinoa resources to particular people.

In 1994, a patent on quinoa was granted to two university professors (USA Patent No. 5,304,718). The quinoa patent claimed the following: a) cytoplasmic male-sterile plants and seeds of the Apelawa variety of quinoa, and b) the methodology of using and producing cytoplasmic male-sterile quinoa plants. In fact, the patent on quinoa seizes crucial agricultural and technological processes. Even an apparently limited property right may actually encompass decisive control over critical biodiversity and biotechnological advancements [20].

In quinoa, cytoplasmic male-sterility is a characteristic found in many varieties. It is especially useful because all the progeny is necessarily hybrid, and the male-sterile condition is maintained through generations. Thus, male-sterile forms necessarily produce new hybrid varieties, which may prove of special value. Andean farmers have for long time known this genetic feature of quinoa, they have also been able to identify male-sterile plants, and they have been using them to create new hybrids [6]. The patented methodology claims modern biological technologies, but these are substantially similar to the traditional peasant ecological practices.

The quinoa patent confronts ethical concerns. Beyond that, there are crucial political implications [20]. The patent is a major threat to both food security and the local biodiversity conservation. Property rights erode the local production and commercialisation of quinoa. A patent or intellectual property right exists to restrict the control, use and, in particular, the

commercialisation of agricultural resources. In this particular case, through the intellectual property system, Andean farmers could legally be prevented from exporting the quinoa that they had produced by means of using cytoplasmic male-sterile types. Food security of the Andean farmers is clearly eroded, since the patented methodology is conceptually a wide and predominant practice in the Andean agricultural context. For these reasons, the Bolivian National Association of Quinoa Producers mobilised together with other institutions and non-governmental organisations worldwide against the quinoa patent [1]. In fact, the promises of peasant development as a result of the increasing commerce in quinoa are eroded by the emergence of alien actors seeking the control of quinoa forms.

Moreover, the intellectual property rights over quinoa erode the coevolutionary process that has nourished the biodiversity flows of quinoa in the Andes. The patent strengthens and spreads the Western paradigm of nature and science. The patent encourages biological research carried out far away from the Andes, because intellectual protection is granted for this kind of research. In the global research centres, the biodiversity of quinoa becomes decontextualised. It may return to the Andean communities, but in the form of a commodity.

3. The indigenous peoples of Pastaza, Western Amazonia

The indigenous peoples of Pastaza comprise mostly the Amazon Quichua, the Shiwiar, and the Zaparo peoples. They inhabit most of Pastaza Province, a region of about 30,000 km² in the Ecuadorian Amazonia. Their leading indigenous body, the Organisation of the Indigenous Peoples of Pastaza, houses about 130 indigenous communities and 20,000 indigenous people [43].

Colonisation processes over the indigenous peoples of Pastaza have mainly focused on land and oil, and, more recently, also on native plants and indigenous ecological knowledge. Such colonisation operates under discourses of modernisation and development. However, most of the development efforts in Pastaza are in fact carried out by the indigenous peoples of Pastaza themselves. The native biodiversity and the indigenous ecological practices sustain livelihood and promise local development alternatives.

The indigenous regime of biodiversity

The indigenous peoples of Pastaza embody traditional ecological practices that shape the conservation, use and transformation of biodiversity in diverse Amazonian ecosystems (field research, 1999). They have developed a complex land-use system, comprising spaces for agroecological practices, areas of low-intensity use, and spaces destined for wildlife to reproduce, among others. Biodiversity is essential for their agroecological practices, their food security, their primary health care, the local ecosystem resilience, and many cultural values alike. They have developed a whole indigenous agroecology, which is conveyed by both ecological practices and cultural meanings, and whose crucial component is biodiversity. They cultivate more than 50 different plant species inside the Amazonian forests, comprising nutritional, medicinal and ritual plants, among others. They also manage a wide genetic agrobiodiversity for many of the cultivated plants. The management of agrobiodiversity is fed by their cultural values, as demonstrated by a culture-biodiversity curve when comparing genetic agrobiodiversity and cultural values of the cultivated plants (field research, 1999). Their agroecological practices also comprise the cultivation of forests over their cleared fields. Their planting of many fruit trees and shrubs gives rise to anthropogenic forests in Amazonia, while reinforcing the ecosystem resilience. From this human ecology context, the mainstream perception of Amazonia as a *wild*

ecosystem and as a pool of *pristine* biodiversity resources is shown to be incorrect, as other ethnoecological research also suggests [2][4][45].

