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(e) Unpublished Work:

Sandee, H. 1995. "Innovations in Production". Unpublished Ph.D thesis. Amsterdam:Free University.

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The Intergovernmental Science-Policy on Biodiversity and Ecosystem Services: Capacity-building Related Considerations from a UNESCO perspective

Lucy Hoareau* and Salvatore Arico**

Abstract:UNESCO as an agency of United Nations has been active in capacity building in basic sciences, environmental and earth sciences as well as science policy, and has helped to launch many global programmes, among these some relating to biotechnology, biosphere reserves, biodiversity and sustainable development. Its programmes involve stakeholders and UNESCO gives importance to collaboration and promotes North-South activities at all levels involving a range of actors, from schools and national governments in its activities. The International Year of Biodiversity was used by UNESCO to create awareness and promote understanding of the importance of biodiversity and ecosystems. UNESCO works closely with governments and has strengthened the science-policy interface in biodiversity. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is a new initiative in which UNESCO is deeply involved. This article discusses UNESCO's experience in capacity building and its relevance for IPBES.

Key words: UNESCO, biodiversity, International Year of Biodiversity, capacity building, IPBES, biotechnology, ecosystem.

Introduction

In the experience of the United Nations Educational, Scientific and Cultural Organization (UNESCO) as a specialized agency of the UN system dealing with, *inter alia,* capacity in the field of natural and social sciences through education and other measures, the building of peace, the alleviation of poverty, sustainable development and intercultural dialogue can benefit enormously from capacity-building in the area of sciences. One of the main means of implementation of science activities in UNESCO in the areas of biodiversity and ecosystem services is indeed the provision of assistance to and capacity-building in Member States in relation to participating actively in scientific research and monitoring; scientific assessments; and capacity-building for the formulation of national science policies and related action plans.

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Catalyzing the further development of capacity for operating effectively at the science-policy interface should be one of the core functions of the forthcoming Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services – IPBES. It has been advocated that IPBES' mandate should include a capacity-building element. This would ensure that the Platform is enabled to trigger capacity-building efforts from, and in support of, the various constituencies that it will address.

We believe that the convening power of IPBES at the science-policy interface would be greatly enhanced by attributing to the Platform an appropriate mandate and functions in the area of capacity-building. The precursors of this proposed initiative were the International Mechanism on Scientific Expertise on Biodiversity (IMoSEB) resulting from recommendations of the Paris Declaration on Biodiversity which was adopted at UNESCO Headquarters in January 2005. Concurrently the Millennium Ecosystem Assessment (MA), a scientific assessment of ecosystem services on which human well-being depends, was completed (MA 2005). UNESCO was one of the co-sponsors for this assessment. The results and follow-up of both can be taken on board in the process of the establishment of IPBES.

The Nature, Role and Contribution of UNESCO's Scientific Assessments to the Sustainability Agenda

Biodiversity and ecosystem services are at the core of UNESCO's mandate. The Organization administers the World Heritage Convention that covers many sites of great biodiversity value. It also administers the Intergovernmental Oceanographic Commission (IOC). UNESCO provides the Secretariat to, and coordinates, the World Water Assessment Programme on behalf of 24 UN agencies. The Organization has also co-sponsored the MA (2000-2005) as well as the International Assessment of Agricultural Science and Technology for Development (IAASTD, 2005-2008), for which it has coordinated the assessment for the Latin American and Caribbean region.

UNESCO is responsible for the implementation of the Man and the Biosphere Programme (MAB), which encompasses expert activities in relation to marine and coastal, island, wetland, mountain, arid, savannah, tropical forest, agricultural and urban/peri-urban ecosystems. One of the main means of implementation of science activities in UNESCO is provision of assistance to and capacity-building in Member States in formulating national science policies and related action plans.

As regards capacity-building, UNESCO runs the MAB Young Scientists Awards scheme, which encompasses biodiversity as a priority area, as well as the UNESCO Fellowships for World Heritage Site Managers. In addition UNESCO possesses more than 50 field offices worldwide, including regional offices for S&T in all continents.

UNESCO's Philosophy of Capacity-building in Support of Science

In 1993, UNESCO produced the first World Science Report. Since then four other reports have been published in 1996, 1998, 2005 and the most recent launched in November 2010 (UNESCO 2010a). This year also saw the launch of UNESCO's first global report on engineering – *Engineering: Issues, Challenges and Opportunities for Development*, which includes contributions on environmental engineering.

In order that science contribute in a real and substantial way to sustainable socio-economic development, a coherent strategy on human resource needs and development needs to be outlined, national priorities in science set and an enabling environment put in place to promote and foster endogenous research and innovation. National legislation needs to be reviewed in view of global changes and challenges like climate change and dependence on decreasing fossil fuel resources.

In this context, UNESCO's work in the natural sciences has made a significant contribution to developing national capacities, especially for the developing countries and least developed countries to attain critical masses of trained teaching and research capacity in basic sciences, science policy, environmental and earth sciences. Capacity-building programmes in science policy formulation both at the regional as well as the national, country levels have been undertaken resulting in policy briefs. The emphasis has always been towards participatory policy formulation bringing on board the numerous stakeholders, in particular policy makers and representatives of the scientific community.

As the lead agency for the UN Decade of Education for Sustainable Development (2005-2014), and UN Focal Point for Water and Oceans, UNESCO attempts to work with governments and civil society in promoting appropriate management strategies for the sustainable use of available natural resources and limiting the damaging impact of increasing human activity on ecosystems' functioning and capacity to deliver services. The importance of science in this endeavour is unarguable in the review of the current status, providing statistical and scientific evidence to underpin

decisions for policy change, advice and best practices. The UNESCO MAB Programme, an intergovernmental programme setup in the early 1970s, provides through its World Network of Biosphere Reserves, living laboratories where the relationship between communities and their environment can be studied and monitored. It provides opportunities for research into workable approaches to sustainable development taking into consideration the environmental, economic, social and cultural perspectives. Education and information activities are organized according to conservation, sustainable use and development issues and related topics. Some of the landmark projects that co-exist alongside the MAB Programme are "Ecole régionale postuniversitaire d'aménagement et de gestion intégrés des forêts et territoires tropicaux" (ERAIFT), UNEP/UNESCO Great Ape Survival Partnership (GRASP) and the Global and Climate Change in Mountain Sites (GLOCHAMOST).

UNESCO works with a range of organizations including scientific organizations and civil society groups and promotes North-South, South-South and North-South-South collaboration and exchange to advance science.

A set of principles were agreed upon that IPBES should take into account in carrying out its work, and UNESCO complies with most of these. UNESCO has the advantage of its multifaceted mandate which brings in not only the social but also the cultural dimensions and in particular within the programmes in the natural sciences, a specific programme dealing with Local and Indigenous Knowledge Systems (LINKS). This dimension should not be underestimated, and some case studies have demonstrated that the reinstating of traditional practices for management and use of bioresources have been successful in improving these (UNESCO 2010b). Involvement of indigenous populations is imperative to the success of any bioresource management strategy (UNESCO 2007; CBD 2009a), and wider policy in this regard should consider and include the issue of benefit sharing; this is already being looked at, at the global level (Normile 2010).

UNESCO sees IPBES as an independent intergovernmental process serving the needs of multiple constituencies. At the same time, UNESCO supports the notion that capacity development in scientific assessments of biodiversity and ecosystem services for sustainable development should constitute one of the core functions of IPBES and, in fact, a function that cuts across all constituencies to which the Platform will address its work.

Box 1: UNESCO and Capacity Building: Selected Examples

UNESCO has established many UNESCO Chairs in the biodiversity and ecosystem services area worldwide. Since 1999, the UNESCO Regional Post-graduate Training School on Integrated Management of Tropical Forests (ERAIFT) has been operating in the Democratic Republic of Congo. UNESCO and TWAS jointly implement an Associateship Scheme at Centres of Excellence in the South. Within the framework of the IBSP, UNESCO's programmes in biotechnology provide research and training opportunities for scientists especially from developing countries. The areas include environmental biotechnology, the inventorisation and management of microbial repositories and appropriate use of this diversity; in this regard increasing attention is being focussed on bioprospecting in extreme environments. In addition, UNESCO possesses more than 50 field offices worldwide, including regional offices for S&T in all continents.

As the lead agency for the UN Decade of Education for Sustainable Development (2005-2014), and UN Focal Point for Water and Oceans, UNESCO attempts to work with governments and civil society in promoting appropriate management strategies for the sustainable use of available natural resources and limiting the damaging impact of increasing human activity on ecosystems' functioning and capacity to deliver services. The importance of science in this endeavour is unarguable in the review of the current status, providing statistical and scientific evidence to underpin decisions for policy change, providing advice and best practices.

Initiatives on dealing with coping strategies for mountain biosphere reserves, is a follow-up on the Global Change in Mountain Regions (GLOCHAMORE) Initiative and has its main objectives to implement some of the research areas identified in the GLOCHAMORE Research Strategy (Mountain Research Initiative 2005). Among these are ecosystem functioning and services impacting on mountain biospheres and the livelihoods of mountain populations, and biodiversity, in particular biodiversity assessment and monitoring in the context of climate change.

The International Year of Biodiversity: Intended Objectives and Results[1]

In the spring of 2008, the Executive Board of UNESCO recalled the UN General Assembly resolution 61/203 proclaiming 2010 as the International Year of Biodiversity (IYB). The UNESCO Secretariat organized a high-

level launch of the Year at UNESCO Headquarters in Paris on 21 and 22 January 2010. The event was attended by Heads of States, governments and their representatives, representatives of UNESCO Member States, high-level representatives of several UN specialized agencies, funds and programmes, and of the Multilateral Environmental Agreements and the non-governmental community.

The IYB launch was followed by a five-day UNESCO International Conference on Biodiversity Science and Policy, held at UNESCO Headquarters from 25 to 29 January 2010. As part of UNESCO's capacity- and awareness-building activities in support of IYB, a UNESCO IYB Travelling Exhibition in English and French was launched on 21 January 2010 at UNESCO Headquarters in Paris. It has travelled widely and at this time has been translated into at least four other languages. An electronic version of all of the Exhibition's panels is available on the UNESCO IYB website[2] as a resource tool on biodiversity for schools.

An International Conference on Biological and Cultural Diversity was held in Montreal from 8 to 11 June 2010. A plan for joint actions by UNESCO and CBD in the area of biological and cultural diversity was developed and subsequently adopted by the CBD COP 10 in Nagoya October 2010.

Several governments that are Member States to UNESCO undertook specific activities in support of the Year. UNESCO field offices were mobilized and engaged actively in IYB.

Several of these activities contributed to building capacity in communicating effectively on various issues and enhanced the capacity to understand the issues related to biodiversity and ecosystem services.

Box 2: A sample of UNESCO sponsored and supported activities during IYB 2010

1. UNESCO IYB Travelling Exhibition in English and French has travelled widely and has been translated into many languages. It has been at many international events related to biodiversity and environmental forums. An electronic version of all of the Exhibition's panels is available on the UNESCO IYB website http://www.unep.org/iyb/.
2. An International Conference on Biological and Cultural Diversity was held in Montreal from 8 to 11 June 2010 with more than

Box 2 continued

Box 2 continued

150 participants and led to a Conference Declaration. A plan for joint actions by UNESCO and CBD in the area of biological and cultural diversity was developed and subsequently adopted by the CBD COP 10 in Nagoya, October 2010.

3. Many governments launched activities like conferences and campaigns to highlight IYB and create awareness among youth and students.
4. UNESCO field offices actively participated in many activities besides initiating activities on their own.
5. The UNESCO Associated Schools Project network (ASPnet) was used to mobilize classrooms, schools and communities in the framework of IYB. Reported ASPnet IYB-related activities took place in Austria, Brazil, Costa Rica, Peru, Portugal and the United Kingdom. Further, several biosphere reserves under UNESCO's MAB Programme undertook activities in the context of IYB. Examples include the ASPnet flagship Blue Danube River Project for which a special IYB publication was prepared, or the Karst Biosphere Reserve in Slovenia, where the first congress for young researchers from elementary schools was organized. The French Federation of UNESCO Clubs coordinated an initiative on biodiversity learning and participation in schools, which led to the publication of a compendium presenting the various projects undertaken in 13 countries from various regions of the world.

Science-policy interface in biodiversity and IPBES[3]

On the occasion of the International Conference on Biodiversity Science and Governance, held at UNESCO Headquarters in January 2005, representatives of governments, the scientific community, NGOs and the international community at large adopted the Paris Declaration on Biodiversity. The Declaration called for a consultative process on the need for an International Mechanism on Scientific Expertise on Biodiversity (IMoSEB). In the same year, the Millennium Ecosystem Assessment (MA) was completed. Launched by the Secretary-General of the UN in 2001, the MA involved more than 1,300 experts from all disciplines and fields and representing more than 100 countries.

In 2007, it was decided that discussions on how to implement the recommendations of the IMoSEB consultations and further assessments of

ecosystem services in the framework of the MA follow-up process should be dealt with in a combined way in the context of consultations on the establishment of a possible Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Moreover, it was recommended that the United Nations Environment Programme (UNEP) should facilitate the organization of these consultations. This was fulfilled. Government representatives attending the third and final *ad hoc* intergovernmental and multistakeholder meeting on IPBES acknowledged the importance of biodiversity and ecosystem services in terrestrial, marine and coastal, and inland water habitats which, while critically important for sustainable development and current and future human well-being, particularly for poverty eradication, are currently experiencing significant loss. They also acknowledged that the science-policy interface on biodiversity and ecosystem services must be strengthened at all levels; the importance of ensuring the highest quality and independence of the science made available; equally that of enhancing cooperation with relevant UN bodies, and of building capacity to mainstream biodiversity and ecosystem services.

Finally, the government representatives concluded that an intergovernmental science-policy platform for biodiversity and ecosystem services should be established to strengthen the science-policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development.

Focusing on government needs and based on priorities established by the IPBES Plenary, which will be the decision-making body of IPBES, government representatives proposed that the Platform should:

- respond to requests from governments, including those conveyed to it by multilateral environmental agreements related to biodiversity and ecosystem services as determined by their respective governing bodies.;
- identify and prioritize key scientific information needed for policy-makers at appropriate levels, and catalyse efforts to generate new knowledge through dialogue with key scientific organizations, policy-makers and funding organizations. These must be scientifically credible, independent and peer-reviewed, including identifying uncertainties, and there should be a clear transparent process for sharing and incorporating relevant data. The new Platform should maintain a catalogue of relevant assessments, identify the need for

regional and subregional assessments and help to catalyse support for subregional and national assessments, as appropriate;

- support policy formulation and implementation by identifying policy-relevant tools and methodologies, such as those arising from assessments, enabling decision-makers to gain access to those tools and methodologies, and where necessary promoting and catalysing their further development;
- prioritize key capacity-building needs to improve the science-policy interface at appropriate levels; provide and call for financial and other support for the highest priority needs;
- be established as an independent intergovernmental body administered by one or more existing UN organizations, agencies, funds or programmes. The IPBES Plenary should be open to participation by all Member States of the UN and regional economic integration organizations. Intergovernmental organizations and other relevant stakeholders should participate in the Plenary as observers, in accordance with the rules of procedure established by the Plenary. Through its rules of procedure, the Plenary should, in general, decide by consensus of government representatives.

It appears clearly that in light of the foreseen functions of IPBES, capacity-building will be a key ingredient of the Platform's success.

In terms of next steps, representatives of governments recommended that the sixty-fifth session of the UN General Assembly be invited to consider the conclusions of the third and final meeting on IPBES, and to take appropriate action for its establishment. The willingness of UNESCO's Member States to be institutionally associated with, and to support, IPBES was stated and reiterated on several occasions and was indeed recently taken note of by the UN General Assembly in its deliberations in relation to the Platform.

In the light of UNESCO's science mandate, as well as its long-standing and active role in relation to biodiversity and ecosystem services, representatives of governments participating in the IPBES consultations have identified UNESCO as a central player with regard to IPBES. Moreover, the Organization's multidisciplinary mandate, as well as its expertise in the area of capacity-building, would be vital assets in the effective implementation of the Platform's programme of work.

Some Considerations on IPCC, with Particular Reference to Capacity-building-related Issues

Following the attribution to the Intergovernmental Panel on Climate Change (IPCC) of the Nobel Peace Prize in 2007, an IPCC Scholarship Programme was setup with the aim to provide opportunities for participation of developing country young scientists in climate change research.

In a recent report by the Inter-Academy Panel (IAC) on the evaluation of the IPCC, capacity-building was referred to as an important area of focus for the IPCC in the future. Currently, although the IPCC does not have a mandate in capacity-building *per se*, *de facto*, through its scientific and technical work, for example, in the area of scenarios development, the Panel assists in building further capacity in the area of climate change research and assessments of related scientific knowledge.

The IAC report recognizes the significant and ever-since growing participation of developing country scientists in the IPCC reports. However, it also stresses that in light of its mandate, the IPCC can mainly encourage relevant competent organization to undertake efforts for building capacity in support of climate change research and assessments (IAC 2010). Lessons can be drawn from the IPCC experience: while in the case of IPBES, the Platform's mandate could and perhaps should encompass capacity-building, a challenge lies in finding a balance between the Platform's focused scientific work and its role as a catalyser and builder of capacity in the area of scientific assessments of biodiversity and ecosystem services.

The Role of UNESCO in Building Capacity in Priority Areas Related to Biodiversity and Biotechnology

Priority areas and issues in the field of biodiversity and bioconservation need to be identified bearing in mind the food, fuel and resource needs of especially rural communities. Much of these broad needs have been identified under the Gap Analysis submitted at the Second *ad hoc* intergovernmental and multi-stakeholder meeting on IPBES (UNEP 2009).

Biopolicies need to be revised, revisited and implemented, and in their formulation, all tiers of stakeholders need to be mobilized and involved, in particular, those who are dependent on the plant biodiversity for their livelihoods and daily needs. Realistic, affordable and accessible fuel alternatives need to be found for those dependent on forests for their fuel source. This remains a real challenge for scientists and governments alike as the impact of rural communities on forest ecosystems is taxing these

dwindling resources. The recent focus on biofuels as alternative fuel options, and monocultures for commercial gain are not without problems, among these, impact on food production, dead forest syndromes and the loss of biodiversity.

The issues of biosecurity and biocontrol have become a real global problem with increased mobility of people across national borders. In particular, small, insular systems like those found in small islands states whose ecosystems are particularly, vulnerable to invasive exotic plant and animal species and new pathogens brought in with these. The introduction of such invasive alien species has an economic cost (McNeely 2001) and directly affects food production and native biodiversity. A statement by the UNEP Executive Director indicated that in sub-Saharan Africa, the cost of one invasive alien species the *witchweed* alone is causing annual maize losses estimated at US$7billion (BBC News Viewpoint 2010). The economic impact is an estimated US$157 billion annually in the United States and up to US$1.4 trillion annually worldwide (BBC News Viewpoint 2010). The importance of this global problem can be noted from the designation by the CBD of Invasive Alien Species as the theme for the International Day on Biological Diversity in 2009. It was proclaimed to be "one of the greatest threats to biodiversity, and to the ecological and economic well-being of society and the planet" (CBD 2009b); this alongside the impact of habitat loss and degradation (UNESCO 2010b; Rands *et al.,* 2010). Some of the challenges that many countries face are the application of appropriate mechanisms to control the transfer of live biological material, ornamental plants and other plant based material as well as animals, across borders, and effectively maintain the integrity of their biodiversity. Policy advice and capacity-building in appropriate related fields is required.

In developing strategies for the sustainable exploitation of biological resources the role of traditional practitioners and use of traditional medicinal plants needs to be taken into account. Development of and training in propagation technologies for traditional medicinal plants, methods of inventorising these plants and their protection and conservation equally in terms of intellectual property and the need to ensure benefits sharing should be addressed. Many of the aforementioned situations involve transboundary reserves and shared resources between adjacent states. UNESCO has a role to play in facilitating exchange and collaboration between the various parties involved to provide the best solutions and to reach commonly agreed strategies for management and conservation (Bawa *et al.* 2010).

With the advent of new technologies especially in the field of biotechnology, issues of containment and safe release of modified plants have become a matter of concern in many countries, in particular, the question of their potential impact on biodiversity. In this context, there is an urgent imperative to maintain reservoirs of the local animal and plant as well as microbial gene pools.

The Statement and Recommendations from the UNESCO International Year of Biodiversity Science Policy Conference (UNESCO Headquarters, Paris, 25-29 January 2010) included the following additional key elements from a capacity-building perspective (UNESCO in press):

- for taxonomy, business as usual is not an option in the face of the grand challenges, with the great majority of species remaining undiscovered, most countries and areas lacking comprehensive biodiversity inventories, and a critical lack of relevant expertise and capacities in most biodiversity rich countries. Scaling-up and sustaining taxonomy is an imperative;
- so that conservation biogeography knowledge can most effectively inform policy-makers on scales, dynamics, and uncertainty surrounding biodiversity impacts from climate change and other anthropogenic forces, it should be used as a basis for producing tools for policy guidance, and explicit communication and interaction between policy-makers, scientists, educators, practitioners and local stakeholders enhanced;
- on issues related to gender and biodiversity, national capacities should be further developed to facilitate the understanding of the importance of including gender issues in biodiversity initiatives.

We believe that this expert advice should be taken into account while pursuing further reflection on the capacity-building function of IPBES.

Capacity-building for Biodiversity and Biotechnology as an Insurance for Mainstreaming the Biodiversity Agenda into Development: A Contribution of UNESCO to IPBES

The importance of biodiversity in the context of the emerging IPBES and the aspiration for UNESCO to play a lead role on it, on the one hand; and the strong and unequivocal support of the international community as a whole – developing and developed nations altogether – for actions aimed at strengthening the science-policy interface, on the other hand, will be the basis for collaborative capacity-building proposals between UNESCO and

relevant partners in the area of biodiversity in general and in the context of IPBES in particular.

Through the support of the governments and civil society to the biodiversity agenda and the Organization's global mandate, currently-available expertise and on-going relevant programmes activities, UNESCO shall support the IPBES process and enhance the equitable participation in the Platform of experts from developing as well as all other regions of the world. It shall also contribute to ensuring a geographically, epistemologically, disciplinarily as well as gender balance, with a particular focus on Africa.

UNESCO's involvement in IPBES will provide a strengthened enabling intergovernmental framework for the Platform. It will enhance the scientific credibility of the process, as UNESCO is the specialized agency of the UN system in charge of science. In light of its mandate in the area of culture, UNESCO will ensure that evaluations under IPBES also take into account cultural services and the influence of human factors on biodiversity.

In the future, an important resolution will be to determine what should be the scope of the capacity-building element of IPBES. Currently, capacity-building in the context of IPBES is seen as addressing the following functions: capacities for the engagement of knowledge holders and scientists; capacities to access, generate, use and disseminate information and knowledge; capacities for planning and policy; capacities for management and implementation; and capacities to monitor and evaluate.

In UNESCO's experience, the two main approaches pursued in the area of capacity-building (direct assistance vs. contributions to country-led strategies and programmes and strategies – UNEP 2010b) are not mutually exclusive. While the tendency may be towards country-led strategies and programmes, there are situations in which direct assistance is still required, namely, in the form of studies on the feasibility of planned interventions. Capacity-building is crucial for the purpose of effectively implementing not only development processes but also other processes, for example, the process of S&T development. In fact, there are capacity-building activities that precisely aim at filling the disconnect between 'science and tools development and the uptake of scientific findings in policy and implementation' (UNEP 2010b). One specific example is the area of planning and, more specifically, UNESCO-MAB and IOC's Programme in Marine Spatial Planning and relevant activities in relation to landscape-level planning.

At this stage, it is premature to assume what the focus of a capacity-building element of IPBES will be. As a description of capacity-building for the purpose of IPBES cannot be derived from what has been discussed thus far, it appears that a full-fledged discussion on capacity-building will be required to take place at the first IPBES Plenary. There is a need to maximize synergies between IPBES, the CBD and other processes in this area.

The discussions on which, if any, of the above-mentioned functions will be retained as part of a possible capacity-building element of IPBES are still open; therefore, this proposal should not prejudice the deliberations at the first IPBES Plenary meeting. Regardless, UNESCO, as the specialized agency of the UN in charge of science, education as well as culture, and as one of the proposed co-sponsors of IPBES, is best positioned to help with IPBES' capacity-building component, in particular, and in IPBES as a whole.

Endnotes

1 This section of the paper relies on the report of the Director-General of UNESCO to the 185th session of the Executive Board of UNESCO on the Board's decision on UNESCO's participation in IYB (UNESCO, 2010c).

2 http://www.unep.org/iyb/.

3 This section of the paper relies heavily on the Report of the third ad hoc intergovernmental and multi-stakeholder meeting on an intergovernmental science-policy platform on biodiversity and ecosystem services (UNEP 2010a) as summarized in a document entitled 'UNESCO and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)' (UNESCO, 2010d).

References

Bawa, K.S, Koh, L.P., Lee, T.M., Liu, J., Ramakrishnan, P.S. and Yu, D.W. 2010. "China, India and the Environment." *Science* 327: pp. 1457-1459.

BBC News – VIEWPOINT, 13 April 2010: Achim Steiner, UNEP, Counting the cost of alien invasions.

Convention on Biological Diversity (CBD) 2009a. *Biodiversity, Development and Poverty Alleviation: Recognizing the Role of Biodiversity for Human Well-being*. Montreal: CBD.

CBD Website 2009b: http://www.cbd.int/idb/2009/.

Global Invasive Species Programme 2007. Economic Impacts of Invasive Alien Species: A Global Problem with Local Consequences. CABI.

Millennium Ecosystem Assessment 2005. Ecosystems and Human Well-Being. Washington DC: Island Press.

Mountain Research Initiative 2005. The GLOCHAMORE Research Strategy. Switzerland.

McNeely, J. 2001. "Invasive Species: A Costly Catastrophe for Native Biodiversity". Land Use and Water Resources Research1: pp. 1–10.

Normile, D. 2010. U.N. Biodiversity Summit Yields Welcome and Unexpected Progress. Science 330: pp. 742-743.

Perrings, C., Naeem, S., Ahrestani, F., Bunker, D.E., Burkill, P., Canziani, G., Elmqvist, T., Ferrati, R., Fuhrman, J., Jaksic, F., Kawabata, Z., Kinzig, A., Mace, G.M., Milano, F., Mooney, H., Prieur-Richard, A.-H., Tschirhart, J. And Weisser, W. 2010. "Ecosystem Services for 2020". *Science*, 330: pp. 323-324.

Rands, M.R.W., Adams, W.M., Bennun, L., Butchart, S.H.M., Clements, A., Coomes, D., Entwistle, A., Hodge, I., Kapos, V., Scharlemann, J.P.W., Sutherland, W.J. and Vira, B. 2010. "Challenges Beyond 2010". Science, 329: pp. 1298-1303.

United Nations Environment Programme (UNEP) 2009. Second *ad hoc* intergovernmental and multi-stakeholder meeting on an intergovernmental science-policy platform on biodiversity and ecosystem services: A Gap Analysis. Nairobi: UNEP.

UNEP. 2010a. Report of the third *ad hoc* intergovernmental and multi-stakeholder meeting on an intergovernmental science-policy platform on biodiversity and ecosystem services. Nairobi: UNEP.

UNEP. 2010b. Third *ad hoc* intergovernmental and multi-stakeholder meeting on an intergovernmental science-policy platform on biodiversity and ecosystem services. Nairobi: UNEP.

United Nations Educational Scientific and Cultural Organization (UNESCO) 2007. *Biodiversity in UNESCO*. Paris: UNESCO Publishing.

UNESCO. 2010a. *UNESCO Science Report 2010*. Paris: UNESCO Publishing.

UNESCO. 2010b. A biocultural alliance. A World of Science, 8(3) (editorial).

UNESCO. 2010c. Report of the Director-General of UNESCO to the 185th session of the Executive Board of UNESCO on the Board's decisions: UNESCO and the International Year of Biodiversity. Paris: UNESCO.

UNESCO (in press). Statement and Recommendations from the UNESCO International Year of Biodiversity Science Policy Conference (UNESCO Headquarters, Paris, 25-29 January 2010).

UNESCO. 2010d. UNESCO and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Paris: UNESCO.

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Plant Genetic Resources and Germplasm Use in India

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Abstract: Plant genetic resource (PGR) scientists now recognize the importance of shifting from a singular focus on conservation to a focus on both conservation and utilization of germplasm in order to meet future challenges. This paper analyzes the patterns of distribution of pearl millet, six small millets, chickpea and pigeonpea germplasm over the last 10 years at the two major genebanks functioning in India: the National Genebank at the National Bureau of Plant Genetic Resources (NBPGR) and a Consultative Group for International Agricultural Research (CGIAR) Genebank at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), as well as the patterns of use of germplasm by millet breeders in India. Between the years of 1999-2009, ICRISAT distributed approximately 48 per cent of all its collections to breeders in India whereas NBPGR distributed 36 per cent of their collection. A total of 20 responses (30 per cent of surveys sent) were collected through this study. Sixty-five percent of respondents said that they rarely (<50 per cent of the time) use germplasm from genebanks in their breeding programs. It is important that both genebanks look into several issues in order to improve levels of distribution and utilization, collection, duplication, engagement of the private sector, access to information, and pre-breeding.

Keywords: Germplasm, traits, plant genetic resources, breeding, ICRISAT, NBPGR.

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Introduction

Germplasm collection in India began in earnest in the 1950s due to threats to the disappearance of landrace varieties. Since then thousands of landraces and crop wild relatives, which have provided the source of genes for breeding improved cultivars, have been collected and conserved in genebanks. However, little information is available about the extent to which their genetic diversity has been used to increase crop production (Pardey *et al.*, 1999). Plant genetic resource (PGR) scientists now recognize the importance of shifting from a singular focus on collection and conservation to a focus on both collection/conservation and access and utilization of germplasm in order to meet the challenges of feeding a burgeoning population in the face of a changing climate (Frankel, 1986; Jie Wang *et al.*, 1998). It is thought that through the incorporation of the valuable genes held in genebanks into new crop varieties, these challenges may be overcome.

FAO (2010, 1998) reported that only a few national genebanks had distributed more than 10 per cent of their germplasm, and most of this went to breeders and researchers. Nevertheless, some larger national programmes, such as the US National Plant Germplasm System, has distributed a significant portion of germplasm both domestically and internationally (Smale and Day-Rubenstein *et al.*, 2002). A 15-year Chinese study showed that a much larger number of cultivars and advanced lines were distributed than landraces, wild relatives or genetic stocks (Weidong, 2000). This implies the existence of a considerable unrealized potential for use of plant genetic diversity for increasing food security.

Plant genetic resources were, up until about 20 years ago, held in an open access regime, as global public goods, and were considered as the "common heritage of mankind" (Raustiala and Victor, 2004; Hammer, 2003). New international treaties, such as Trade Related Aspects of Intellectual Property Rights (TRIPS) and International Union for the Protection of New Varieties of Plants (UPOV), established an intellectual property rights regime on plant variety development; and the Convention of Biological Diversity (CBD), granted sovereign rights to nations over biodiversity including genetic resources. These developments have had a large impact on the flows and rules for the access and use of germplasm. The policy and legal regimes along with *sui generis* laws in signatory countries have raised uncertainty with regards to access and benefit sharing and may be responsible for decline in flow of PGR (Gotor and Caracciolo, 2008).

Some of the most nutritious and valuable crops for small scale farmers in South Asia, the millets and pulses, have not been included in systematic analyses of the extent of use and distribution among genetic resources users (i.e. breeders and researchers). This gap in understanding and the general one-sided focus of agricultural research on major crops of global economic importance (e.g. rice, wheat, and maize) limits our ability to meet the needs of the over 1 billion small scale farmers which rely on neglected crops like the millets and pulses (Mazoyer, 2001).

There is global concern over whether genebanks are achieving the far reaching goals for which they were created such as the conservation and use of the world's PGR. Principle among those goals is the exchange of germplasm between genebanks and users of germplasm which includes researchers, breeders and farmers. The aim of this paper is to analyze the patterns of distribution and use of millet and pulse germplasm over the last 10 years at the two major genebanks functioning in India: the National Genebank at the National Bureau of Plant Genetic Resources (NBPGR) and a CGIAR Genebank at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT).

NBPGR conserves over 3000 crops of India with a total number of accessions of 395,168, while ICRISAT only conserves the five mandate crops (pearl millet, sorghum, pigeonpea, chickpea, and ground nut) as well as six small millets of the Semi-Arid Tropics with a total of 119,739 accessions. With regard to the four target crops of this study (i.e. pearl millet, minor millets, chickpea, and pigeonpea), ICRISAT holds 66,345 accessions while NBPGR has 57,596 accessions. NBPGR distributes germplasm maintained in network mode from its regional stations and other National Active Germplasm Sites (NAGS), where the active collections are held, while ICRISAT distributes samples from the genebank maintained at its headquarter near Patancheru in India.

This paper examines germplasm sources and flows for these valuable and often neglected crops in India. The data provide the basis for identifying ways to conserve and make available this local germplasm for crop improvement and direct use. In doing so, we also look at the constraints breeders and researchers face in accessing genebank materials and discuss how best to address them.

Methods

To assess the exchange and use of germplasm in India, we collected

information about germplasm distribution and use based on surveys from two distinct stakeholder groups: genebanks and breeders/researchers. We focused our analysis on four major crops namely, pearl millet, minor millets, chickpea, and pigeonpea. These crops were deliberately chosen for several reasons: comparative purposes, as pairs (cereals and legumes), based on their economic and food security importance in India, and because these genebanks hold major collections of these crops in India.

NBPGR and ICRISAT provided germplasm distribution information regarding the quantity of samples, type of recipient, and total collections conserved for the last 10 years for all four target crops. Additionally, a short questionnaire was completed by genebank staff, which explored the mechanisms that link genebanks to users as well as the constraints that impede access to germplasm. This survey also sought to answer the following questions: What percentage of the genebank collections are being accessed by users? Which crops have been accessed most frequently by whom? How can genebank management be improved to facilitate increased germplasm distribution?

We also collected information directly from germplasm requestors or "indenters", as they are called in India, through a survey which was sent to 60 millet indenters, breeders, and researchers, both public and private, registered in India. The breeder survey was designed to elicit responses to better understand the following questions: What are the constraints to germplasm exchange? What mechanisms can be developed to overcome those constraints? Who is requesting germplasm? How much germplasm is used by the average indenter?

This survey was delivered both electronically and by post with instructions and a letter of support from associated institutions. The respondents were given 3 months to complete the 15 questions included therein. All surveys were mailed by 30 July 2010 and received by 30 October 2010.

The Active Germplasm Distribution Index (AGDI) was calculated for the target crops in order to provide indicators of the degree of distribution of these particular crop groups. The AGDI is an indicator of the relative utilization of a germplasm collection in comparison to the overall holdings of a specific crop. It has been used in the past by others (Iwanga, 1993; Hodgkin *et al.*, 2003), which makes it apt for cross genebank comparisons. It is calculated as:

AGDI = [n/(a/100)]/b

where n= total number of accessions distributed, a= total accessions conserved, and b= number of years)

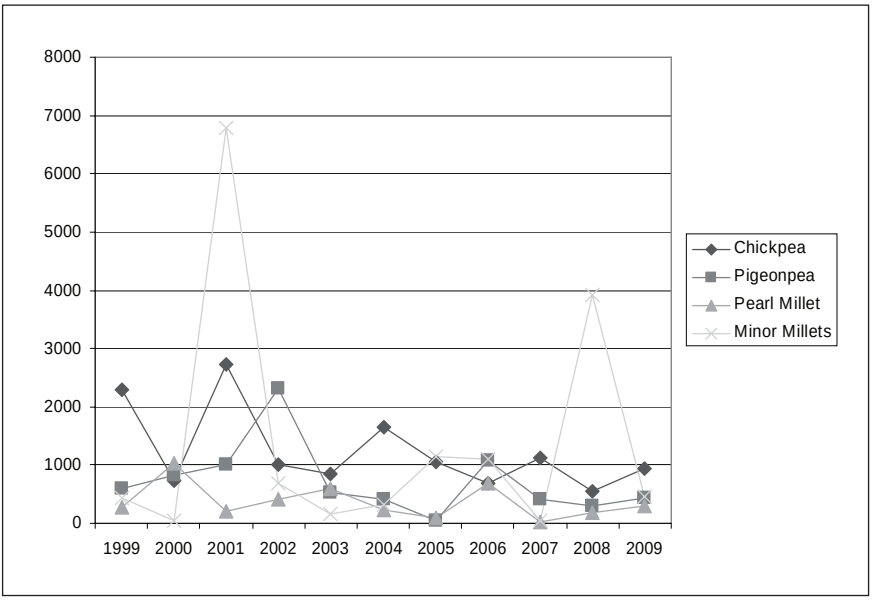
An analysis of the commonalities among breeders was also undertaken in order to understand the needs and focus of millet breeding programmes in India. This analysis serves to inform genebank management decisions in light of the current policy scenario governing exchange of PGR.

Results

Patterns of Distribution - Genebanks

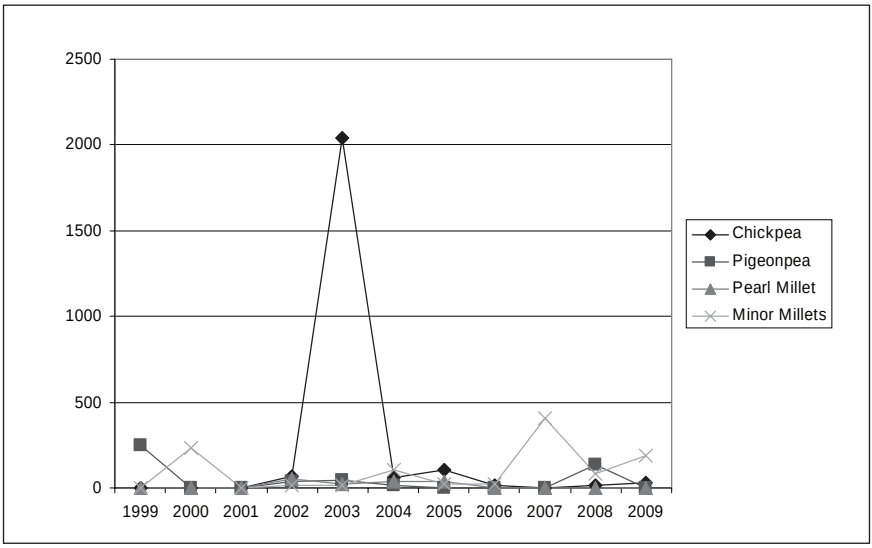
The trend in germplasm distribution over 10 years in each genebank is shown in Figures 1 and 2.

Figure 1: Germplasm Accession Distribution from ICRISAT Genebank during 1999-2009.



Source: Calculated from data provided by ICRISAT update to SINGER/Genesys on Aug 2010. Includes data for germplasm accessions distributed in India from 1999-2009.

Figure 2: Germplasm Accession Distribution from NBPGR Genebank during 1999-2009.



Source: Calculated from data provided by NBPGR on September 2010 encompassing germplasm distributed from 1999-2009.