The indigenous biodiversity regime also comprises a collective system of managing and sharing plant genetic resources, which feeds an open flow of knowledge and innovations on biodiversity. The indigenous people often exchange seeds and cuttings of their cultivated plants, and they broadly disseminate innovations and discoveries. Their cultivated fields, and also the forests, are in-situ and in-vivo germoplasm banks, where large amounts of biodiversity are conserved, managed, shared, and cultivated. The Amazonian ecosystems have become the ecological space where the indigenous people secure not only their food provision and health care, but also the conservation, management and research of their plant genetic resources.

The indigenous construction of biodiversity processes is conveyed by both ecological practices and cultural meanings. The crucial role of culture is disclosed by the above mentioned culture-biodiversity relationships in the cultivated fields. In fact, the value of biodiversity is deeply rooted in the indigenous culture, so the indigenous people argue that they keep cultivating every variety of cassava so that they do not disappear ["Tarpunchi karan lumu kaspita manachingarichun nisha"] (Verónica Andi, personal communication, 1999). In fact, there is a cultural codification of deep ecological insights [3], so that the indigenous ecological knowledge is inextricable from the cultural practices.

In essence, the indigenous people are generators, managers, conservationists, and transformers of their Amazonian native biodiversity, within the coevolution of the ecological processes with the indigenous ecological and cultural practices. The indigenous people construct biodiversity as a local ecological process that ensures food security, health care, and ecosystem resilience.

Colonisation: land, oil and plants

Land, oil and plant resources have been attracting a number of people and projects into the territories of the indigenous peoples of Pastaza. Land colonisation, which started to be promoted by the Ecuadorian state in the 1960s, has affected the Western strip of Pastaza. Oil colonisation, which has been largely extended in Northern Ecuadorian Amazonia, is currently threatening Pastaza. Finally, the search for plants in Amazonia, which already caused social disruption in the region during the first colonising period, in the 17th-18th centuries, has resumed under the lead of modern biological ventures.

As illustrated by the land colonisation in the Western strip of Pastaza, the spread of mainstream development models drives changes in both land use and agricultural practices. Land colonisation enforces the dismantling of the indigenous ecological and cultural practices. Native biodiversity loss has followed this mainstream development that is based on land colonisation, agricultural exports, and industrial-like economic systems. In the indigenous communities at the colonised strip, just a few plants are cultivated. Cassava biodiversity has been reduced to 3 varieties only. Monocultures of naranjilla (*Solanum quitoense*), sugar cane (*Saccharum officinarum*), and tea (*Camellia* sp.) have largely spread. Pastures for cattle have been introduced. There is clearly a whole loss and decontextualisation of biodiversity, which has caused the erosion of food security, the strong market-dependence of the communities, the impoverishment of the nutrition and the health care systems, and the abandonment of cultural and ecological practices.

Oil exploitation has also made a dramatic socio-ecological impact in Northern Ecuadorian Amazonia [29][32][60]. Oil colonisation is currently threatening Pastaza. The Ecuadorian State has granted in recent years 6 large oil concessions in Pastaza Province. They amount to around

12,000 km², which is about half of the indigenous territory. The discourse of development raised by the Ecuadorian State and some economic oligarchies has legitimised oil exploitation as the means to overcome underdevelopment and poverty in both Ecuador and Pastaza. The notions of underdevelopment and poverty, which are not deeply examined, serve to legitimise a large project of transformation of nature and society in Amazonia. The indigenous models of resource use and ecosystem management are ignored, even regarded as a barrier to development and modernisation.