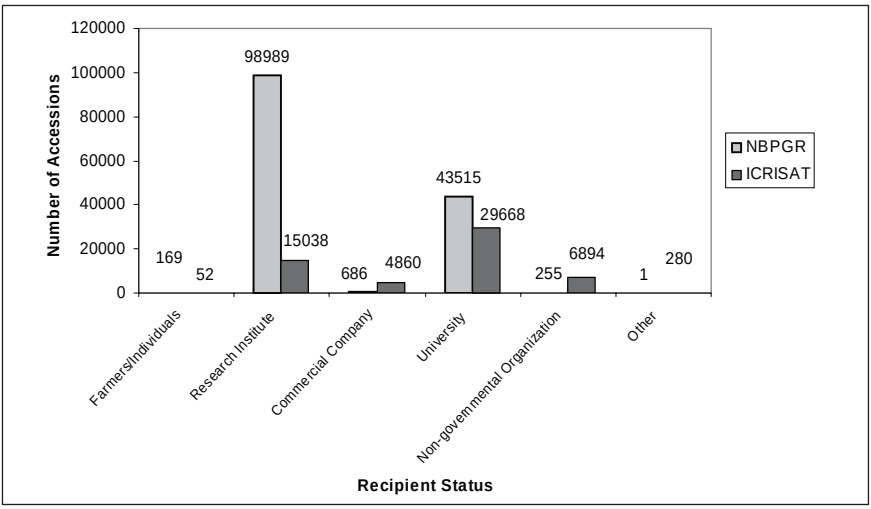
AGDI calculated for four selected crops from the two genebanks data is presented in Table 1 below.

Table 1: Sample Distribution Per Crop and its Corresponding AGDI over 10 Years for ICRISAT and NBPGR Genebanks.

Genebank	Crop	Number of Accessions Distributed	Number of Accessions Conserved	Active Germplasm Distribution Index
ICRISAT	Chickpea	13625	20267	6.72
	Pigeonpea	7939	13632	5.82
	Pearl Millet	4001	22211	1.80
	Minor Millets	18882	10235	18.45
	All Crops	56792	119739	4.74
NBPGR	Chickpea	2341	9325	2.51
	Pigeonpea	486	7629	0.64
	Pearl Millet	148	8031	0.18
	Minor Millets	1092	21706	0.50
	All Crops	143615	395168	3.63

It is also important to understand what types of users are accessing germplasm conserved in genebanks. Figure 3 shows the total volume of germplasm distributed to particular user groups by each of the genebanks considered. It shows that research institute and university researchers were among the major recipient of germplasm from both genebanks, especially from the national genebank. ICRISAT on the other hand distributes more germplasm to private and Non governmental organizations.

Figure 3: Germplasm Distribution from ICRISAT and NBPGR Genebanks to different Recipient Groups from 1999-2009

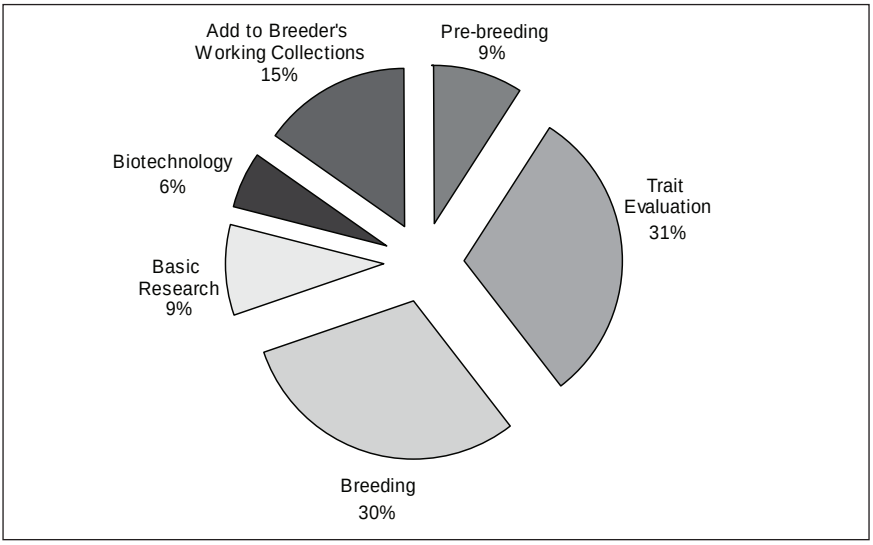


Patterns of Use - Plant Breeders

A total of 20 responses (30 per cent of surveys sent) were collected through this study. Due to the limited sample size, this analysis can only be considered preliminary in nature. Nevertheless, the results highlight some important trends with regards to germplasm use by breeders.

Although, genebanks potentially house a vast repository of novel genes that could be useful in breeding new crop varieties, 65 per cent of respondents said that they rarely (<50 per cent of the time) use germplasm from genebanks in their breeding programs. Of those respondents that accessed germplasm from genebanks, the average number of accessions requested during the 10 year period was 466 accessions, and of those accessions an average of 25 per cent (116 accessions) were being actively utilized in breeding programmes. The various uses of this germplasm by respondents are presented in Figure 4.

Figure 4: Use of Millet Germplasm by Breeders in India



Source: Survey by authors.

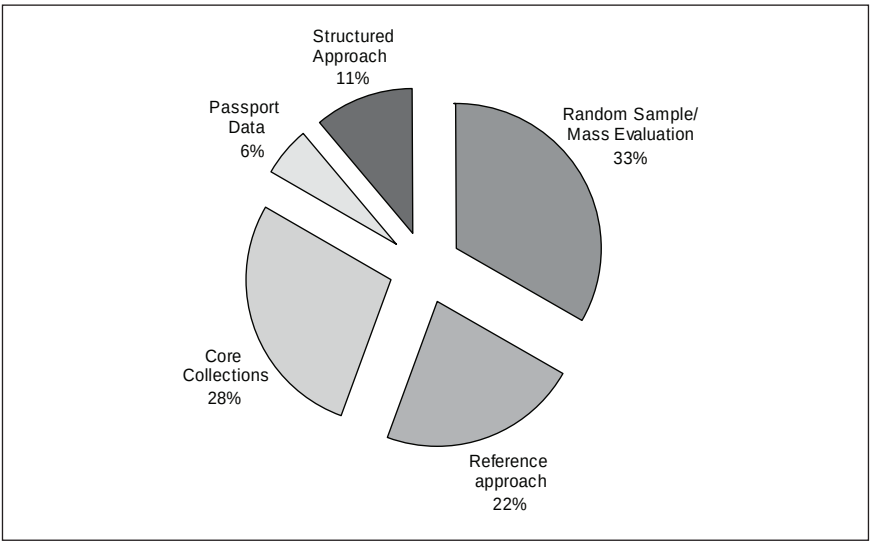
The most important characters that breeders sought to develop in their new varieties were elicited through the survey, and the gaps in the array of traits already available in their breeding collections were also identified. The results of the most common responses are presented in Table 2.

Table 2: Sought-after-traits and Gaps

Traits	**Response Rate)**
Character Sought	
High Yield	85
Drought Tolerance	40
Disease Resistance	75
Early Maturity	55
Gap Found	
High Yield	55
Drought Tolerance	45
Disease Resistance	45
Early Maturity	35

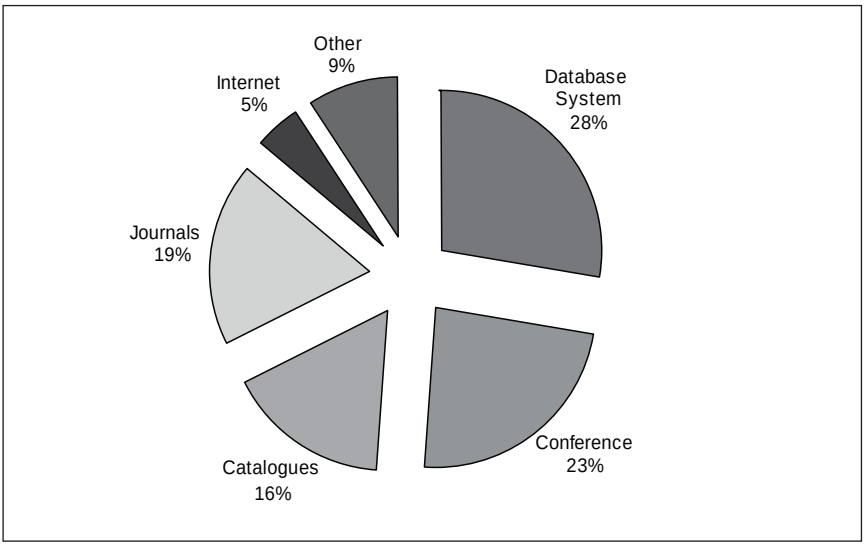
Breeders have a variety of methods and approaches for acquiring and accessing information about germplasm in order to target specific accessions of interest (see Figure 5 and 6). Among the different approaches is Random Sample, which refers to requests for large numbers of germplasm of unknown genotype and origin, the most widely used method with 33 per cent. Core collections, that is the use of a subset of defined genotypes selected through principle component analysis was the next highest strategy adopted by users. Reference approach, the use of some reference to target a particular accession, be it through literature or by personal recommendation, also represented a high percentage (22 per cent). The use of simple passport information associated with accessions to target specific accessions (passport data), and Structured approach which includes an indenter-defined strategy or system for targeting specific accessions were also used to some extent. Figure 6 also shows the different sources by which breeders obtain their information. Breeders are primarily using some form of a database system as well as interactions at conferences or conference proceedings in order to avail themselves of useful accessions held by genebanks. While it appears that the potential for internet dissemination of accession related information is underutilized.

Figure 5: Breeders Approaches to Germplasm Acquisition



Source: Survey by authors.

Figure 6: Breeders Approaches to Accessing Information about Germplasm



Source: Survey by authors.

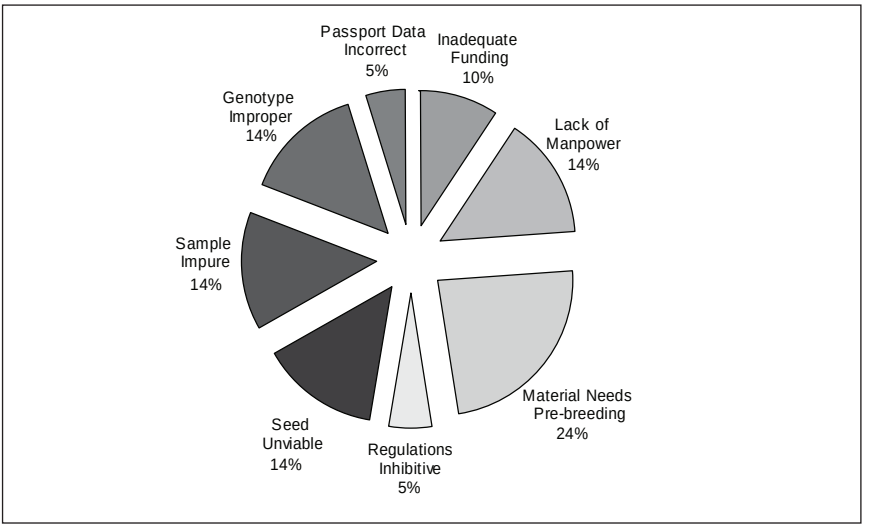
While breeders identified a number of mechanisms of accessing germplasm collections they also recognized several constraints which limit their access to *ex situ* collections. Those constraints are highlighted in Figure 7. The need for pre-breeding is highlighted as the most important problem hindering the usage of germplasm provided to breeders. Additionally, technical issues are also mentioned as constraints to effective germplasm utilization, such as, lack of manpower, impure, unviable samples, and improper genotypes.

It is important to note that 40 per cent of respondents suggested that field days and demonstration trials be conducted more frequently in order for breeders to be able to see the accessions in the field. Additionally, 45 per cent of respondents suggested that access to data be improved through regular publication and wider circulation of germplasm catalogues, publication of information on the internet, or linking passport data with evaluation data on a single database.

The survey also elicited responses about perceived benefits accrued through the use of germplasm which is displayed in Figure 8. The enhancement of breeding lines and cultivar development constitute the major benefits of using germplasm mentioned by breeders, but it's clear

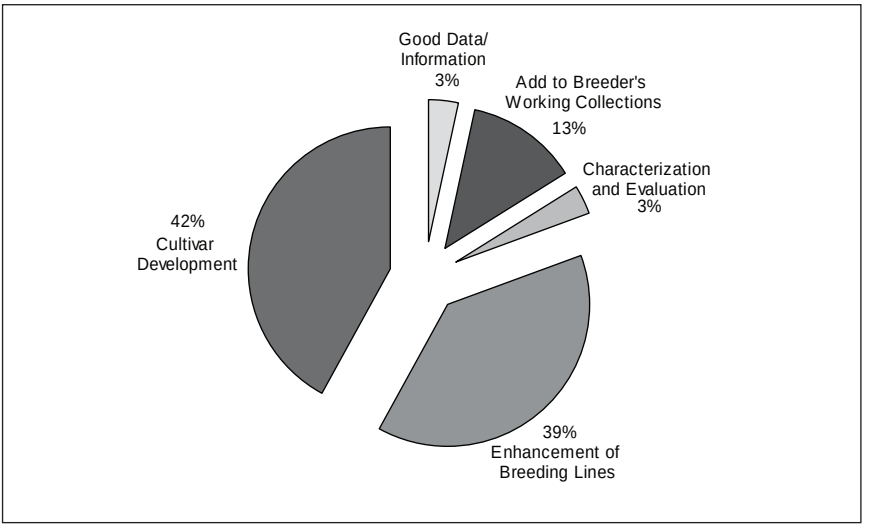
that breeders are also using germplasm from genebanks to establish their own in house PGR collections (13 per cent).

Figure 7: Problems Which Limit the Access to and Utility of Germplasm from Genebanks



Source: Survey by authors.

Figure 8: Benefits Associated with Germplasm Use



Source: Survey by authors.

Discussion

Patterns of Distribution - Genebanks

Between the years of 1999-2009, ICRISAT distributed approximately 48 per cent of all its collections to breeders in India, whereas NBPGR distributed a relatively smaller proportion of 36 per cent. This level of distribution is considerable in light of the relative size of these collections. NBPGR is the third largest genebank in the world and ICRISAT is the third largest gene bank among the CGIAR genebanks (FAO, 2010). This analysis only encompasses data of germplasm distribution to indenters located in India. Nevertheless, these levels of distribution are comparable to annual levels of germplasm distribution reported by other large genebanks (FAO, 1998; FAO, 2010; Hodgkin *et al.*, 2003).

There is also a great degree of fluctuation between levels of distribution from year to year which highlights the importance of analysis of distribution data over the course of multiple years. It is not clear what is responsible for these large year to year fluctuations, but they may be a response to the initiation of a particular research institute's germplasm evaluation projects which aim to carry out mass evaluation of specific crop germplasm.

ICRISAT has a greater AGDI for all four target crops, but this doesn't mean that NBPGR distributes less germplasm. In fact, NBPGR distributed almost three times the amount of germplasm that ICRISAT did over this 10 year period. When the AGDI of these genebanks' total distributions and holdings is compared, the result is actually quite similar as is evident from the AGDI value for all crops as mentioned in Table 1. These data may allude to the fact that a duplication effect is occurring. Where genebanks that hold similar materials are both accessible, germplasm users have a preference for one genebank at the expense of the other. Since ICRISAT specializes in five mandate crops, it is more sought-after for the four target crops of this study which are among those five mandate crops and are common to both genebanks. For other crops not held in the ICRISAT genebank, germplasm users in India are more likely to use the collections held by NBPGR. By conserving similar accessions these genebanks may be inadvertently duplicating their efforts with regards to these four target crops. The unique accessions held by each genebank should be identified so that breeders can easily access truly distinct accessions and avoid replication in their breeding programmes.

Although there are several categories of germplasm users, there is no doubt that the largest recipients of germplasm samples are from the research

institute and university sectors. In India, from a plant breeding perspective, this distinction is almost not worth making as the line between a research institute and a university is blurry due to the structure and intersection of funding from the central government to the land grant universities and research institutes. Often these two sectors operate on the same campuses and have tight linkages in their research objectives.

However, it is worth noting that ICRISAT distributes a much higher quantity of germplasm to commercial companies and non-governmental organizations (NGOs) than does NBPGR. This may be due to the fact that only few indenters from commercial companies and NGOs send their requests for germplasm of these target crops to NBPGR.

This network of private companies has the capability of developing useful new varieties for the benefit of small farmers. Private sector companies also need to more openly share germplasm collections and information held by them with public sector users. This will further build trust and strengthen the public-private relationship. The National Seed Association (NSA), a consortium of private seed companies in India, has also voiced the need for the harmonization of germplasm exchange so that this untapped potential can be readily accessed by the private sector. ICRISAT has made recent inroads into developing working relationships with the private sector through public-private partnerships, which is reflected in the relatively larger share of germplasm being exchanged with commercial enterprises.

Additionally, farmers/individuals account for a negligible amount of germplasm exchange. Although genebanks were not initially designed with farmer-genebank exchange in mind, the benefits of creating such linkages have been the subject of several analyses (Bramel-Cox, 2000; Ngoc De, 2000; Worede, 2000) and could be a logical and beneficial extension of genebank activities.

Patterns of Use – Plant Breeders

The majority of the millet breeders surveyed used the requested germplasm for trait evaluation and basic breeding. Most breeders are particularly interested in developing high yielding, disease resistant, drought tolerant and early maturing varieties. These traits are also identified as major gaps in the genotypes that they currently have available to them. It is true that the same traits figure in both traits preferred and gap in availability as in Table 2. This is can be considered as more a reflection of the importance placed on the traits than a reflection on their availability.

With respect to the methods breeders use to acquire germplasm from genebanks, it is clear that breeders generally use random selection and simultaneous mass evaluation of many accessions obtained from the genebanks. However, the traditional practice of reviewing the scientific literature for the identification of potentially useful accessions is also a prevalent method used to access germplasm. More recently, the use of core collections has become an important method that breeders use to access the range of diversity conserved in the genebank (van Hintum *et al.*, 2000).

One of the major improvements suggested by breeders to increase utilization of germplasm is to improve the information that is available about accessions. Currently, breeders primarily use some form of a database system, whether managed by genebanks or the breeders themselves, in order to request germplasm, but conferences, journals, and catalogues are also identified as important sources of information about potentially useful germplasm. ICRISAT has made available a catalogue of all its accessions including passport data on-line through their own website and the SINGER portal. However, NBPGR has yet to publish a comprehensive database of its accessions on-line. In neither of these cases is evaluation and characterization data linked to accessions made readily available in a searchable web-based format. Searchable web-based databases that link evaluation data from multi-location trials to passport data about accessions were mentioned as a suitable way to share information. Nevertheless, often breeders are located in remote field stations that have limited access to the internet and publications.

Additionally, field days were commonly mentioned as solutions to this problem. Breeders maintained that "seeing is believing" and that there is no substitute for seeing the accession in the field. Although NBPGR has been organizing field days for demonstration of promising genetic diversity and germplasm registered with unique traits in the field, there is further scope to invite more breeders/researchers to select germplasm of interest.

As this study shows, one of the main problems associated with the use of germplasm in breeding programmes identified by respondents is the need for pre-breeding (Figure. 7). The major importance of pre-breeding in linking breeders to germplasm collections has also been identified by breeders and scientists elsewhere (FAO, 2010; Tikader and Dandin, 2007; Valkoun, 2001; Nass and Paterniani, 2000). Much of the germplasm available in genebanks is unimproved and has a broad genetic base with many undesirable characteristics. Breeders are looking to develop traits

which are tightly coupled, such as high yield and early maturity, and this requires many successive iterative selections requiring a high investment of time. Therefore, the initial time investment needed for pre-breeding is often a disincentive to the use of unimproved germplasm by breeders, as they are under pressure to produce results as quickly as possible. For this reason, it is common that many breeders turn to advanced breeding materials already maintained in their respective institutes and make crosses with this material instead of exploring the possibility of incorporating new material from genebanks into their breeding programs. Nass and Paterniani (2000) state that pre-breeding is the most promising alternative to linking genetic resources and breeding programmes. Genebanks can increase the value of accessions as well as their use by playing an active role in not only evaluating phenotypic characteristic, but by also making preliminary selections and identifying the desirable traits of a subset of the germplasm conserved.

While the difficulty in finding useful accessions in genebanks is a particularly daunting challenge, a majority of respondents identified both the enhancement of breeding material and the development of new cultivars as the most important benefits accrued through the use of germplasm from genebanks. Ultimately the goal of any breeding programme is to develop new varieties and the fact that these benefits are perceived by breeders is a positive indicator that these genebanks are achieving their goals and that breeders will continue to use the germplasm conserved in genebanks.

Conclusions

The results from this analysis point to a healthy well functioning system of germplasm conservation and use. It is apparent that a large volume of germplasm is being distributed by both of these genebanks and that Indian plant breeders are interested and engaged in germplasm acquisition. Nevertheless, any system that is not continually calibrated can easily fall into disrepair. As such we outline several points which need careful consideration in order to improve the efficiency of this system and ultimately deliver the products needed to address the challenges of food security in India.

- The duplication of collections, although a standard practice from a safety back up perspective, has been viewed as a waste of capacity and inefficiency, when it is done inadvertently (van Hintum and Knupffer, 1995). It appears that there is some overlap between the collections conserved in these genebanks and it is important to

identify where this duplication is occurring. It is also important that NBPGR and ICRISAT work together to find synergies wherein complementary projects can be developed such as linking available data to commonly held accessions.

- Although public sector breeders at universities and national research institutes are accessing large amounts of germplasm, the private sector has not been fully engaged by either of the genebanks. NBPGR may follow ICRISAT's lead by establishing joint projects with private companies, which aim to develop new varieties of not only lucrative crops like hybrid maize, but also for composites and open-pollinated varieties of crops like the millets and pulses, which are important for small scale food insecure farmers.
- A common theme among breeders responding to the survey was the need to develop mechanisms for information exchange between genebanks and breeders. In order to provide these breeders with information regarding available accessions it is necessary that more resources be allocated to the development of information systems and the dissemination of information about germplasm holdings in genebanks.
- In order to make germplasm more valuable and readily usable breeders have emphasized the importance of pre-breeding. Breeders from this study identified the need for pre-breeding as the largest problem associated with the utilization of PGR held in genebanks. Thus, there is a need to give equal emphasis on pre-breeding and germplasm utilization to both important crops at the national level as well as the target crops of this study.
- These challenges and the necessity for timely solutions to them, become all the more relevant in light of the fact that the "green revolution" varieties that have been credited with averting the starvation of millions of people were developed through the use of diverse plant varieties originating in myriad countries at a time when there was essentially free exchange of genetic resources. We are now faced with the dual challenge of meeting the needs of a growing population while also adapting our agricultural systems to climate change. For these reasons, a coherent and efficient system of germplasm exchange is needed which addresses the needs of the small scale farmers in India.

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References

Bramel-Cox, P. 2000. "Toward Establishing Links between Farmers and ICRISAT Genebank" in Friis-Hansen, E and B. Sthapit (eds.) *Participatory Approaches to Conservation and Use of Plant Genetic Resources*. International Plant Genetic Resources Institute, Rome, Italy. Pp. 69-74.

FAO (Food and Agriculture Organization). 2010. *The State of the World's Plant Genetic Resources for Food and Agriculture*. Rome: FAO

FAO. 1998. *The State of the World's Plant Genetic Resources for Food and Agriculture*. Rome: FAO

Frankel, O.H. 1986. "Genetic Resources: Museum or Utility" in T.A. Williams and G.S. Wratt (eds.) *Plant Breeding Symposium*. DSIR; 1986. Agron. Soc. New Zealand, Christchurch. Pp. 3-7.

Gotor E., Caracciolo F., and J. Watts. 2008. "The Impact of the In-Trust Agreements on CGIAR Germplasm Exchange and the Role of Bioversity International in establishing the Agreements" in *Impact of Policy-Oriented Research in the CGIAR - Case Study Results*. Science Council Secretariat: Rome, Italy. Pp 15-24

Hammer, K. 2003. "A Paradigm Shift in the Discipline of Plant Genetic Resources". *Genetic Resources and Crop Evolution* 50**:** 3–10

Hodgkin, T., Rao, R., Cibrian-Jaramillo, A., and S. Gaiji. 2003. "The Use of ex situ Conserved Plant Genetic Resources". *Plant Genetic Resources* 1:19–29.

Iwanaga, M.1993. "Enhancing the Links between Germplasm Conservation and Use in a Changing World". *International Crop Science* 1: 407–413.

Jie Wang, Y.L., Cao, Y., Weidong, G., Fang, J, and X. Lou. 1998. "The Use of Genetic Resources in Crop Improvement: Lessons from China". *Genetic Resources and Crop Evolution* 45: 181–186

Mazoyer, M. 2001. *Protecting Small Farmers and the Rural Poor in the Context of Globalization*. FAO, Rome, Italy. P. 24.

Nass, L.L. and E. Paterniani. 2000. "Pre-breeding: A Link between Genetic Resources and Maize Breeding". *Scientia Agricola*, 57(3):581-587

Ngoc De, N. 2000. "Linking the National Genebank of Vietnam and Farmers in Friis-Hansen, E and B. Sthapit (eds.) *Participatory Approaches to Conservation and Use of Plant Genetic Resources*. International Plant Genetic Resources Institute, Rome, Italy. Pp. 62-68

Pardey, P.G., Koo, B., Wright, B.D., van Dusen, M.E., Skovmand, B., and S. Taba. 1999. "Costing the ex situ Conservation of Genetic Varieties Developed through Farmer Selection Resources: Maize and Wheat at CIMMYT". EPTD Discussion Paper 52. IFPRI, Washington, DC.

Raustiala, K and D.G. Victor. 2004. The Regime Complex for Plant Genetic Resources.

International Organization 58: 277-309

Smale M and Day-Rubenstein K. 2002. "The Demand for Crop Genetic Resources: International Use of the US National Plant Germplasm System". *World Development* 30:1639-1655.

Tikader, A. and S.B. Dandin. 2007. "Pre-breeding Efforts to Utilize Two Wild Morus Species". C*urrent Science* 92(12): 1729-1733

Valkoun J. 2001. "Wheat Pre-breeding Using Wild Progenitors". *Euphytica* 119: 17-23

van Hintum, Th.J.L., A.H.D. Brown, C. Spillane and T. Hodgkin. 2000. "Core Collections of Plant Genetic Resources". *IPGRI Technical Bulletin No. 3*. International Plant Genetic Resources Institute, Rome, Italy.

van Hintum, T. and H. Knupffer. 1995. "Duplication within and between Germplasm Collections: Identifying Duplication on the Basis of Passport Data". *Genetic Resources* and Crop Evolution 42: 127-133

Weidong, G., Fang, J., Zheng, D., Li, Y., Lu, X., Rao, R.V., Hodgkin, T., and Z. Zhang. 2000. "Utilization of Germplasm Conserved in Chinese National Genebanks - A Survey". *Plant Genetic Resources Newsletter* 123: 1–8.

Worede, M., Teshome, A., and T. Tesemma. 2000. "Participatory Approaches Linking Farmer Aaccess to Genebanks: Ethiopia" in Friis-Hansen, E and B. Sthapit (eds.) *Participatory Approaches to Conservation and Use of Plant Genetic Resources*. International Plant Genetic Resources Institute, Rome, Italy. Pp. 56-61

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Traditional Conservation Practices, Biodiversity Conservation and Ecosystems

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Abstract: The omnipresent existence of human-nature relationship all over India has been grossly neglected as a tool for conservation management. The sacred groves, patches of forests conserved due to associated religious faith have been described by foresters, travelers, anthropologists, ecologists for more than two hundred years from different parts of the country. The sacred grove institution in the Western Ghats of India which has been nurtured by the local communities has been serving as ecological refugia for a range of species and habitat of the Western Ghats. The sacred groves compete with larger evergreen forest tracts like *Kans* in terms of relative number of endemic and evergreen species of the Western Ghats. In light of climate change where there could be possible shifts in the geographical boundaries of the species and the related ecosystems, the sacred groves would play an important role in the process of adaptation by possibly providing genetic resources for various purposes. These ecosystems might be important to serve as the refugia in form of conducive habitat for many species.

Key words: Western Ghats, Sacred groves, ecological refugia

Introduction

In India, as elsewhere in many parts of the world, a number of communities practise different forms of nature worship. One such significant tradition of nature worship is that of providing protection to patches of forests dedicated to deities or ancestral spirits. These vegetation patches have been designated as sacred groves. The sacred groves have been described by foresters, travelers, anthropologists, ecologists for more than two hundred years from different parts of the country. The most scholars emphasize the natural or near-natural state of vegetation in the sacred groves, and the preservation of these groves by local communities through social taboos and sanctions that reflect spiritual and ecological ethos of these communities.

Sacred groves can be defined as the patches of forests traditionally protected by local communities due to the faith associated with those forests. These groves in India are 'treasure troves' of biodiversity with a

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recorded 23,000 sacred groves from about 19 states in India covering about 68,633 ha (Malhotra, Gokhale, Chaterjee, *et al*. 2007). These represent ecosystems that act as 'refugia' for the endemic as well as endangered species (Malhotra, Gokhale, Chaterjee, *et al*. 2007). Studies suggest that about 3177 species have been reported from sacred groves from only seven states in India (Gokhale and Gazdar 2009).

These ecosystems which are conserved by the local communities as a part of traditions are becoming an important as habitat which could serve as refugia for the species to thrive or act as a biological corridor. The Biological Diversity Act, 2002 of India defines biodiversity as diversity at the level of genes, species and ecosystems. The sacred groves have unique genetic resources, higher endemic species and they represent endangered ecosystems. In light of climate change where there could be possible shifts in the geographical boundaries of the species and the related ecosystems, the sacred groves would play an important role in process of adaptation by possibly providing genetic resources for various purposes; these ecosystems might be important to serve as the refugia in form of conducive habitat for many species.

The local communities follow regulations in terms of various activities to be performed inside the sacred groves, with respect to the use of natural resources and so on.

Approach

The approach of this paper is to explore the institution of sacred groves in Karnataka in the context of conservation of biodiversity which would play an important role by providing the options for adaptation to tackle the impacts of the climate change. The knowledge about the traditional conservation practices such as sacred groves has been limited. This paper thus focuses on the documentation of sacred groves in a case study manner along with exploring the importance of species diversity horboured by these forest patches.

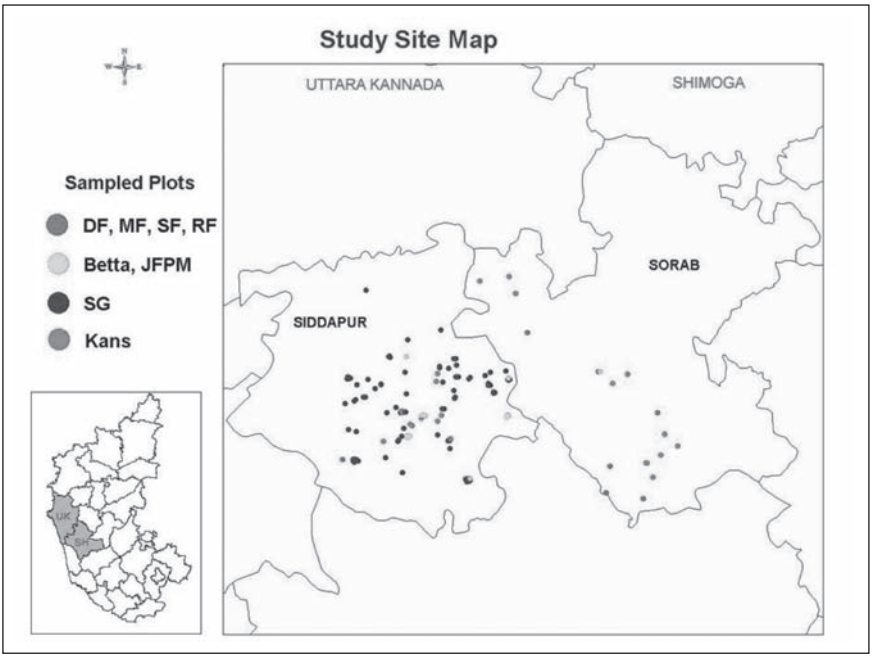
Methodology

Various forest management regimes such as sacred groves, Reserve Forests, Minor Forest, and District Forests in Uttara Kannda district of Karnataka have been sampled by developing the species checklist and by laying quadrats for sampling vegetation. The map (Fig.1) provides the geographical location of the study sites. The quadrats of size 10m X 10m have been used to enumerate all the plants above 10cm girth at breast height (GBH). A

subquadrat of 5m X 5m has been laid to enumerate the individuals below 10cm GBH. Similarly, 2 subquadrats of 1m X 1m are laid to sample the vegetation in the herbaceous layer.

The species attributes such as endemic to the Western Ghats, RET (rate, endangered and threatened), medicinal, NTFP (non timber forest produce), economic, evergreen and timber have been assigned to the enumerated species.

Figure 1: Geographical Location of the Various Forest Management Regimes



DF- District Forests,

MF - Minor Forests,

SF - State Forests,

RF - Reserve Forests

Betta - Soppina betta

JFPM - Joint Forest Protection and Management

SG - Sacred grove

Kans

Harvesting of Biomass

Typically the harvesting of biomass from the sacred groves is regulated and most of the times there are strict restrictions on use of any biomass or any other material from the sacred groves all over India. In the western India, Gadgil and Vartak (1976), Roy Burman (1995) and Godbole *et al.* (1998), etc. have reported such groves with total restriction on harvesting biomass. Malhotra *et al.* (1998) report such groves in southwest Bengal and in Koraput district of Orissa. Pushpangadan *et al.* (1998) and Swamy *et al.* (1998) report such groves from southern India.

However, there are many groves from where biomass is extracted, and thus the local communities derive certain direct economic benefits from the groves. A few illustrative examples are: Singh and Saxena (1998) and Jha *et al.* (1998) report that in many *orans* people graze their animals; Godbole *et al.* (1998) report collection of dead wood and dried leaf litter and harvesting of certain species of trees (*Caryota urens and Mangifera indica*) from groves in Ratnagiri district of Maharashtra; Malhotra *et al.* (1997) report 192 out of 322 groves from Koraput district from which dead wood and several non-timber forest products are gathered; Unnikrishnan (1990) observes that certain plants extracted from sacred groves of Kerala provide livelihood to many artisans; and Gadgil and Vartak (1976) report that villagers of Tunbad in Kolaba (now Raigad) district use the bark of *Entada phaseoloides Merr.* for the treatment of cattle against snake bite, wood for cremation is also extracted from many groves dedicated to ancestor spirits (Mitra and Pal 1994).

Biological Value

As mentioned, earlier, the institution of sacred groves is very ancient in the country. Access and interference with sacred groves has been culturally restricted, and thereby reduced the human impact in terms of harvesting of natural resources. The consequence of such restriction has been that sacred groves have evolved as important reservoirs of biological diversity.

A number of studies have emphasized that many sacred groves are repositories of rare species, and probably constitute the only representative of near-natural vegetation in many parts of India. Haridasan and Rao (1985) have reported at least 50 endangered and rare species in sacred groves of Meghalaya. Such island of climax vegetation amidst a degraded landscape can be seen in many parts of the Western Ghats, Koraput and Kalahandi districts of Orissa and South-west Bengal. Several studies have shown that many groves in Meghalaya (Tiwari *et al.* 1998), Kerala (Chandrashekara

and Sankar 1998), Maharashtra (Gadgil and Vartak 1976) and Himachal Pradesh (Singh *et al.* 1998) harbour rich floral and faunal biodiversity. Pushpangadan *et al.* (1998) demonstrated that the biological spectrum of groves in Kerala closely resembles the typical spectrum of tropical forest biodiversity. For example, the sacred groves occupying only 1.4 sq. km contained 722 species of angiosperm, compared with 960 species occurring in 90 sq. km of the Silent Valley forest.

Kunstleria keralensis, a climbing legume, reported from a sacred grove in southern Kerala, is a species found only in that sacred grove (Mohanan and Nair 1981). *Belpharistemma membranifolia* (Miq.) Ding Hou, Buchanania lanceolata Wight and Syzygium travuncoricum Gamb. are rare species found only in some sacred groves of Kerala (Nair and Mohanan 1981). Mohanan also discovered a rare species of cinnamon, *Cinnamomum quilonensis*, in some of the kavus of Alapuzha district in Kerala (Unnikrishnan 1995). The Kallabbekan sacred grove in Kumta taluk, Karnataka, over 50 ha in extent, despite being in the midst of arecanut-spice gardens of a populated village, is rich in endemics like wild nutmegs *(Myristica malabarica), Cinnamomum malabathrum* (Burm. f.), *Garcinia gummi-gutta* (L.) Robson and wild pepper (Chandran *et al.* 1998). Table 1 suggests the number of species reported from various sacred groves in India.

Table 1: Inventories of Species Reported from Sacred Groves in Selected States in India

State	No. of plants	No. of animals	No. of fungi	Reference
Andhra Pradesh	118			WWF – Andhra Pradesh, 1996
Karnataka				
a Kodagu		86	163	Bhagwat *et al.* (2005)
b Uttara Kannada	291			Gokhale (2005)
c Dakshina Kannada	294	95		Achar and Naik (2006)
Kerala	139	229		Sasikumar (2005), Subramanium *et al.* (2005)
Maharashtra	1040			Deshmukh (1999)
Manipur	90			Khumbongmayum *et al.* (2005)
Meghalaya	416			Tiwari et al (1999)
Tamil Nadu	216			Sukumaran *et al.* (2005), Amrithalingam (2005)

Source: Malhotra, Gokhale, Chaterjee, *et al.* (2007)

Sacred Groves in Karnataka Western Ghats

The sacred groves vary in terms of size, ownership patterns and also with respect to the vegetation. These factors are influenced by the biogeography of the species harboured and the human influence on sacred groves. The groves broadly come under two classes such as smaller groves (less than 0.4 ha to 1 ha in size) and larger groves (Above 1 ha in size).

Smaller groves are the ubiquitous features of the landscape in the Uttara Kannada, Udupi and Dakshina Kannada districts. The locally these patches are referred as *deverbana, nagabana*, etc. The majority sacred groves are owned by the State Forest Department and managed by the local people. The management of local people involves the protection to the vegetation of the groves and decisions regarding performance of rituals with the help of the local priests. Siddapur taluk of Uttara Kannada district has about 100 sacred groves. Whole district could be culturally a single unit similar in terms of Areca nut economy, major landuses like reserved forests, Soppina bettas (leaf manure forests), paddy fields, Bena lands (managed grass lands), minor forests and sacred groves. Hence, the Siddapur case study data can be extrapolated for the entire Uttara Kannada comprising of 11 taluks, totally covering 10,291 sq. km. It could suggest the existence of more than 1000 sacred groves in the district. Some of the rare ecosystems like *Myristica* swamps are often found as sacred grove in the district.

The *Nagabanas* are abundant in Udupi and Dakshina Kannada districts. The *Nagabanas* are mainly owned by families and occasionally are linked with the temple complexes in the districts. The number of Nagabanas is expected to be very high in these two districts but no enumeration of these sacred groves has been done.

Larger groves are referred by names such as *devarkadu, devarkan*, etc. These sacred groves are mainly reported from Uttara Kannada, Shimoga and Kodagu districts. Brandis and Grant (1868) mentioned that these groves were functioning as resource forest, offering both economic sustenance and ecological security. The people of the village gathered fallen deadwood, non-wood produce such as pepper, mango, jackfruit, etc., and tap toddy from a palm (Caryota urens).

Devarkans used to be an important landscape feature in Uttara Kannda, Shimoga and Chikmagalur districts about 150 years back. The forest management by the British regime in these districts altered the landuse pattern substantially by either discontinuing the traditional practices or exploiting those for the revenue and timber. Uttara Kannada was part of the erstwhile Bombay Presidency where British regime abolished the rights of local people over the *devarkans* (Chandran and Gadgil 1993).

Wingate (1888), the forest settlement Officer of Uttara Kannada, noted that the kans were of "great economic and climatic importance. They favour the existence of springs, and perennial streams and generally indicate the proximity of valuable spice gardens, which derive from them both shade and moisture" (Chandran and Gadgil 1993).