The third main colonising project is the search for biodiversity resources. It is, however, an old colonising venture, which already brought many alien people into Pastaza in the past searching plants like vanilla (*Vanilla planifolia*) and cinnamon (*Ocotea quixos*). In recent years, large biomedical research projects have focus on both native plants and local ethnobiological knowledge to advance scientific research on plants. Such study of biodiversity for the discovery of biological resources of commercial interest is known as bioprospecting [7][47]. Private companies carry out most of these research projects. They aim to secure commercial benefits from the products they discover or develop. They also claim ownership over the resources they study, use, and manipulate. The intellectual property system seems to grant them the control of both the resources and the markets that they are interested in. As a consequence, the expansion of intellectual property rights over local resources and knowledge suggests a new form of colonisation. The race over plant genetic resources has already two prominent cases in Pastaza: the plants ayahuasca and sangre de drago.

Behind Amazonian medicinal and ritual plants

Ayahuasca (*Banisteriopsis caapi*) is a plant that the indigenous peoples of Pastaza grow in their fields for very relevant medicinal and ritual purposes. It is a sacred plant for many indigenous peoples of Amazonia. Ayahuasca is the vernacular name among the Amazon Quichua people, in whose language ayahuasca means "vine of the spirits". In 1986, after research in Ecuadorian Amazonia, the president of the International Plant Medicine Corporation was granted a patent on ayahuasca (USA Plant Patent No. 5,751). Because of the patent, ayahuasca has become internationally known. Criticisms of the patent have spread worldwide. The Coordinating Body of the Indigenous Organisations of the Amazon Basin (COICA) condemned, in its fifth congress, the foreign appropriation of native plants and cultural values. It also declared the holder of the ayahuasca patent an "enemy of the indigenous peoples", prohibiting his entrance to any indigenous territory [13]. Immediately after, the Inter-American Foundation, a development agency linked to the US government, broke all the cooperation agreements and projects with COICA. These controversies illustrate the underlying colonising struggles. The case of ayahuasca has generated deep discussions around intellectual property rights over biodiversity, because they convey particular ways of control over biodiversity that cannot suit the plurality of actors involved. While reviewing this paper, the USA Patent Office has decided to cancel the patent of the ayahuasca plant after long opposition [11].

Sangre de drago (*Croton lechleri*) is another plant widely used in Amazonia for its medicinal value. In the 1990s, it attracted increased interest among some scientists in industrialised countries for commercial purposes. In the period 1992-94, the USA-based Shaman Pharmaceuticals company conducted research on this plant in Jatún Molino, an indigenous community of Amazon Quichua people in Pastaza. The corporation did not get authorisation from the leading indigenous organisation, the OPIP. Instead, the corporation's researchers contacted an indigenous community that belongs to the small evangelical indigenous organisation FIPRA, which is little mobilised in issues of access to biodiversity and the indigenous intellectual rights [50]. In return for the research work, the company gave the community around USA \$1,500,

technical assistance to improve the airstrip, one cow, a first-aid kit, some copies of a handbook on traditional medicine, salaries for 30 indigenous people employed for plant collection work, and some free medical examinations to community people [48]. However, the improvement of the airstrip was essential for the company to take plant materials out of the community for biochemical analysis in the USA [7]. The Vice-President of the company claims that, first, more development infrastructure was granted to the indigenous people, and, second, the company has designed a system to share the future benefits of their bioprospecting activities among all indigenous people, communities and organisations worldwide that have cooperated with them (T. Carlson, personal communication, 1999).

The corporation Shaman Pharmaceuticals (currently Shaman Botanicals) has opened innovative approaches to the sharing of benefits. However, the central issue of ownership of resources and knowledge remains unclear, because the company seeks intellectual property protection for its research activities. Currently, on the basis of *sangre de drago*, the company has developed two compounds against herpes and a respiratory virus, while it has received a patent for anti-viral activity [9][25]. Overall, fair exchange of both rights and benefits, rather than charity, is what the indigenous people claim [50]. The research on Jatún Molino by Shaman Pharmaceuticals focused on both the indigenous knowledge and the native plant resources.

Both cases of ayahuasca and *sangre de drago* disclose bioprospecting, backed by intellectual property rights, as a new form of colonialism. The indigenous peoples of Pastaza have stated that "transnational, pharmaceutical and bioprospecting companies are trading illegally with the biodiversity genetic resources" and "are appropriating the traditional knowledge of the Quichua and Shiwiar peoples of Pastaza" [42]. In conclusion, the mainstream intellectual property system encourages a unilateral framework for the control of biodiversity resources and for the support of biological research. It feeds a decontextualised approach towards the plant genetic resources and the local ethnobotanical knowledge of Amazonia.

Indigenous struggles for development

To advance development, the indigenous peoples of Pastaza are launching a set of institutions and projects. They are aiming for development alternatives based on the indigenous culture, the traditional ecological practices, and native biodiversity. These institutions comprise a centre for research on native animals for potential productive purposes (Fátima Centre), an ethnobotanical park for the study of Amazonian plants (Omaere Ethnobotanical Park), a project to rescue and improve traditional ecological practices in agriculture on the basis of native biodiversity (Nunguli Project), an indigenous savings co-operative to offer credits to family and community projects based on both Amazonian biodiversity and the indigenous ecological practices (Palati Co-operative), and an Amazonian research institute (Amazanga Institute).

These indigenous movements arise as an alternative to mainstream development. They are based on the indigenous construction of biodiversity. They emphasise the coevolution between ecological and social systems, where native biodiversity, indigenous ecological practices, culture, and identity are integrated. These political movements address development as the contextualisation of biodiversity in the very human and ecological environments in Amazonia.

The market-oriented and market-demanding paradigm of biological research that intellectual property rights enforce ignores the fact that many indigenous peoples are rooted in a community economy rather than a full market economy [26]. The mainstream pressures for a global, market-based, and privately-run framework for biodiversity and research not only neglect the indigenous context, but also force it to drastic transformations. As in the cases of land and oil colonisation,

the global biodiversity venture threatens a large decontextualisation of lands, biodiversity, knowledge and development at the grassroots.

4. The impasse between social actors

The controversies on the control of biodiversity, the hegemonic spread of intellectual property rights, and the leading paradigm of science are also rooted in unequal power relations between the diverse actors involved in the biodiversity issue. In May 1998, indigenous and peasant representatives were expelled from a meeting of IV Conference of the Parties to the *Convention on Biological Diversity*, a United Nations institution.

Towards the end of the conference, in the last session of the contact group on article 8(j), a decision had to be adopted in relation to the establishment of the mentioned working group. The decision would then have been endorsed at the plenary the following day as a binding decision of the conference. Some countries led by Brazil opposed the presence of observers at the final discussions and deliberations of the contact group. The observers comprised representatives from indigenous peoples, local communities, non-governmental organisations, and international institutions. The chairman of the contact group surrendered to such pressures and decided to give the floor to observers for 10 minutes, after which they were to leave the room. State representatives without any witness would then have continued to deliberate alone.

These events, happening even at a United Nations conference, illustrate the impasse between social actors. Many international institutions and states are blind to, or uninterested in the viewpoints of social actors at the grassroots, particularly indigenous peoples and powerless peasant communities. The conventional intellectual property system reproduces these attitudes, because it is too state-based and too industry-oriented from its very origin. Its intrinsic ignorance towards traditional ecological practices, farmer's rights, local contextualisations of biodiversity, and community control of natural resources is likely to increase the social inequalities among the different actors involved in biodiversity.

5. The increasing expansion of intellectual property rights

Along the 1990s, there has been an increasing expansion of the world of intellectual property rights. The patent system is undergoing a process of expansion and globalisation [14]. This expansion occurs in two ways: geographically and materially. The geographical expansion means that more and more countries and societies are entering, or being forced to enter into the intellectual property system of the Western world, which aims to become a global intellectual property regime. The material expansion implies that the traditional field of materials and processes subject to property rights is broadening; in particular, it is incorporating life forms and processes.

The geographical expansion is backed by institutions like the World Trade Organisation and the World Intellectual Property Organisation, and by some technologically and economically powerful countries. The World Trade Organisation and the *TRIPs Agreement* are thus the main and most recent tools enforcing both a global market system and intellectual property rights worldwide.