Buchanan (1870) observed that wild pepper requires human attention for better yield. He found people taking care of pepper vines in evergreen forest patches called *"Maynasu Canu"* meaning *menasu kan or pepper kan*. Such kans were intermixed with gardens and rice fields. High demand for pepper in other lands could have been good incentive for village societies to maintain `kans'.

In Kodagu district of Karnataka, devarakadus are larger forest tracts of several hectares in size and are officially considered as sacred forests in the records of the forest department as the ownership of the land is with the State Forest Department. For unknown reasons *kans* in Uttara Kannada, Shimoga and Chikmaglur districts could not get such official status of being sacred in the records of the State Forest Department. *Kans* were not spared for commercial logging by the working plans of the forest department. And hence, here kans have been referred as the historical sacred forests as people continued the faith in the local deities but the sacredness could not be protected from the larger commercial interests.

The *kans* having the *Myristica* swamps now getting converted to other land uses. Chandran *et al*. (1999) reports 51 *Myristica* swamps from Uttara Kannada district. Out of 51 swamps nine are having the history of protection being the sacred groves. These nine sacred swamps cover an area of 25,800 sq. km.

Analysis

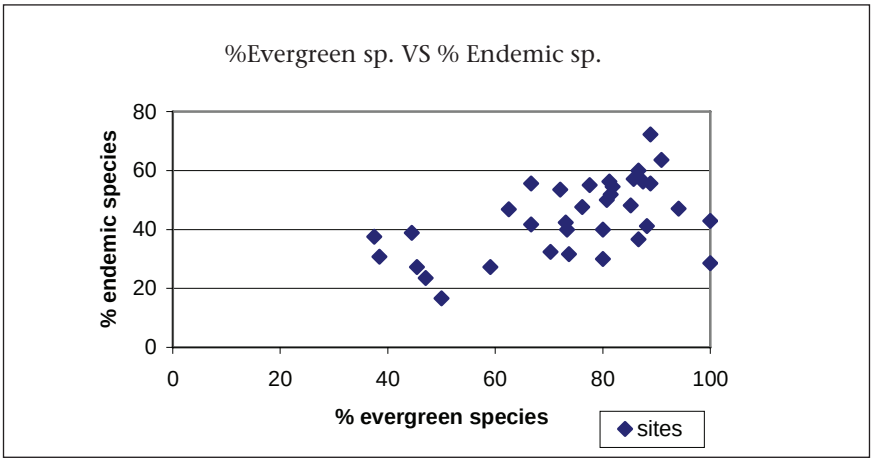
Pattern of Different Attributes of Species

In present study the species checklists of the sacred groves for five different attributes has been analyzed – evergreen species, endemic species, non-timber species, RET (rare, endangered and threatened) species and timber species. Two data sets for species checklists have been prepared – one is generated from the 35 sampled sacred groves for quadrats and the second is the full checklist of species prepared for 97 sacred groves which also include the sampled 35 sacred groves.

Almost 80 per cent of the species in the sacred groves can be considered as 'important' species because these are evergreen, endemic and RET species.

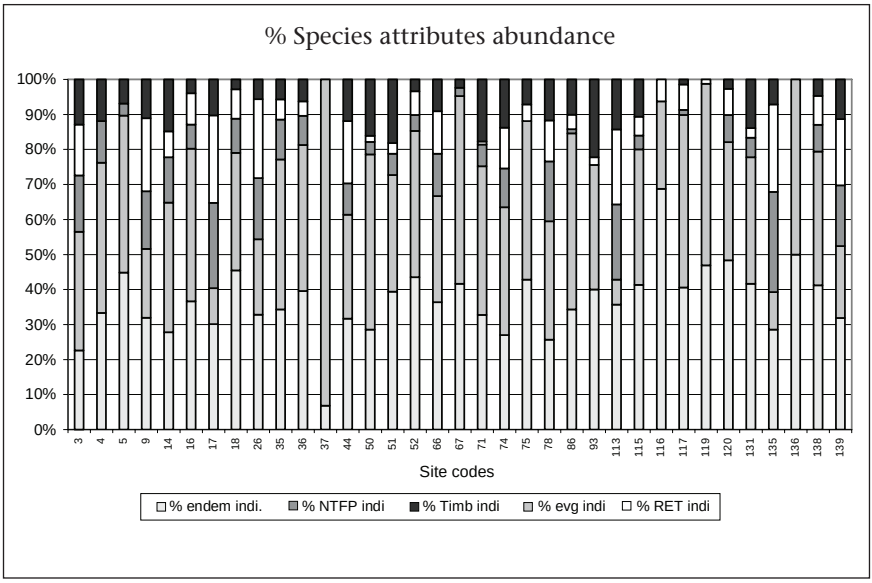
There is an overlap of species between endemic and evergreen species. Nearly 25 per cent species are evergreen in sacred groves and almost 30 per cent of the total species are endemic in sacred groves.

Figure 2: Percentage Evergreen Species Versus Percentage Endemic Species



Relative Abundance of Attribute Species Individuals

Figure 3: Percentage Species Attribute Abundance



For this analysis the data from 35 sampled sacred groves is used. Unlike other regimes considered for analysis in other chapters, the sacred groves have a basis of definition which is more or less common at all places irrespective of the ownership pattern. The basis is the 'near-natural' forest pockets (Malhotra *et al*. 2001). This basis gives the sacred groves the status of markers in the vegetation history of the local area. The flora represents the original vegetation of the local area. The disturbance in the vegetation of sacred groves can hence be immediately observed by looking at the composition of forest stand. The vegetation in Siddapur taluk as shown in *Kans,* which are the extensive patches of forests, is mainly evergreen in nature.

As seen in the graph endemic and evergreen individuals have the highest percentage share in the relative abundance of total individuals in sacred groves. About 22 sites are having 80 per cent endemic and evergreen individuals. Higher percentage of timber species suggests more opening of the grove canopy so as to create conducive habitat for hardy species to replace the primary species. About 10 sites have proportion of timber species above 10 per cent suggesting moderately disturbed sites.

Assessing Uniqueness of Sacred Groves in The Western Ghats of Karnataka

Joshi and Gadgil (1991) have explored a model of utilization in a pre-market economy of a biological resource population by a social group, where the resources are owned by the group. The group is assumed to be motivated to derive as large a harvest as possible while at the same time attempting to keep the risk of extinction of the resource population at a low level. It is shown that this can most likely be achieved through total protection of the resource population in parts of its range set aside as refugia. Many primitive societies indeed follow this strategy, which deserves to be given more serious attention as a tool for the management of renewable resources. Here in this context of refugia, it is attempted to analyze the sacred groves for the vegetation affinities with other forests in the local area and the uniqueness of the species mainly in terms of various species attributes.

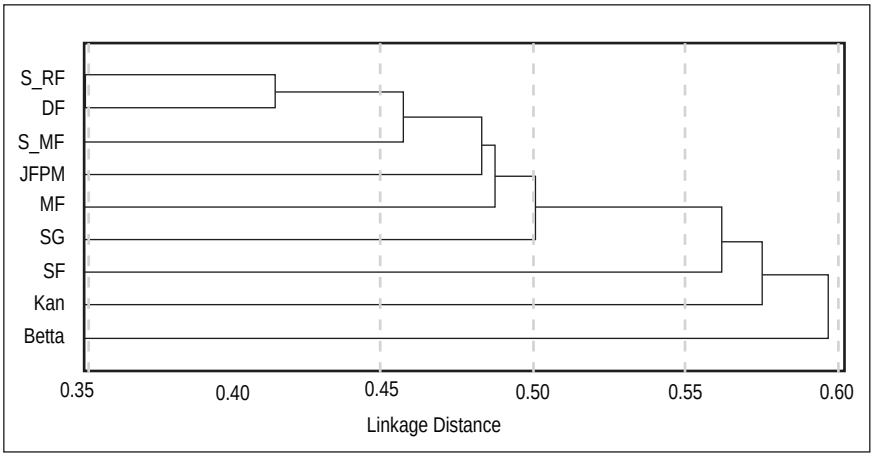
Vegetation Affinities

Cluster analysis was performed using Jaccard's index of similarity for nine management regimes, namely reserved forests (Uttara Kannada) – S_RF, Minor forests (Uttara Kannada) – S_MF, District forests (Sorab) – DF, Betta (Siddapur), JFPM (Siddapur and Sorab) – Joint Forest Planning and Management, Kan (Siddapur and Sorab), Minor forests (Sorab) – MF, State

forests (Sorab) – SF and Sacred groves (Siddapur) – sacred grove. Species check lists were used for the analysis. These management regimes are spread over Uttara Kannada district covering Sirsi, Kumta, Siddapur, Ankola taluks and the Sorab taluk of Shimoga district.

The graph shows mainly two clusters – one of plantation mixed forests (DF, JFPM, MF, S_MF). RF is not mixed in terms of plantations but it shows more affinity with the DF; and other of worked forests (SF, Kan, Betta). The species composition of the sacred groves stand in between these two clusters, which is not worked but probably confirming its near natural nature. The vegetation of Betta lands is quite different than the sacred groves, in spite of the fact that several sacred groves are found amidst the Betta lands. Hence, it is concluded that the vegetation in sacred groves is different than most of the management regimes.

Vegetation on Affinities of Different Management Regimes,Karnataka Western Ghats Single Linkage Euclidean Distances



There are several studies like Induchoodan (1996), Pushpangadan, Rajendraprasad and Krishan (1998), Godbole, Watve, Prabhu and Sarnaik (1998), Gadgil and Vartak (1976), Nipunage, Kulkarni and Vartak (1993) in different parts of the Western Ghats to understand the potential of sacred groves as resorts for the vulnerable species. But all these studies were done in isolation with the sacred groves and there was a lack of comparison of vegetation of sacred groves with the local forests. But the above analysis overcomes this lacuna proving the role of sacred groves as refugia in the broader context of the Western Ghats of India.

It has been observed all over India that the practice of sacred groves is mainly associated with the human groups primarily associated with forests like hunter-gatherers and agriculturists (Malhotra *et al*. 2001). These groups have been managing these patches in the name of local deities but at the same time these patches are serving as the refugia for several species of plants and animals. In the case of Siddapur taluk where about 80 per cent land is owned by the forest department, management of such big areas is extremely difficult. But unfortunately local practices of management and their utility in present context has been never paid attention as a tool for better management of forests in response to local demands and the conservation of species diversity.

Conclusion

Despite the smaller size about half acre, the sacred groves in Siddapur taluk of Uttara Kannada harbour vulnerable species of the Western Ghats. The sacred groves compete with larger evergreen forest tracts like *Kans* in terms of relative number of endemic and evergreen species of the Western Ghats.

Sacred groves stand out as the distinct pockets of vegetation in Siddapur taluk as well as at the scale of Uttara Kannada district in spite of being surrounded by various kinds of local landuses like *soppina betta* lands, etc.

The biological uniqueness of sacred groves is also supplemented by their social function and the role of humans in managing these landscapes with faith in the local deity of the forest patch. This omnipresent existence of human-nature relationship all over India has been grossly neglected as a tool for conservation management. The diverse culture of nature worship has tremendous potential even in the new context of conservation of biological diversity. And last but not least, there is a strong felt need for planners to recognize faith of local people in management of forests.

The sacred grove institution in Uttara Kannada which has been nurtured by the local communities has been serving as ecological refugia for a range of species and habitat of the Western Ghats. These patches of forests serve as buffers to guard against the impacts of the climate change on the forest resources. At the same time the genetic resources conserved by these patches are important to render various ecosystem services for the future.

References

Brandis D. and Grant. 1868. Joint Report No. 33, dated 11th May 1868, on the kans in the Sorab taluka "Forest Department, Shimoga"

Buchanan F. 1870. *Journey through the Northern Part of Kanara*. Madras: Higginbothams (1801-2). Vol. 2,

Chandran M.D.S. and M. Gadgil. 1993. Kans-safety Forests of Uttara Kannada "M. Brandl (ed.) Proceedings of the IUFRO Forest History Group Meeting on Peasant Forestry 2-5 September 1991, No. 40 Forstliche Versuchs-und Forschungsanstalt, Freiburg, pp. 49-57."

Chandran M. D. S., Diwakar K. M., Naik M. B. 1999 "Myristica Swamps of Uttara Kannada." *MyForest*, Vol. 35 (3) September 1999. Pp. 207-221.

Chandran M.D.S., Gadgil, M. and Hughes, J.D. 1998. "Sacred Groves of the Western Ghats" in Ramakrishnan, P.S., Saxena, K .G. and Chandrashekara, U.M. (eds.) *Conserving the Sacred for Biodiversity Management*. New Delhi, Oxford and IBH. Pp. 211-32.

Chandrashekara U.M. and Sankar, S.1998. "Structure and Function of Sacred Groves: Case studies in Kerala" in Ramakrishnan, P.S., Saxena, K.G. and Chandrashekara, U.M. (eds.) *Conserving the Sacred for Biodiversity Management*. New Delhi, Oxford and IBH., Publishing Co. Pp. 323-36.

Deb D. and Malhotra K. C. 1997. "Interface between Biodiversity and Tribal Cultural Heritage: An Exploratory Study". *Human Ecology* , 8:157-63.

Gadgil, M. and Vartak, V.D. 1976. "Sacred groves in Western Ghats in India". *Economic Botany*, 30:152-60.

Godbole A., Watve, A., Prabhu, S. and Sarnaik, J. 1998. Role of Sacred Groves in Biodiversity Conservation with Local People's Participation: "A Case Study from Ratnagiri District, Maharashtra" in Ramakrishnan, PS., Saxena, K.G, and Chandrashekara U. M. (eds.) *Conserving the Sacred for Biodiversity Management*. New Delhi, Oxford and IBH Publishing Co. Pp. 233-46.

Haridasan, K. and Rao,P.R. 1985. *Forest Flora of Meghalya*, Vol . 1, Bishen Singh, Dehradun.

Haridasan, K. and Rao R. R. 1985. *Forest Flora of Meghalaya*. Bishen Singh Mahendra Pal Singh, Dehra Dun, India."

Gokhale Y and Gazdar S. 2009. Biological Diversity: Conservation and Benefit Sharing in D Datt and S Nischal (eds.) *Green India: Looking Back to Change Track*. New Delhi: The Energy and Resources Institute. Pp. 109–131

Induchoodan N.C. 1996. Ecological Studies on the Sacred Groves of Kerala. Thesis submitted for the degree of Doctor of Philosophy.

Jha, M., Vardhan, H., Chatterjee, S., Kumar, K. and Sastry, ARK. 1998. "Status and Role of Orans (Sacred Groves) in Peepasar Village (district Naguar) and Khejarli in (district Jodhpur), Rajasthan" in Ramakrishnan, P.S., Saxena, KG. and Chandrashekara, U.M. (eds.) *Conserving the Sacred for Biodiversity Management*. Oxford and IBH Publishing Co., New Delhi, pp. 263-276.

Joshi, N. V. and M. Gadgil 1991. "On the Role of Refugia in Promoting Prudent Use of Biological Resources". *Theoretical Population Biology,* Vol. 40, No. 2"

Nipunage, D.S., D.K. Kulkarni and V.D. Vartak. 1993. "Floristic Studies on Sacred Groves from Sinhagad Hills in Pune District, Maharashtra State". *Higher Plants of Indian Subcontinent*, Vol. IV. B.S.M.P.S., Dehra Dun, U.P. Pp. 153-159

Malhotra K. C., Gokhale Y., Chatterjee S. and Srivastava S. 2001. *Cultural and Ecological Dimensions of Sacred Groves in India*. Indian National Science Academy , New Delhi and Indira Gandhi Rashtriya Manav Sangrahalaya, Bhopal.

Malhotra, K.C. 1998. "Anthropological Dimensions of Sacred Groves in India: An Overview" in P.S. Ramakrishnan, K.G. Saxena and U.M. Chandrashekara (eds.) *Conserving the Sacred for Biodiversity Management*. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.

Malhotra, K.C. and K. Das. 1997. "Interface between Faunal Biodiversity and Cultural Heritage in South West Bengal". *Bioethics in Asia: Proceedings of the UNESCO Asian Bioethics Conference*. Pp. 346-351.

Malhotra K. C., Gokhale Y., Chatterjee S. and Srivastava S. 2001. *Cultural and Ecological Dimensions of Sacred Groves in India*. Indian National Science Academy, New Delhi and Indira Gandhi Rashtriya Manav Sangrahalaya, Bhopal.

Malhotra K. C., Gokhale Y., Chatterjee S. and Srivastava S. 2007. *Sacred Groves in India*. Aryan Books International, New Delhi and Indira Gandhi Rashtriya Manav Sangrahalaya, Bhopal.

Mitra, A. and Pal, S. 1994. "The Spirit of the Sanctuary". *Down to Earth*, January 31.

Mohanan, C.N. and Nair, N. C. 1981. "Kunstleria Pram - A New Genus Record for India and a New Species in the Genus". *Proc. Ind. Acad. Sci.* B 90:207-210.

Nipunage, D.S., D.K. Kulkarni and V.D. Vartak. 1993. "Floristic Studies on Sacred Groves from Sinhagad Hills in Pune District, Maharashtra State". *Higher Plants of Indian Subcontinent*, Vol. IV, Bishen Singh Mahendra Pal Singh, U.P. Pp. 153-159.

Pushpangadan, P., Rajendraprasad, M. and Krishnan, R. N. 1998. "Sacred Groves of Kerala : A Synthesis on the State of Art of Knowledge" in Ramakrishnan, P.S., Saxena, K.G. and Chandrashekara,U.M.(eds.) *Conserving the Sacred for Rio-diversity Management*. New Delhi: Oxford and IBH Publishing Co. Pp. 193-210.

Roy Burman, J.J. 1995. "The Dynamics of Sacred Groves". *Journal of Human Ecology,* 6: 245-254.

Singh, G.S. and Saxena, K.G. 1998. "Sacred Groves in the Rural Landscape: A Case Study of the Shekhala Village in Jodhpur District of Desert Rajasthan" in Ramakrishnan, P. S., Saxena, K.G. and Chandrashekara, U.M. (eds.) *Conserving the Sacred for Biodiversity Management*. New Delhi: Oxford and 'IBH Publishing Co. Pp. 277-88.

Singh, G.S., K.S. Rao and K.G. Saxena. 1998. "Eco-cultural Analysis of Sacred Species and Ecosystems in Chhakinal Watershed, Himachal Pradesh" in P.S. Ramakrishnan, K.G. Saxena and U.M. Chandrashekara (eds.) *Conserving the Sacred for Biodiversity Management*. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.

Swamy, P.S., Sundarapandian, S.M. and Chandrasekaran S. 1998. "Structure and Function of Sacred Groves: Case Studies in Tamil Nadu in Ramakrishnan, P.S., Saxena, K.G. and Chandrashekara, U.M. (eds.) *Conserving the Sacred for Biodiversity Management,* New Delhi: Oxford and IBH Publishing Co.Pp.364-75.

Tiwari, U.K., Bank S.K. and Tripathi, R. 1998. "Sacred Groves of Meghalaya" in Ramakrishnan, P.S., Saxena, K.G. and Chandrashekara, U.M. (eds.) *Conserving the Sacred for Biodiversity Management*. New Delhi: Oxford and IBH Publishing Co. Pp. 253-62.

Unnikrishnan, E. 1990. *Part Played by the Sacred Groves in Local Environments*. Centre for Science and Environment, New Delhi.

Unnikrishnan, V. 1995. *Sacred Groves of North Kerala: An Ecofolklore Study* (in Malayalam). Jeevarekha, Thrissur.

Wingate R. T. 1888. Settlement proposals for 16 villages of Kumta taluk. No. 210 dt. 18-12-1888. Deputy Commissioner's Office, Karwar.

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Community Protocols and Access and Benefit Sharing

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Abstract: The adoption of Nagoya Protocol was a landmark event in the history of Convention on Biological Diversity. This article examines the promises and potentials of the Protocol for indigenous peoples and local communities in light of previous experiences in Access and Benefit Sharing (ABS). It points out the pitfalls within the Access and Benefit Sharing framework. Community protocols that are community-led instruments can help communities in engaging with Access and Benefit Sharing and can be useful to communities in legal empowerment. This can transform ABS from ABS- to ABS+.