At the same time, there are pressures towards a simultaneous material expansion of intellectual property rights. Article 27(1) of *TRIPs Agreement* states that "patents shall be available for any inventions, whether products or processes, in all fields of technology". Because of the concerns of intellectual property rights over life forms and processes, article 27(3)(b) offered the optional

possibility to exclude plants and animals from patent applications. Major industrial and corporate sectors, and some states support the supremacy of article 27(1). They want all life forms and processes to come under the scope of intellectual property rights. The International Chamber of Commerce, which is a lead world business organisation, has stated that "life-forms should be patentable" [28]. The European Chemical Industry Council, which represents more than 20 European countries and around 40 major companies, has stated that no form or processes should be excluded from intellectual property rights and, in particular, from patentability [16]. The Biotechnology Industry Organisation, representing nearly a thousand biotechnology companies worldwide, announced recently that it would support in the courts a case of a patent on genetically modified plants "to reaffirm the importance of patents to the agricultural sector" [5]. Some developed countries also support the expansion of intellectual property rights over life forms and processes. The United States Department of Agriculture itself received in 1998 a patent on a methodology named precisely "control of plant gene expression", which popularly has become known as the "terminator technology" (USA Patent No. 5,723,765). The European Parliament and the Council of the European Union endorsed a directive on legal protection of biological materials, in which intellectual property can comprise "biological material which is isolated from its natural environment" (article 3.2) and "an element isolated from the human body" (article 5.2) [17].

The criticisms against the expansion of intellectual property rights over life forms have not been made only in developing countries. The government of the Netherlands considered the European directive on patents on life to be void, thus bringing it before the Court of Justice of the European Communities [18]. The leading scientific journal *Nature* has stated that, concerning the issue of intellectual property, those who benefit most are those already the most economically powerful, and that it is not in the best interests of those who are excluded [40].

In conclusion, the conventional intellectual property system is increasingly expanding over life forms, biodiversity, countries, and cultures worldwide, in an unrestricted way. This expansion clashes with a plurality of regimes of control and use of biodiversity, which become neglected in the globalisation of biotechnology and property rights.

6. Biodiversity struggles at the roots of development

Many indigenous and peasant constructions of biodiversity question the global assumptions that biodiversity is a material resource, an object that is just planted or collected, a mere asset that can be owned and traded. Besides, indigenous knowledge systems, expert peasants, and collective regimes of biodiversity dispute the hegemonic authority of the global scientific and biotechnological elite on life issues.

Intellectual property rights over life forms and processes lead to the construction of biodiversity as a private resource, as a global object. Even indigenous ecological and medical knowledge becomes appropriated for the global biodiversity ventures [30]. Pharmaceutical companies do not aim at any transfer or sharing of intellectual property rights [22]. Indigenous knowledge is neglected, at most approached as a local resource, uprooting its crucial cultural and ecological context.

The holders of global intellectual property rights and international biotechnological research aim to transform Amazonia and the Andean agroecosystems into a marketplace of biodiversity. Global markets and intellectual property rights constitute the framework for such processes. To claim that this ensures biodiversity conservation and brings development is hardly defensible because both local knowledge systems and cultural practices are completely neglected. Instead,

powerless people and grassroots movements claim collective flows of genetic resources for agriculture, equitable control over biodiversity, and effective sovereignty over the biotechnology that may affect them.

In its latest report, even the World Bank recognises the crucial role of knowledge in the development process [62]. *Who* controls technology and knowledge around the plural biodiversity issue is also critical, especially for the development of many rural societies. A leading worldwide agricultural corporation, Monsanto, argues that their biotechnology will feed people and ensure that they escape poverty [51]. At the same time, this corporation argues that "food biotechnology is a matter of opinions" [37]. However, particular regimes of biodiversity prove more valuable in a multiplicity of aims. Both biotechnology and the control over biotechnology have decisive effects on many people. Public and boundless knowledge is extremely crucial in poor rural communities. In essence, the expansion of intellectual property rights over life forms enforces the privatisation of biological resources, neglects crucial knowledge systems, and undermines resilient development alternatives within the grassroots. Intellectual property rights promise development, but require indigenous and peasant societies to adopt a full market and private system, where they will clearly become peripheral and marginalised actors. In essence, the way in which life forms are transformed, managed, generated, delivered, used, conserved, and controlled is critical for improving and empowering the indigenous and peasant livelihood.

Collective flows of plant genetic resources have been at the root of agricultural development for centuries, even across large distances. Cassava (*Manihot esculenta*) is the leading native crop of Amazonia, but due to historical processes it reached Africa, where it is now cultivated, feeding very poor peasants (field research, Kakamega, Kenya, 1999). None of the crops that today make the United States an agricultural power is native to North America [31]. The Andean communities have their own *research peasants* and institutions to foster exchange of genetic resources and knowledge. In the Andes, seed fairs, local markets, and diverse peasant institutions enforce the exchange of genetic resources, knowledge, and technologies [58]. In Amazonia, the exchange of plant genetic resources is embedded in complex and dynamic cultural practices. Even capitalist societies assimilate the existence of public goods, which is particularly relevant in the realm of producing knowledge [8]. These historical trends are drastically dismantled by current globalisation processes.

Amid all the biodiversity struggles, some experiences have been advanced towards improving the relationships between powerless local communities in the South and powerful transnational corporations. Partnerships and bilateral agreements have spread. Such agreements improve the payment in monetary terms of the appropriation of traditional knowledge and biodiversity, but do not represent an integrated perspective on biodiversity, food security, community health care, and local development. Not just money but political and scientific empowerment is what many indigenous people and local communities urgently need for their development.

Moreover, corporations increasingly fall into a private-charity schizophrenia when addressing how development is to be pursued. Biodiversity-related corporations stand for the private control of biodiversity and technology, often belligerently so at international meetings. But, at the same time, they promote corporate philanthropy, community projects, a millenium seed bank, and wetlands conservation [21][35]. These contradictions reveal how corporations perceive development: they are ambitious to be at the crossroads of the global development process, while at the same time they are so proud of their scientific power that they promote paternalism. The alleviation of poverty among rural communities is not likely to be sufficiently addressed through either global private models or charitable projects, but through the empowerment of the powerless peoples in their control of biodiversity, knowledge, research, and innovation. Such empowerment

is based on a contextualist paradigm over native biodiversity, and on a rather public domain of biodiversity and innovation.

In essence, the intellectual property system is not an obvious advancement for development. The claim that patenting is an ethically-neutral act is also weak [14]. Globalising intellectual property conveys an asymmetric way of conserving, using, transforming, managing, and controlling life forms. By claiming a private control of such processes, biotechnology corporations exclude citizens and peasants from crucial global transformations of biodiversity, agriculture, and genetic resources.

The expansion of the conventional intellectual property system towards life forms and processes is claimed as essential to modern biomedical and agricultural advancements. Such advancements are certainly important, but the means to ensure them neglect and even undermine crucial ecological knowledge and practices among many indigenous and peasant people. Conventional intellectual property rights are tailored to North-based research while neglecting local biodiversity regimes. Many people of the South are becoming suppliers of biodiversity and knowledge, while dispossessed of control over these biodiversity and knowledge flows. Countries of the North are specialising in the production of a transformed nature for benefiting medicine, food, and agriculture. The new assets may even return to the people in the South, but in the form of an alien and expansive commodity. Intellectual property rights over life forms reinforces North-South inequalities.

Intellectual property rights over life forms and processes drive the ambition of global capitalism to produce a commodified nature. Mainstream capitalism is a large geographical project [52], like the above-described unrestricted expansion of intellectual property rights demonstrates. The spreading discourses on *globalisation* enforce the geographical adventure of corporate capitalism. However, the plurality of actors, cultures, knowledge systems, and ecological practices involved in biodiversity, biotechnology and life forms require an alternative geographical envisioning. Biodiversity conservation, local development, agricultural advancement, and ecosystem resilience are critical processes for many powerless people; leaving them in the sole hands of corporate and biotechnological elites increases the power of the most powerful.