Key words: Nagoya Protocol, Convention on Biodiversity, Access and Benefit Sharing, Hoodia, Community Protocols

Introduction

At 1:30 am on October 30, 2010, the Conference of the Parties to the Convention on Biological Diversity (CBD) adopted the Nagoya Protocol on Access and Benefit Sharing (Nagoya Protocol). The Nagoya Protocol is a significant achievement for developing countries in asserting sovereignty over their biodiversity and traditional knowledge. For Indigenous peoples and local communities[2], it represents a high-water mark in international jurisprudence, clearly establishing a number of important biocultural rights. Yet, whether the Nagoya Protocol will deliver the environmental and (non-)monetary benefits for which it was designed will depend on the ways in which communities engage with the framework at the local level. Towards that end, we provide an analysis of the Nagoya Protocol and highlight a number of potential pitfalls inherent in access and benefit sharing (ABS) with reference to the Hoodia benefit sharing agreement. After

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exploring the challenges communities face with the implementation of international environmental law in general, as well as the importance of social mobilization and legal empowerment in that context, we describe a community-led instrument embedded in the Nagoya Protocol that may assist communities to engage with ABS according to their values and on their own terms, namely, community protocols.

The Nagoya Protocol and the Emergence of Biocultural Rights

In his seminal work, "Indigenous Peoples in International Law," James Anaya, the United Nations (UN) Special Rapporteur on the Situation of Human Rights and Fundamental Freedoms of Indigenous Peoples, argues against a positivist understanding of international law. Moving away from the classical sources of international law prescribed by Article 38 of the Statute of the International Court of Justice[3], Anaya states that international law is a normative system that aspires towards common values. Any analysis of international law, according to Anaya, must move beyond an examination of treaties and customary international law to an analysis of processes and trajectories. Based on such an analysis, Anaya concludes that international law is developing – albeit imperfectly and grudgingly - in ways that supports Indigenous peoples' demands (Anaya 2004).

At the core of these demands of Indigenous peoples and local communities is the demand for self-determination. As Anaya notes, self-determination in this context is not always a claim for separate statehood, but is grounded in international human rights. In this sense, self-determination has certain core values, including non-discrimination, protection of cultural integrity, rights over lands and natural resources, social welfare for economic well-being, and self-government (Anaya 2004). In the six years since the publication of that work, under the auspices of the CBD, the Ad Hoc Open-ended Working Group on Access and Benefit Sharing has "elaborated and negotiated" an international regime on ABS (CBD Decision VII/19.D). Using Anaya's approach, we provide an analysis of the Nagoya Protocol from the perspective of Indigenous peoples and local communities. By approaching the Protocol not as an end in itself, but as a normative tendency, we ask, "How does the Nagoya Protocol affirm the self-determination of Indigenous peoples and local communities?"

The trajectory towards increased support for Indigenous peoples and local communities self-governance of their natural resources and traditional knowledge begins with Articles 8(j) and 10(c) of the CBD. The CBD makes

the normative assertion that there is an intelligible link between the traditional ways of life of Indigenous peoples and local communities and the conservation and sustainable use of biodiversity. Accordingly, the CBD requires State Parties to protect the knowledge, innovations and practices of communities whose ways of life lead to the conservation and sustainable use of biodiversity (Article 8(j)) and to support the customary uses of natural resources (Article 10(c)). The CBD's various instruments and provisions[4], coupled with provisions from multiple other UN treaties and bodies and other international organizations[5] are being increasingly recognized as providing rights to communities to self-govern their territories, natural resources and traditional knowledge. This set of emerging rights, with the distinction of being linked to the conservation discourse surrounding multilateral environmental agreements, are arguably an integral dimension of third generation rights[6]. The leverage of these rights is uniquely tied to the current environmental crisis and the alternatives presented by the values that are unique to the traditional ways of life of many Indigenous peoples and local communities. It is the exceptional nature of these rights that mark them as 'biocultural rights'.

Biocultural rights, we suggest, are rights of Indigenous peoples and local communities over all aspects of their ways of life that are relevant to the conservation and sustainable use of biodiversity. These aspects include rights relating to, among other things, their knowledge, innovations and practices, natural resources, lands and waters, traditional occupations, and customary laws and systems of governance. Effectively, these are rights to self-determination, but specifically self-determination oriented towards stewardship of Indigenous peoples' and local communities' traditional lands and waters.

The Nagoya Protocol draws on certain biocultural elements of the CBD and codifies them in legally binding obligations that States must enact. The Protocol establishes the following four pivotal biocultural rights that significantly affirm the self-determination of Indigenous peoples and local communities:

- The right over their genetic resources;
- The right over their traditional knowledge;
- The right to self-governance through respect for their customary laws and community protocols; and
- The right to benefit from the utilization of their traditional knowledge and genetic resources by third parties.

The first two rights are enshrined in Articles 5.1.bis and 5bis of the Nagoya Protocol. These articles require the prior informed consent of communities before any access to their resources and knowledge. While there are qualifiers in both articles that say "in accordance with domestic law", these qualifiers are a result of the significant whittling down of the (much more restrictive) CBD Article 8(j) requirement of "subject to national law". The Nagoya Protocol makes a paradigm shift by clarifying that the role of the State is to facilitate the rights of Indigenous peoples and local communities and that the State does not have the discretion of whether or not to recognize these biocultural rights. Article 5.1.bis is particularly significant for establishing a new right not included in the CBD, requiring States to uphold rights of communities over their genetic resources when communities have such "established rights".

The third right, enshrined in Article 9, requires States to take into consideration customary laws and community protocols in implementing their obligations under the Protocol with respect to traditional knowledge associated with genetic resources. In doing so, the Nagoya Protocol reaches a new apogee in recognizing community rights to self-determination. For the first time in international treaty law, the 193 States that adopted the Protocol are explicitly required to recognize community systems of governance and, thus, legal pluralism.

Fourth, Articles 4.1.bis and 4.4 establish the rights of Indigenous peoples and local communities to fair and equitable sharing of benefits arising from the utilization of their genetic resources and traditional knowledge by third parties. While Article 8(j) of the CBD establishes the right of communities to share in the benefits arising from the utilization of their traditional knowledge, the right of communities to benefit sharing arising specifically from third party utilization of their genetic resources is a major step forward in the Nagoya Protocol.

While none of these rights are absolutely unqualified and do allow for limited State involvement, they should be seen as substantial gains for Indigenous peoples and local communities. This is especially true if we understand them, as Anaya points out, as a normative direction in which international law is heading. In this light, the Nagoya Protocol is a major milestone on the path towards self-determination of Indigenous peoples and local communities in international law. It highlights the previously unacknowledged emergence of biocultural rights and highlights the role of multilateral environmental agreements as some of the most important

terrains of struggle for Indigenous peoples and local communities in which there is much to gain. With the global urgency to stem the environmental crisis coupled with a growing environmental movement, Indigenous peoples and local communities have prudently employed their identity as trustees of the earth to gain support for their claims of self-determination from States in the form of biocultural rights.

ABS: The Dangers of Commodification, Objectification and Subordination

Ensuring that communities' rights are enshrined in international and national laws is of paramount importance to ensuring respect and support for biocultural diversity at the local level (Maffi and Woodley 2010). As such, communities and their representatives are compelled to engage with the negotiations of multilateral environmental agreements and their protocols, as well as soft law instruments. Yet the harsh paradox is that even when hard-fought negotiations result in communities' rights being enshrined in law, their local effects are often muted because of the complex socio-political contexts within which communities live (Nelson 2010). For example, Linda Siegele et al. (2009) detail a plethora of rights relating to communities across a range of hard and soft law instruments. Their exhaustive review, including multilateral environmental agreements, human rights instruments, UN agencies' policy documents, and International Union for Conservation of Nature (IUCN) resolutions, illustrates the scale of communities' rights agreed at the international level. However, their telling conclusion is that "good policy is just a starting point – good practice is more difficult to achieve" (Siegele, Roe, Giuliani, and Winer 2009:69). Similarly, Lorenzo Cotula and James Mayers (2009) highlight the gap between what is "on paper" and what happens in practice in the context of local land tenure and projects intended to reduce emissions from deforestation and forest degradation (REDD) (Cotula and Mayers 2009:23). They underscore the fact that despite a growing international recognition of communities' rights to self-determine their futures and manage their natural resources,[7] international rights are far from a panacea against local disempowerment or the denial of procedural and substantive justice.

In efforts to secure their rights over natural resources and traditional knowledge and protect their ways of life, the International Indigenous Forum on Biodiversity and their supporters have fought for the above four biocultural rights in the Nagoya Protocol. However, whether the Nagoya Protocol will help or hinder communities at the local level will only

emerge over time (Ling 2010). For communities to secure their biocultural rights through the Nagoya Protocol, the gains made through successful international advocacy must be capitalized on by improved exercise of rights at the local level.

The many potential pitfalls that ABS entails for Indigenous peoples and local communities can be illustrated by the Hoodia benefit sharing agreement[8]. Much has been written about the original benefit sharing agreement (for example, Wynberg 2004; Vermeylen 2007, 2008; Bavikatte, Jonas and von Braun 2009), signed between the South African San Council and the Council for Scientific and Industrial Research (CSIR) in 2003. The agreement, which was considered visionary at its time, related to traditional knowledge of the San, Indigenous peoples of Southern Africa, about hunger suppressing properties of a desert succulent called Hoodia. The overarching challenge the San communities had was engaging with a totally novel legal framework in a short amount of time. This stricture has manifested itself in a number of ways and led to a variety of impacts.

First, ABS forces communities to be defined. "The San" are in fact many communities living in very different socio-economic contexts and their cultural heritage and traditional knowledge is non-uniform. For example, some of the Khwe communities living in and around the Okavango Panhandle in Angola, Namibia and Northern Botswana live in rural areas, as compared to the Khomani San, many of whom live in urban and semi-urban environments in South Africa's Northern Cape, 2,000 kilometers away. To assert their ownership of the knowledge relating to Hoodia, the San decided to project a 'pan-San' identity, forging a notion of who or how they 'are' for the sake of the benefit sharing agreement. The pressure of impending deadlines and financial windfalls limited the process of self-identification when it arguably should have been undertaken at a more appropriate pace to enable effective participation of the wider community. As much as possible, the self-identification process should also have been decoupled from the benefit sharing agreement itself to ensure that both are rooted in the community's broader endogenous development plans and priorities. In addition, the knowledge about Hoodia's properties is shared between the San and the Nama, a community indigenous to what is now Namibia. Yet the Nama were not included in the original benefit sharing agreement, a decision that fostered inter-community mistrust and resentment.[9] As traditional knowledge is often shared unequally within communities and in many cases across communities and borders (variously

defined), fundamental questions are raised about the nature of "ownership" of knowledge and concomitantly what constitutes prior informed consent from the "community". Time and widespread participation is critical to ensure that the views of individuals within or across communities are taken into account when considering whether and/or how to engage a potential bioprospector.

Second, and linked to the above point, is the fact that prior to the Hoodia issue arising, San communities had neither considered ABS nor mandated a particular body to manage and protect their traditional knowledge. The advent of an ABS agreement compelled San communities to be represented by an elected group to negotiate the agreement on their behalf. This led to the creation of a new body called the South African San Council, which, among other things, exacerbated existing tensions between "traditional" and "modernist" people in the South African San communities, especially the Khomani, and led to questions about the body's representativeness and transparency. Saskia Vermeylen's research highlights the fact that while many people know of the Hoodia agreement, they lack any in-depth understanding about ABS in general and the agreement in particular. She also points out that the timing and structure of the negotiations intensified knowledge and power asymmetries in the communities (Vermeylen 2007).

Third, the San Council negotiating team members themselves had a significant task, having to rapidly grasp a number of challenging concepts and specific intellectual property rights-related aspects of commercial agreements such as milestone payments and royalties. These were huge demands for the community members selected for the task. As non-lawyers with no prior knowledge about ABS working within a limited negotiations timeframe, they were severely disadvantaged in terms of making independent assessments of the most appropriate terms of the agreement and types of benefits for their communities. The net result is that they relied to a large extent on external expert advice. A strong reliance on external experts by communities in future benefit sharing agreements raises questions of how "informed" consent and the subsequently negotiated mutually agreed terms can be.

Fourth, in 2006, San from Botswana, Namibia and South Africa met to assess the governance challenges presented by the Hoodia agreement. The resulting Molopo Declaration states, among other things:

- All structures should respect San values, including respect for culture and consensus decision making;

- San structures must strive to make sure the majority of funds are used to benefit San communities;
- Administrative costs of all funds should be kept to a bare minimum, around 20% of total funds, depending on the level of income;
- Corruption in any form is totally unacceptable. Good management of funds, transparency and accountability will be required;
- Priorities will be different in Namibia, Botswana and South Africa. San Councils must strive to accommodate differences in the three countries; and
- Projects that are environmentally sustainable and economically viable will be prioritized.

The San have faced many institutional and community capacity challenges while attempting to fulfil the aspirations of the Molopo Declaration. For example, attempting to manage the funds has been difficult. As in the case of the San Council, a new institution (the Hoodia Trust) was established to manage the funds. It suffered from questions of legitimacy and there continues to be a widespread lack of understanding of its role. Compounding this issue is the fact that Hoodia Trustees and San Council members have few financial management capabilities, members of both bodies lack experience with conducting public office, and terms of reference for the bodies' members, codes of conduct, and dispute resolution mechanisms either do not exist or are not applied. Because the South African San Council is established as a Voluntary Association under South African law, it is not required to submit audited accounts to any governmental agencies. The result is that representatives are accountable only to their constituencies, who in turn are limited in their ability to either demand or fully comprehend financial accounts. These factors are intensified by the fact that many of the Council members are otherwise unemployed, increasing the likelihood of mismanagement of funds. Transparency, accountability, representativeness, cultural legitimacy, and authority of the 'Hoodia governance' system remain in question.

Fifth, expectations were raised that the community would benefit financially. However, the original Hoodia benefit sharing agreement amounted to little,[10] with Unilever pulling out of a commercial license in late 2008. While it is difficult to measure how this has affected the community, the disappointment and lack of understanding about the latest developments is palpable when discussing it with community members. Finally, the agreement led to no increase in the conservation or customary

uses of Hoodia. In fact, the opposite happened, with widespread reports of unsustainable harvesting of wild Hoodia across the region by a variety of different stakeholders at the height of the 'Hoodia boom' in 2007-2008.

In sum, the Hoodia benefit sharing agreement simultaneously represents a moral victory for the San community for recognition of their rights relating to traditional knowledge and a process that has arguably further undermined their traditional values and knowledge and resource governance systems. The deal asserted their rights to provide prior informed consent for the use of their traditional knowledge, but the nature of the negotiation, the terms of the agreement, and the governance reforms that they have undertaken have, among other things: weakened the San's traditional forms of authority; increased the community's reliance on external expert opinion; led to largely misunderstood and at times corrupt new forms of governance; raised and dashed hopes of new found wealth; exacerbated power and information asymmetries in and across San communities; and initially fostered mistrust between the San and Nama communities.[11] As stated above, the Hoodia agreement was considered groundbreaking at the time. The experience since then, however, highlights certain lessons that other communities and NGOs are advised to consider when evaluating ABS as a legal and policy framework through which to protect their traditional knowledge and to support their ways of life. By increasing the participation among and across communities and spending more time evaluating the pros and cons of ABS, and thus avoiding the pitfalls of "commodification, objectification and subordination" (Vermeylen 2008:234), communities are likely to make more informed decisions about whether to either decide to spurn the framework or negotiate for more appropriate economic, cultural, social, and/or environmental benefits. Before turning to evaluate a reflexive and proactive tool that can assist communities with the above challenges, we explore the inherent difficulties communities face when engaging any positive legal framework.

Biocultural Diversity and the Law

Indigenous peoples' and local and mobile communities' diversity of worldviews, cultures and ways of life are helping to conserve and sustainably use the world's biological diversity (Maffi and Woodley 2010). Biological diversity cannot be seen as separate from cultural and linguistic diversity, as "the diversity of life in all its manifestations … are interrelated (and likely co-evolved) within a complex socio-ecological adaptive system" (Maffi and Woodley 2010:5). The multiplicity of interrelated knowledge, innovations,

practices, values, and customary laws[12] are embedded within mutually supporting relationships between land, natural resource use, culture, and spirituality (Descola 1992). This connectivity underpins communities' dynamic worldviews and understandings of the laws of nature (Davidson-Hunt and Berkes 2003; Alexander, Hardinson and Arhen 2009).

Within this context, communities face a number of interrelated challenges when engaging with positive (State) legal systems. Three in particular have ramifications for communities seeking to assert their rights to self-determination and well-being, namely, legal disaggregation, the dynamic interplay between external definitions of a community and intra- and inter-community self-definitions, and the potential conflicts between customary and positive law.

First, laws compartmentalize the otherwise interdependent aspects of biocultural diversity by drawing legislative borders around them and addressing them as distinct segments. While communities manage integrated landscapes (Watson, Alessa and Glaspell 2003), the State tends to view each resource and associated traditional knowledge through a narrow lens, implementing corresponding laws through agencies that separately address, for example, biodiversity, forests, agriculture, and Indigenous knowledge systems.[13] The result is that communities' lives are disaggregated in law and policy, which effectively fragments and reduces their claims to self-determination into specific issue-related sites of struggle.

The second overarching challenge relates to how the law affects the nature of whom or what is defined as 'community'. In general, people have a variety of ways of establishing who is a member of a family or community and who is an outsider. Communities may define themselves in a number of different ways and in different contexts, based on multiple factors such as heritage, ethnicity, language, geographical proximity, and shared resources or knowledge (Agrawal and Gibson 1999). State law, however, is insensitive to local, adaptive conceptions of community and tends to impose an over-generalized and homogeneous classification as a static and rigidly defined entity. This contradicts local realities and can further divide and weaken local institutions and social structures (Bosch 2003). However, this challenge can be overcome by using the law as the basis for adding a new dimension to local constructions of community that progresses the right to self-determination. For example, in Bushbuckridge, South Africa, a group of traditional healers spread across a large number of villages and from two different language groups came together to define themselves as

a community of knowledge-holders in the context of new rights provided under South African ABS law.[14] Although this type of law tends to place a disproportionate emphasis on the sharing of traditional knowledge as the means by which to characterize a community, the Bushbuckridge Traditional Health Practitioners are using its provisions to create and occupy a new legal space, within which they are asserting their rights to traditional knowledge and customary practices in line with their own terms, values and priorities.[15] All communities are dynamic and issues of self-definition and fluid identity are neither new to traditional communities nor inherently destructive to their social structures. The critical determinant is whether they are able to engage adequately with legal and policy processes to avoid potential negative impacts of change and drive positive developments according to their own values and priorities (Cotula and Mathieu 2008).

As a third and cross-cutting challenge inherent to engaging with legal frameworks, positive law (both international and State) may conflict with the customary laws that govern communities' sustainable use of natural resources (Cotula and Mathieu 2008). For example, the understanding of 'property' under positive law is based on the private rights of a person (human or corporate) to appropriate and alienate physical and intellectual property. In contrast, communities' property systems tend to emphasize relational and collective values of resources (Tobin and Taylor 2009).[16] Furthermore, the implementation of positive law tends to overpower and contravene customary law. A system that denies legal pluralism[17] has direct impacts on communities' lives, for example, by undermining the cultural practices and institutions that underpin sustainable ecosystem management (Sheleef 2000). While recognition of communities' customary laws and traditional authority over resources is progressing in some jurisdictions (Van Cott 2000), the challenge of legal pluralism goes beyond the mere co-existence of legal regimes, wherein customary law is applicable only to Indigenous peoples within their territories. Instead, meaningful legal pluralism requires "incorporation directly or indirectly of principles, measures and mechanisms drawn from customary law within national and international legal regimes for the protection of traditional knowledge" (Tobin 2009:111).[18]

These three challenges, among others, highlight the fact that the implementation of international and national environmental laws such as ABS has the potential to undermine the interconnected and adaptive systems that underpin biocultural diversity. The implementation of such

laws compounds these challenges by requiring communities to engage with disparate stakeholders[19] according to a variety of disconnected regulatory frameworks, many of which may conflict with their customary laws and traditional governance structures. Communities thus face a stark choice to either spurn these inherently limited frameworks (something which is a virtual impossibility, considering the ubiquitous nature of State law) or engage with them at the potential expense of becoming complicit in the disaggregation of their otherwise holistic ways of life and governance systems. If the latter is chosen, the resultant challenge is for communities to draw upon and further develop appropriate means to effectively engage with State and international legal and policy frameworks, specifically in ways that accord with their biocultural heritage, support their integrated systems of ecosystem management, are commensurate with their customary laws, and recognize traditional forms of governance. In the absence of such approaches, the very act of using rights can be disempowering and disenfranchising.[20]

Legal Empowerment and Endogenous Development

Participatory legal empowerment will further enable Indigenous peoples and local and mobile communities to understand a variety of laws, including those relating to customary uses of natural resources, ABS, REDD, and protected areas and Indigenous and community conserved areas. Legal empowerment is defined as "the use of legal tools to tackle power asymmetries and help disadvantaged groups have greater control over decisions and processes that affect their lives" (Cotula and Mathieu 2008:15). Evidence suggests that non-lawyers are equally equipped to use the law (and sometimes more adept at doing so) to solve local challenges when they are empowered in a legal context (Maru 2006). Legal empowerment of the poor[21] is based on the twin principles that law should not remain a monopoly of trained professionals and that in many instances, forms of alternative dispute resolution are more attuned to local realities than formal legal processes. Ideally, the act of using the law becomes as empowering as the outcome of the process itself (Maru 2006). By organizing themselves around rights and duties, communities initiate adaptive dialogue processes both internally and vis-à-vis outsiders. Building internal resilience to external influences and responding proactively and according to local values and priorities are both critical to a community's well-being (Subramanian and Pisupati 2009). A court victory handed to a community, for example, can be supremely useful, but a process that is

driven by the community is tangibly more powerful.[22] As such, effective legal empowerment is a combination of social mobilization and legal action (Cotula 2007) that acts as a positive feedback loop towards both aims.

The law is sometimes described as 'a sword and a shield'.[23] Negotiating in the shadow of the law[24] is an important strategy for communities who might otherwise not have the opportunity to engage with conservation policy and practice (Cotula and Mathieu 2008). However, law is about more than just establishing due process. When used imaginatively, laws can be the platform for creating an enabling legal and political environment by negotiating "space to place new steps of change" (Angelou 1993:line 92) and opening avenues of discussion between disparate groups towards previously unimagined relationships (Rozzi, Massardo, Anderson, Heidinger, and Silander 2006). In this sense, legal empowerment can enable communities to break free from the typical patronizing dichotomy of either being 'spoken at' or 'spoken for'.

A recent compilation of case studies highlights the diversity of rights-based approaches that communities and supporting organizations are experimenting with (Campese, Sunderland, Greiber, and Oviedo 2009). A dominant theme that emerges is the multifaceted attempts by a variety of communities to use the law to conserve their biocultural diversity. It highlights the critical need for the further development and sharing of communities' methods and approaches to using rights and engaging with the law on their terms, according to their values, and in ways commensurate with their customary laws – in other words, endogenously. Endogenous development is a community process of defining and working towards future plans according to local values and priorities (ETC Foundation and COMPAS 2007). In contrast with other theories of development that emphasize varying degrees of external input, it draws on a body of experience that suggests that communities are more likely to remain cohesive and sustain their traditions, cultures, spirituality, and natural resources when they develop their future collectively and base their plans on the resources available within the community. Endogenous development does not reject the notion of external agencies providing assistance, but stresses that any interventions must be undertaken only after the free, prior and informed consent of the community is given and when the activities are developed, driven, monitored, and evaluated by the community (ETC Foundation and COMPAS 2007). Endogenous development theory supports the proposition that the more endogenous the legal education and rights-based approach,

the more likely the process is to be genuinely empowering. Community protocols are one endogenous rights-based approach that communities are using to draw on a variety of biocultural rights to affirm their right to self-determination, including within the context of ABS.

Biocultural Community Protocols and ABS

Biocultural community protocols or "community protocols", as described in the Nagoya Protocol, are a response to the challenges and opportunities set out above. Although each is adapted to its local context, a biocultural community protocol is a community-led instrument that promotes participatory advocacy for the recognition of and support for ways of life that are based on the customary sustainable use of biodiversity, according to standards and procedures set out in customary, national, and international laws and policies (Jonas, Bavikatte and Shrumm 2010). In this sense, biocultural community protocols are community-specific declarations of the right to diversity and claims to legal pluralism.[25] Their value and integrity lie in the process that communities undertake to develop them, in what they represent to the community, and in their future uses and impacts.

The process of developing and using a community protocol is an opportunity for communities to reflect on their ways of life, values, customary laws, and priorities and to engage with a variety of supporting legal frameworks and rights. A biocultural approach to the law empowers communities to challenge the fragmentary nature of State law and to instead engage with it from a more nuanced and integrated perspective and assess how certain laws may assist or hinder their plans for the future. A wide variety of community members are involved by integrating legal empowerment processes with endogenous development and communication methodologies such as group discussions, written documentation, various types of mapping and illustrations, participatory video and photography, performing arts, and locally appropriate monitoring and evaluation (Taylor 2008; Hoole and Berkes 2009; Tobias 2000; Lunch and Lunch 2006; Davies and Dart 2005; Schreckenberg, Camargo, Withnall, Corrigan, Franks, Roe, Scherl, and Richardson 2010). Community protocols vary in how they are documented, shared, and utilized and have been highlighted as something meaningful and affirmative that a community can be proud of (Köhler-Rollefson 2010). The approach is intended to mobilize and empower communities to use international and national laws to support the local manifestation of the right to self-determination.

Community protocols assist communities to establish a firm foundation upon which to develop the future management of their natural resources by setting out their values and customary procedures that govern the management of their natural resources. They also provide a vehicle for articulating their procedural and substantive rights to, among other things, be involved in decision-making according to the principle of free, prior and informed consent, develop the specific elements of projects that affect their lands, and ensure that they are involved in the monitoring and evaluation of such projects. This provides clarity to the drivers of external interventions such as protected areas, ABS agreements, REDD projects, and payment for ecosystem services schemes, and can help communities gain recognition for, among other things, their territorial sovereignty, community-based natural resource management systems and community conserved areas (Ryan, Broderick, Sneddon, and Andrews 2010), sui generis laws, sacred natural sites (Wild and McLeod 2008), and globally important agricultural heritage systems. In this regard, community protocols enable communities to bridge the gap between the customary management of their biocultural heritage and the external management of their resources, as mandated by positive legal frameworks. They also help communities to minimize the power asymmetries that often characterize government-community relations and promote a more participatory and endogenous approach to the future governance of their territories, natural resources and biodiversity. By enabling a community to be proactive in relation to agencies and frameworks to which they have normally been reactive, protocols have the potential to shift the dynamic of conservation initiatives from merely attempting to 'ensure' communities' participation to becoming inclusive, locally appropriate processes driven by legally empowered communities. These points are highlighted by the experience of the Traditional Health Practitioners of Bushbuckridge, South Africa.

Biocultural Community Protocol of the Traditional Health Practitioners of Bushbuckridge[26]

The Kruger to Canyons Biosphere Region (K2C) is part of UNESCO's World Network of Biosphere Reserves. Bridging the Limpopo and Mpumalanga provinces in northeast South Africa, the K2C spans more than 4 million hectares and contains two national parks, namely, the Kruger National Park and Blyde River Canyon Nature Reserve. The biosphere reserve is not only extremely biodiverse but also culturally diverse. Its buffer and transition zones are home to about 1.6 million people from different ethnic

backgrounds and language groups. Yet despite the area's conservation value, many of the local communities are economically poor and live in semi-rural areas.

Traditional healers provide primary healthcare for many people in the region. They also play an important cultural role by promoting traditional values and acting as the custodians of the complex knowledge of plants growing in the biosphere region. In their capacity as holders of traditional knowledge, they acquired new rights under the South African Biodiversity Act (2004) and the Bioprospecting Access and Benefit-Sharing Regulations (2008). In spite of this, few health practitioners knew of their rights. In March, 2009, the Biosphere Committee[27] began supporting a group of healers based at the Vukuzenzele Medicinal Plants Nursery in Bushbuckridge who wished to host a series of meetings with other groups of healers to discuss these issues. Over the next five months, they held regular meetings to share views and learn more about South African law on the conservation of medicinal plants and the protection of traditional knowledge.

On the basis of a number of shared concerns, more than 80 healers decided to form a governance structure under the name of Bushbuckridge Traditional Healers, with an Executive Committee to assist them in presenting their views to stakeholders. As mentioned above, the Bushbuckridge Traditional Healers come from two separate language groups, the Sepedi and Tsonga, yet see themselves as a single group because of their specialist knowledge and reliance on the same medicinal plants. They then worked with the Biosphere Committee and Natural Justice,[28] an NGO of lawyers who advise communities on environmental issues, to develop their own biocultural community protocol. This protocol was first presented to the local authorities and other stakeholders in the K2C in September, 2009.

In their seven-page protocol,[29] the traditional healers outline the contribution they make to the health of their communities. They explain that, although they share common knowledge of the main types of illnesses in the community, each has a specific way of treating those illnesses. Their specialization in different ailments means that they also refer patients to one another. Since their patients are poor, the healers often provide healthcare regardless of whether the patient can pay. "Our ancestors prohibit us from pressuring people for money," they explain, "so we rely on goodwill and reciprocity" (Biocultural Community Protocol of the Traditional Health Practitioner of Bushbuckridge:2).

In the protocol, the healers explain their communities' affinity with the surrounding biodiversity. "We believe that only harvested leaves or bark that are taken in ways that ensure the survival of the plant or tree will heal the patient', they say. 'This means that we take only strips of bark, selected leaves or stems of plants and always cover the roots of trees or plants after we have collected what we require. Also, we have rules linked to the seasons in which we can collect various plants, with severe consequences such as jeopardizing rains if they are transgressed. Because we harvest for immediate use, we never collect large-scale amounts of any particular resource. We protect biodiversity in other ways, such as guarding against veld fires and discouraging poaching of plants by muti hunters" (Biocultural Community Protocol of the Traditional Health Practitioner of Bushbuckridge:3).

The healers describe the threats posed to their livelihood by limited access to, or loss of, local biodiversity. "The numbers of plants are falling due to overharvesting by herbalists or muti hunters who collect large quantities using unsustainable methods" they state. "The Mariepskop conservation area is important to us because of the great diversity of plants it sustains but difficult for us to access because we have, until recently, been unsure of the regulations relating to collecting medicinal plants and face logistical and cost-related barriers to travelling to those areas. We are excluded from the Bushbuckridge Nature Reserve, which is closer to us than Mariepskop but remains totally inaccessible." They add that "private land is off-bounds to us" (Biocultural Community Protocol of the Traditional Health Practitioner of Bushbuckridge:4).

Turning to the issue of their traditional knowledge, they say, "We have been visited by scores of researchers who generally provide us with few details of who they are working for and what our knowledge will be used for. We have not yet entered into any benefit-sharing agreements regarding our knowledge or material transfer agreements for the plants they have accessed. This has made us jaded about sharing information with researchers, whom we now distrust. We want our consent to be sought before our knowledge or plants are taken and to be acknowledged as the holders of the knowledge and benefit from any commercialization" (Biocultural Community Protocol of the Traditional Health Practitioner of Bushbuckridge:4).

Based on their understanding of the law, the healers then decided that the conditions they posed for transferring their traditional knowledge would depend largely on the user. This means that students wishing to become healers will be expected to make arrangements with the local

healers to set up a mentorship and can expect to pay a fee. Healers from other areas and academic researchers will be directed to the Executive Committee formed by the healers for due consideration of their proposal. "We know our rights", the healers affirm, and "will require to see the letter from the Department of Water and Environmental Affairs stating that [researchers] can conduct the research" (Biocultural Community Protocol of the Traditional Health Practitioner of Bushbuckridge:5). Commercial bioprospectors will also be expected to apply to the Executive Committee as the first step in negotiations with the company towards a benefit sharing agreement, monetary or otherwise.

In the protocol, the healers propose working with traditional authorities to regulate access to communal lands by muti hunters to tackle the problem of over-harvesting. They also ask for better access to conservation areas. "Now we are clear about the procedures for accessing plants from Mariepskop," they say, "we want to be recognized by the Department of Agriculture, Forest and Fisheries (DAFF) as both contributing to, and benefiting from, the region's biodiversity" (Biocultural Community Protocol of the Traditional Health Practitioner of Bushbuckridge:2). They also propose working with DAFF to establish a system that facilitates their access to the resources under its management. They call on the department to "explore the establishment of a medicinal plants conservation and development area on Mariepskop to increase the in situ cultivation of the most important medicinal plants" (Biocultural Community Protocol of the Traditional Health Practitioner of Bushbuckridge:2).

Concluding their protocol, the healers appeal to the Biosphere Committee for assistance in evaluating how they could replicate successful community-run medicinal plant nurseries in the area. They also ask the Mpumalanga Tourism and Parks Agency to set aside some land for the purpose. Similarly, the Department of Health and Social Development is invited "to speed up" (Biocultural Community Protocol of the Traditional Health Practitioner of Bushbuckridge:6) its registration process for healers so that they can carry cards certifying them as traditional health practitioners.

The Bushbuckridge Traditional Healers' ongoing experiences illustrate a number of points about the nature of biocultural community protocols as a community-based response to the many challenges of engaging with legal frameworks explored above. As highlighted in the first part of this article, the Bushbuckridge Traditional Healers have international and national rights that were otherwise unknown to them at the local level. The

endogenous process of developing the protocol served as an opportunity for the community to think through a number of interrelated issues and to learn about new legal and policy frameworks according to their own timeframe and in their own context. The process was not driven by outsiders. Learning about the laws that support their ways of life helped the traditional healers develop intra- and inter-community awareness and mobilize towards a forward-looking strategy. By articulating their worldviews, concerns and suggested ways forward in the form of a protocol, they have reconstituted the terms of the debate about their local challenges, broadening it to include the inter-linkages between conservation, the medicinal plants trade, local prejudice, and shared traditional knowledge. In this sense, biocultural community protocols enable communities to communicate both a focused response to activities in and around their communities and an integrated and value-laden response to the broader trend towards the legal disaggregation of their ways of life and reification of their traditional knowledge. For the traditional healers, their protocol serves as an interface for constructive dialogue about their values and ways of life with government officials and the private sector in a manner that embodies both the resilience and vulnerabilities of their endemic ways of life. In doing so, they are reclaiming the law to make a strong moral and legal claim to their right to biocultural diversity.

Community Protocols: Useful but no Panacea

As a result of the Traditional Health Practitioners' community protocol, the healers are involved in two new initiatives. First, steps towards establishing a medicinal plants conservation area are being undertaken through a UNESCO-sponsored feasibility study relating to medicinal plants. The study has two objectives. The first is to assess how to develop a carbon offset program whereby tourists who come to the K2C pay a certain amount of money to offset the carbon they generate to get there. That fund would be used to plant medicinal plants that are identified by the healers as under threat, providing conservation and sustainable use value to the healers. The second objective is to identify medicinal plants under threat and identify areas where nurseries and conservation zones of these medicinal plants can be established. The study is being conducted in partnership with the K2C management committee and the healers' association.

The second initiative relates more directly to bioprospecting. The traditional healers decided to pool their individually distinct knowledge under the auspices of the Association. In this case, the healers engaged in a

participatory and non-time bound process towards defining themselves as a group with shared interests in protecting their local biological resources and traditional knowledge. As per above, they then defined the terms and conditions upon which they would share their knowledge and made that known through their community protocol. A local company responded to their terms, as opposed to it being the other way round as is the case with most instances of bioprospecting. Subsequently, the healers resolved to enter into a non-disclosure agreement with a local company for bioprospecting. The healers speak of this endogenous response to new challenges as having been empowering.

Standing back from the above account, community protocols are not a panacea. Over 2010, Natural Justice and partners held a number of consultaions focusing on biocultural community protocols in India, Sri Lanka and South Africa. Various challenges and potential weakenesses were raised, including that the process of developing a protocol could be abused by certain parties either from outside or from within the community (Jonas and Shrumm 2010). This is closely linked to the potential of such processes to further entrench or perpetuate existing power asymmetries at the local level such as the exclusion of women and youth from decision-making mechanisms (Köhler-Rollefson 2010). The fact that biocultural community protocols may become another top-down imposition by the development industry was raised, with one of the meeting's participants describing the approach as a potential "monster" (Jonas and Shrumm 2010:15). Ensuring community-based monitoring and evaluation of the approach was also heavily underscored. With the inclusion of community protocols in the Nagoya Protocol on ABS, all 193 State Parties are now obliged to "support, as appropriate, the development by indigenous and local communities, including women within these communities, of … [c]ommunity protocols in relation to access to traditional knowledge associated with genetic resources and the fair and equitable sharing of benefits arising out of the utilization of such knowledge" (Nagoya Protocol, Article 9(3)(a)). With increased emphasis on community protocols, the potential for the above concerns to become a reality have increased exponentially. The growing challenge to assist communities to determine whether and how to develop community protocols should be addressed by inter-community lesson-sharing, good practice guidelines, and rigorously tested methodologies and resources.[30]

Conclusion: Towards ABS+

As the world clamours to address unprecedented levels of biodiversity loss and increasingly unpredictable impacts of climate change, communities – who have contributed least to the underlying causes of such change – are being disproportionately affected by both the environmental changes and the measures being implemented to address those changes (United Nations Department of Economic and Social Affairs 2009). In this context, Indigenous peoples and local communities' struggle for biocultural rights is a countervailing measure, intended to enshrine their right to self-determination within their territories, including respect for their diversity of ecosystem management practices, customary laws and traditional authority. Communities who are intent on conserving and promoting their biological and cultural diversity thus face the challenging and dynamic interplay between increasing the breadth and strength of biocultural rights at the international and national level and developing improved methods at the local level to secure those rights.

Under the auspices of the UN Framework Convention on Climate Change, an instrument relating to the UN-REDD Programme is currently being negotiated. In those negotiations, Indigenous peoples and local communities are voicing their concerns that REDD may be implemented in ways incommensurate with their rights to self-determine their futures and to the customary uses of their natural resources. NGOs are also raising serious questions regarding perceived flaws in REDD's environmental integrity, including about the definition of what constitutes a forest and what practices are included in the term 'sustainable management of forests'. The result is that communities and NGOs are either shunning the proposed REDD mechanism or calling for safeguards to ensure that REDD projects also contribute to environmental and social justice. The latter, broader conception of REDD is referred to as REDD+. Proponents of REDD+ argue that it is not sufficient for an individual REDD project to lead only to climate change mitigation. Any REDD project should also comply with human rights standards and support local biodiversity. In other words, a REDD+ project must respect the biocultural rights of Indigenous peoples and local communities, including their right to free, prior and informed consent, and must have ecological integrity.

This paper makes a similar argument for ABS. The Hoodia case highlights an instance where a community's right to enter into a benefit sharing agreement was upheld, yet the results of the Hoodia agreement

have yet to improve the San's economic, social, cultural or environmental contexts, perhaps even undermining them. We stand at a new vantage point, looking beyond the Nagoya Protocol towards an era of biocultural rights. The question of whether the Nagoya Protocol and its national level implementation will move beyond merely facilitating the transfer of traditional knowledge to supporting communities' biocultural rights to self-govern their natural resources and associated traditional knowledge can only be answered at the local level, one territory and one community at a time. We have argued that communities' ability to purposefully exercise their rights to protect their knowledge, innovations and practices and to support their customary uses of natural resources will hinge on how well they are able to understand the legal framework in the broader context of their rights and obligations at various levels, to foresee the practical ramifications of engaging with ABS, and to overcome the power asymmetries inherent in their interactions with external stakeholders such as state agencies and private interests. Community protocols are embedded in the Nagoya Protocol as a community-led instrument that provides a potentially useful framework with which communities can appraise whether ABS will help or hinder their local endogenous development aspirations and engage a variety of stakeholders towards "protecting" or "promoting" (CBD Article 8(j)) their territories, knowledge, innovation and practices. It is hoped that community protocols will help communities to ensure that ABS - where they engage with the framework - is in fact ABS+.