The struggles for the conservation, use and control of biodiversity and life forms rather suggest the constitution of a sort of cross-cultural common agreement, an overlapping consensus [46]. Traditional ecological knowledge deserves adequate recognition [15]. An alternative system of control over life forms and processes should benefit both the highly modernised science of the North and the traditional ecological practices of the South on an equitable basis, not through any sort of compensation. A cross-cultural expansion of the public domain over biodiversity is simultaneously required.

7. Conclusions

The sustainable development movement is constructing biodiversity as a global resource, which fits natural parks, markets, the biotechnology industry, and intellectual property. Green developmentalism proposes to both value biodiversity and advance human wealth by integrating biodiversity and life forms into international markets, into intellectual property systems, and into the globalisation process. However, the expansion of intellectual property rights over life neglects the value of profound indigenous and peasant ecological knowledge. Local regimes of biodiversity ensure food security, health care, and ecosystem resilience alike. They also convey a collective management of biodiversity, plant genetic resources, and biological innovation. They are thus powerful basis for advancing development as the coevolution of social and ecological

systems. However, global discourses on biodiversity and development neglect local biodiversity regimes: *Western* science ignores the wholeness of *indigenous* ecological knowledge; *modern* biotechnology thinks it overcomes in every aspect *traditional* ecological practices; *global* research is advocated despite the many socio-ecological *contexts* around biodiversity; and the biodiversity issue raises mainstream *technical* perspectives rather than awareness of the deep *political* implications of both biodiversity and biotechnology. Development does not seem to advance beyond these contradictions, but it claims democratic hybridisations over knowledge, innovation, and resources.

Biodiversity, biotechnological innovations, and ecological knowledge are increasingly becoming hybrid. Peasants and indigenous people engage in cross-cultural and cross-boundary movements. However, the overall control of biodiversity and biotechnology is increasingly shifting towards a global elite. Intellectual property rights over life convey an asymmetric system of conserving, using, transforming, managing, and controlling biodiversity. This asymmetry is detrimental to many indigenous and peasant people, who are precisely amongst those most in need of biological innovation, who perform a crucial role in biodiversity conservation, and who embody a valuable collective management of biodiversity. The very indigenous and peasant context that generates and maintains biodiversity flows is neglected, and therefore eroded in the global biodiversity framework.

The conservation, use and control of biodiversity are inextricable processes for many people in the South. Current intellectual property rights convey an ontological and political fragmentation of these three processes. Development among many indigenous people and peasant communities needs the control and the contextualisation of both biodiversity and knowledge at the grassroots level. The improvement of food security, biodiversity conservation, and local development requires the democratic empowerment of many local ecological knowledge forms and practices. Therefore, an alternative biodiversity paradigm that benefits most interests in nature, that maintains contextualised and coevolving biodiversity flows, and that empowers knowledge and life of the poorest people must be urgently explored, not abandoned.

Acknowledgements

I am very grateful to the indigenous peoples of Pastaza and to many Andean peasant communities for their generosity during the field research in Amazonia and the Andean Altiplano in 1998-1999. I wish to acknowledge diverse people and institutions for valuable research cooperation. Mario Tapia, for his research support in the Peruvian and Bolivian Andes. Leonardo Viteri and the Organisation of the Indigenous Peoples of Pastaza, for the support in the field research in the Ecuadorian Amazonia. The African Centre for Technology Studies, for the invitation to a Conference on Biodiversity and Intellectual Property Rights (Nairobi, February 1999) in which the first version of this paper was introduced and discussed. Richard Norgaard, for the rewarding interdisciplinary opportunity that he provided while I was a visiting scholar in the University of California at Berkeley. I wish to acknowledge fruitful discussions with Elisabeth Bravo (Quito), Ignacio Chapela (Berkeley), Peter Drahos (London), Graham Dutfield (Oxford), José Esquinas-Alcázar (FAO, Rome), Darrell Posey (Oxford), and Erik Swyngedouw (Oxford). This research has been financially supported by a Marie Curie Research Fellowship of the European Commission.

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