Additional Resources

For more information see: www.naturaljustice.org

Endnotes

[1] For their contributions to the theory and practice of biocultural community protocols, Natural Justice thanks the communities with whom we have worked for placing their trust in a young NGO. For their ideas, inspiration, and support, we also gratefully acknowledge, among others, Alejandro Argumedo (Asociación ANDES), Barbara Lassen and Andreas Drews (The ABS Capacity Development Initiative for Africa), Govindaswamy Hariramamurthi and Professor Balakrishnan Nair (Foundation for the Revitalization of Local Health Traditions), Wim Hiemstra (COMPAS), Ilse Köhler-Rollefson (League for Pastoral Peoples and Endogenous Livestock Development and LIFE Network), Florina Lopez Miro and Heraclio Herrera (Kuna Tribe, Panama), Balakrishna Pisupati (United Nations Environment Programme), Suneetha Subramanian (United Nations University), Krystyna Swiderska (International Institute for Environment and Development), and Brendan Tobin (Irish Centre for Human Rights).

[2] It should be noted that the CBD and negotiations under its auspices refer

to "indigenous and local communities", rather than to Indigenous *peoples* and local communities. This runs contrary to the UN Declaration on the Rights of Indigenous Peoples and has been criticized by Indigenous organizations such as the International Indigenous Forum on Biodiversity. In this article, we use the term "Indigenous peoples".

3 This article is generally considered the most authoritative account of the sources of international law.

4 For example, the Programme of Work on Protected Areas, ABS, Tkarihwaié:ri Code of Ethical Conduct on the Respect for the Cultural and Intellectual Heritage of Indigenous and Local Communities Relevant to the Conservation and Sustainable Use of Biological Diversity, Addis Ababa Principles and Guidelines for the Sustainable Use of Biodiversity, and Akwe:Kon Voluntary Guidelines for the conduct of cultural, environmental and social impact assessments regarding developments proposed to take place on, or which are likely to impact on sacred sites and on lands and waters traditionally occupied or used by indigenous and local communities.

5 For example, the UN Convention to Combat Desertification, UN Framework Convention on Climate Change (including under the programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries), UN Forum on Forests, Food and Agriculture Organization (including the International Treaty on Plant Genetic Resources for Food and Agriculture), UN Educational, Scientific and Cultural Organization (including cultural conventions and Biosphere Reserves), International Union for Conservation of Nature (including World Conservation Congress resolutions and World Parks Congress recommendations), UN Permanent Forum on Indigenous Issues, International Convention on the Elimination of All Forms of Racial Discrimination, International Labour Organization Convention 169 Concerning Indigenous and Tribal Peoples in Independent Countries, UN Declaration on the Rights of Indigenous Peoples, Expert Mechanism on the Rights of Indigenous Peoples, Agenda 21, and the World Intellectual Property Organization.

6 While civil and political rights are considered first generation, social, economic and cultural rights are considered second generation. Third generation rights go beyond both of these to include group and collective rights and rights to a healthy environment, to intergenerational equity and sustainability, to natural resources, and to participate in cultural heritage.

7 For example, see Morel, C., 2010. "Communication 276 / 2003 – Centre for Minority Rights Development (Kenya) and Minority Rights Group International on behalf of Endorois Welfare Council v. Kenya". *Housing and ESC Rights Law Quarterly*, 7(1). Last accessed July 14, 2010, at: http://www.cohre.org.

8 The following brief analysis does not intend to critique the decisions taken at the time of the agreement, but aims to draw on the authors' experience of how the story has unfolded to highlight the inherent challenges that ABS poses to communities.

9 A benefit sharing agreement has since been signed between the San and the Nama.

10 The Hoodia Trust had received 587,305 South African Rands by the end of 2008, circa 58,000 US Dollars.

11 This has been addressed by the recent San-Nama Benefit Sharing Agreement.

[12] This is also referred to as 'collective biocultural heritage', which is the knowledge, innovations, and practices of Indigenous peoples and local and mobile communities that are "collectively held and inextricably linked to traditional resources and territories, local economies, the diversity of genes, varieties, species and ecosystems, cultural and spiritual values, and customary laws shaped within the socio-ecological context of communities." This definition was developed at a workshop of research and Indigenous partners of the project on Traditional Knowledge Protection and Customary Law that was held in Peru in May, 2005. See Swiderska, K., 2006. *Banishing the Biopirates: A New Approach to Protecting Traditional Knowledge*, Gatekeeper Series 129. IIED: London. Also see IIED, 2010. "Protecting community rights over traditional knowledge". Last accessed August 24, 2010, at: http://www.iied.org/natural-resources/key-issues/biodiversity-and-conservation/protecting-community-rights-over-traditio.

[13] In South Africa, for example, the Department of Environmental Affairs has a mandate to manage the country's biodiversity, but it shares responsibility to protect communities' associated traditional knowledge with the Department of Science and Technology.

[14] Bioprospecting, Access and Benefit Sharing Rules, 2008. *Government Gazette* No. 30739, February 8, 2008. Department of Environmental Affairs and Tourism, Pretoria, South Africa.

[15] This example is elaborated below.

[16] Such systems have been described as "...commonly characterized by collective ownership (where the community owns a resource, but individuals may acquire superior rights to or responsibilities for collective property), and communal ownership (where the property is indivisibly owned by the community)." See Tsosie, R., 2007. "Cultural challenges to biotechnology: Native American cultural resources and the concept of cultural harm". *Journal of Law, Medicine & Ethics*, 35: 396, cited in Tobin and Taylor, 2009, page 36.

[17] This type of system could be referred to as legal monoculture.

[18] This is arguably a huge challenge and most States are a long way from incorporating Indigenous worldviews into legal and policy frameworks.

[19] Examples include government agencies, conservation and development NGOs, private sector companies, and researchers.

[20] This is also supported by anecdotal evidence by public interest lawyers such as Fatima Hassan (former senior attorney, AIDS Law Project, South Africa) who argues that even when ordinary people do use the law and engage legal systems, the process is often both disempowering because of the asymmetrical "lawyer-client" relationship and dehumanizing because of the Kafkaesque nature of legal proceedings.

[21] This is a reference to the United Nations Development Programme, 2010. "Initiative on Legal Empowerment of the Poor". Last accessed August 4, 2010, at: http://www.undp.org/legalempowerment/.

[22] "The most valuable, useful and transformative legal challenges are those that include communities and that mobilize and educate people so that communities use the law to give effect to their own voices and their own issues." Hassan, F. (draft in progress). *10 Year History of Treatment Action Campaign*. Treatment Action Campaign: Cape Town, South Africa.

[23] The phrase is used to describe the perceived nature of laws' ability to 'attack' criminality and 'defend' against injustice.

[24] 'Negotiating in the shadow of the law' references the way the existence of laws that

provide rights and obligations can change the dynamic of a meeting of parties, especially in the context of power asymmetries. In this context, rights and obligations can help the weaker party overcome an initially disadvantaged position.

[25] A forthcoming paper by the authors focuses on the notion of the "right to diversity" as a way to define the body of rights required to support a community's biocultural diversity.

[26] This section is adapted from A. Persic & H. Jonas, 2010. "The Bushbuckridge healers' path to justice", pages 18-21 in A *World of Science*, 8:1.

[27] The Biosphere Committee is the body responsible for the K2C's overall management.

[28] www.naturaljustice.org

[29] The Biocultural Community Protocol of the Traditional Health Practitioners of Bushbuckridge is available from Rodney Sibuyi, CEO of the Executive Committee, PO Box 1270, Thulamahashe 1365, Mpumalanga, South Africa, and from www.naturaljustice.org

[30] Natural Justice is working with partners such as the COMPAS Network, LIFE Network, Global Diversity Foundation, ABS Capacity Development Initiative, UNEP-DELC, UN University, and others in Africa, Asia-Pacific, and Latin America to develop the approach.

References

Agrawal, A., and C. C. Gibson. 1999. "Enchantment and Disenchantment: The Role of Community in Natural Resource Conservation". *World Development*, 27(4): 629-649.

Alexander, M., P. Hardinson, and M. Arhen. 2009. Study on Compliance in Relation to the Customary Law of Indigenous and Local Communities, National Law, Across Jurisdictions, and International Law, CBD Information Document prepared for the 7th Meeting of the Ad Hoc Open-ended working Group on Access and Benefit Sharing. UNEP/CBD/WG-ABS/7/INF/5.

Anaya, James. 2004. *Indigenous Peoples in International Law*. 2nd ed., NY: Oxford University Press.

Angelou, M.1993. "Inaugural Poem". Last accessed on August 4, 2010, at: http://poetry.eserver.org/angelou.html.

Bavikatte, K., and H. Jonas (eds.). 2009. Bio-cultural Community Protocols: A Community Approach to Ensuring the Integrity of Environmental Law and Policy. Natural Justice and UNEP: Montreal.

Bavikatte, K., H. Jonas, and J. von Braun. 2009. "Shifting Sands of ABS Best Practice: Hoodia from the Community Perspective". United Nations University Traditional Knowledge Initiative. Last accessed August 4, 2010, at: http://www.unutki.org/default.php?doc_id=137.

Bosch, D., 2003. "Land Conflict Management in South Africa: Lessons Learned from a Land Rights Approach". Last accessed August 4, 2010, at: http://www.fao.org/docrep/006/j0415t/j0415t0a.htm.

Chee, Y. 2010. "Mixed Reactions on New Access and Benefit Sharing Treaty", Third World Network Biosafety Information Service, Last accessed November 10, 2010 at www.biosafety-info.net.

Cotula, L.2007. *Legal Empowerment for Local Resource Control: Securing Local Resource Rights Within Foreign Investment Projects in Africa*. IIED: United Kingdom.

Cotula, L., and P. Mathieu (eds.). 2008. *Legal Empowerment in Practice, Using Legal Tools to Secure Land Rights in Africa*. IIED: London.

Cotula, L., and J. Mayers. 2009. Tenure in REDD – Start-point or afterthought? Natural Resource Issues No. 15. International Institute for Environment and Development (IIED): London, UK.

Davidson-Hunt, I., and F. Berkes. 2003. "Learning as You Journey: Anishinaabe Perception of Social-ecological Environments and Adaptive Learning". *Conservation Ecology*, 8(1): 5-26.

Davies, R., and J. Dart. 2005. *The Most Significant Change Technique: A Guide to Its Use*. CARE International: United Kingdom.

Descola, P., 1992. "Society of Nature and the Nature of Society" in Kuper, A. (ed.) *Conceptualizing Society. European Association of Social Anthropologists*. Routledge: London. Pp. 107-157

ETC Foundation and COMPAS. 2007. *Learning Endogenous Development: Building on Bio-cultural Diversity*. Practical Action Publishing: United Kingdom.

Hassan, F. (draft in progress). 10 Year History of Treatment Action Campaign. Treatment Action Campaign: Cape Town, South Africa.

Hoole, A., and F. Berkes. 2009. "Breaking Down Fences: Recoupling Social-ecological Systems for Biodiversity Conservation in Namibia". *Geoforum,* 31: 304-317.

Jonas, H., and H. Shrumm. 2010. Exploring Bio-cultural Community Protocols in the Sri Lankan Context: A Report of an International Consultation and Training-of-Trainers Workshop on Bio-cultural Community Protocols in Avissawella, Sri Lanka. Available online at www.naturaljustice.org.

Jonas H., K. Bavikatte and H. Shrumm. 2010. "Biocultural Community Protocols and Conservation Pluralism". *Policy Matters* 17, IUCN-CEESP, Malaysia. Pp.102-112

Köhler-Rollefson, I. 2010. *Bio-cultural Community Protocols for Livestock Keepers*. Lokhit Pashu-Palak Sanstan: Rajasthan, India.

Lunch, N., and C. Lunch. 2006. *Insights into Participatory Video: A Handbook for the Field*. InsightShare: UK.

Maffi, L., and E. Woodley. 2010. *Biocultural Diversity Conservation: A Global Sourcebook*. Earthscan: UK.

Maru, V. 2006. "Between Law and Society: Paralegals and the Provision of Justice Services in Sierra Leone and Worldwide". *The Yale Journal of International Law,* 31: 427-476.

Nelson, F. 2010."Conservation and Citizenship: Democratizing Natural Resource Governance in Africa" *Policy Matters* 17, IUCN-CEESP, Malaysia. Pp. 233-241.

A. Persic & H. Jonas. 2010. "The Bushbuckridge Healers' Path to Justice". *A World of Science,* 8:1. Pp. 18-21

Rozzi, R., F. Massardo, C. Anderson, K. Heidinger, and J. A. Silander, Jr. 2006. "Ten Principles for Bio-cultural Conservation at the Southern Tip of the Americas: The Approach of the Omora Ethnobotanical Park". *Ecology and Society*, 11(1): 43-70.

Ryan, S., K. Broderick, Y. Sneddon, and K. Andrews. 2010. *Australia's NRM Governance System: Foundations and Principles for Meeting Future Challenges*. Australian Regional NRM Chairs: Canberra.

Schreckenberg, K., I. Camargo, K. Withnall, C. Corrigan, P. Franks, D. Roe, L. M. Scherl, and V. Richardson. 2010. "Social Assessment of Conservation Initiatives: A Review of Rapid Methodologies". *Natural Resource Issues*, No. 22. IIED: London.

Sheleef, L. 2000. *The Future of Tradition: Customary Law, Common Law and Legal Pluralism*. Frank Cass: London, England, and Portland, Oregon.

Siegele, L., D. Roe, A. Giuliani, and N. Winer. 2009. "Conservation and Human Rights, Who Says What?" in Campese, J., T. Sunderland, T. Greiber, and G. Oviedo (eds.) *Rights-based Approaches: Exploring Issues and Opportunities for Conservation*. CIFOR and IUCN: Bogor, Indonesia. Pp 47-76.

Subramanian, S. M., and B. Pisupati. 2009. *Learning from the Practitioners: Benefit Sharing Perspectives form Enterprising Communities*. UNEP and UN University: Nairobi.

Swiderska, K. 2006. "Banishing the Biopirates: A New Approach to Protecting Traditional Knowledge". Gatekeeper Series 129. IIED: London. Also see IIED, 2010. "Protecting Community Rights Over Traditional Knowledge". Last accessed August 24, 2010, at: http://www.iied.org/natural-resources/key-issues/biodiversity-and-conservation/protecting-community-rights-over-tradition.

Taylor, J. 2008. "Naming the Land, San Countermapping in Namibia's West Caprivi". *Geoforum*, 39: 1766-1775.

Tobias, T., 2000. *Chief Kerry's Moose: A Guidebook to Land Use and Occupancy Mapping, Research Design and Data Collection*. The Union of BC Indian Chiefs and Ecotrust Canada: Vancouver, Canada.

Tobin, B. 2009. "Setting Traditional Knowledge Protection to Rights: Placing Human Rights and Customary Law at the Center of Traditional Knowledge Governance" in Kamau, E., and G. Winer (eds.) *Genetic Resources, Traditional Knowledge and the Law: Solutions for Access and Benefit Sharing*. Earthscan: UK. Pp. 101-115.

Tobin, B., and E. Taylor. 2009. "Across the Great Divide: A Case Study of Complementarity and Conflict Between Customary Law and TK Protection Legislation in Peru". *Initiative for the Prevention of Biopiracy*, Year IV: 11.

Tsosie, R. 2007. "Cultural Challenges to Biotechnology: Native American Cultural Resources and the Concept of Cultural Harm". *Journal of Law, Medicine & Ethics*, 35: 396, cited in Tobin and Taylor, 2009.

United Nations Department of Economic and Social Affair., 2009. *State of the World's Indigenous Peoples*. United Nations: New York.

Van Cott, D. 2000. "A Political Analysis of Legal Pluralism in Bolivia and Colombia". *Journal of Latin American Studies*, 32: 207-234.

Vermeylen, S. 2007. "Contextualizing 'Fair' and 'Equitable'". *The San's Reflections of the Hoodia Benefit Sharing Agreement Local Environment,* Vol. 12, No. 4, 423–436.

Vermeylen, S. 2008. "From Life Force to Slimming Aid: Exploring Views on the Commodification of Traditional Medicinal Knowledge". *Applied Geography* 28 (2008) 224–235.

Watson, A., L. Alessa, and B. Glaspell. 2003. "The Relationship Between Traditional Ecological Knowledge, Evolving Cultures, and Wilderness Protection in the Circumpolar North". *Conservation Ecology*, 8(1): 2-15.

Wild, R., and C. McLeod (eds.). 2008. *Sacred Natural Sites: Guidelines for Protected Area Managers*. IUCN: Gland, Switzerland.

Wynberg, R. 2004. "Rhetoric, Realism and Benefit-sharing: The Use of Traditional Knowledge of the Hoodia Species in the Development of an Appetite Suppressant". *The Journal of World Intellectual Property,* 7: 851–876. http://www.biowatch.org.za/main.asp?include=pubs/wjip.html

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International Regime on Access and Benefit Sharing: Where Are We Now?

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Abstract: Limitations of the national law in remedying biopiracy led to the negotiations on an international regime on Access and Benefit Sharing. The deliberations were stuck for a long time due to the extreme divergent views of the developed countries on the one hand and of the biodiversity rich developing countries on the other. A compromise was reached recently during the tenth COP at Nagoya, Japan, after more than six years of negotiations. To what extend did the developing countries succeed in meeting their demands? This paper provides an overview of the positions held by the developed countries, the biotech and pharmaceutical industries and the developing countries during the negotiations and makes an assessment of the provisions of the Nagoya Protocol to see if the developing countries really stand to gain.

Key words: Convention on Biodiversity, international regime, Nagoya Protocol, Access and Benefit Sharing and compliance.

Introduction

The Convention on Biological Diversity (CBD) was adopted as a framework for realizing the three objectives of conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. In order that these objectives are met, States were given sovereign right to exploit their own resources. Thus, exploitation of genetic resources was possible only after the competent authorities in a CBD Contracting Party gave prior informed consent (PIC) to exploit these resources. Additionally, the users of the resources were to share the benefits arising from the commercialization of the products that were based on the genetic resources. At the same time, the CBD encouraged the Contracting Parties to provide a mechanism for the protection of traditional knowledge (TK) associated with genetic resources.

The commitments that they took under the CBD were translated into national laws by several Contracting Parties of the Convention. These laws were aimed at ensuring that the triple objectives of the CBD were realized

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in their own territories. However, the national laws were unable to provide a legal remedy if genetic resources and associated TK were accessed without PIC having been sought in other jurisdictions. In other words, cases of illegal prospecting of biological resources and misappropriation of TK associated with the genetic resources could not be checked.

The solution to this problem was seen in the form of an International Regime on Access and Benefit Sharing (henceforth "International Regime"), which could check such cross-boundary infringements involving the use of genetic resources and associated TK. Negotiations for an International Regime were initiated after the seventh meeting of the Conference of Parties of (COP) the CBD convened in 2004, gave the mandate to the "Ad Hoc Open-ended Working Group on Access and Benefit-sharing … to elaborate and negotiate an international regime on access to genetic resources and benefit-sharing with the aim of adopting an instrument\instruments to effectively implement the provisions in Article 15 and Article 8(j) of the Convention and the three objectives of the Convention". The ninth meeting of the COP held in 2008 instructed the "Ad Hoc Open-ended Working Group to complete its work at the earliest possible time before the tenth meeting of the Conference of the Parties". COP 10, which was held in October 2010, adopted the "Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization".

This paper examines the progress towards the establishment of the International Regime. It looks into the context leading to the demand for an International Regime, deliberations in the CBD and other fora on the Regime and the achievements so far – what has been greed upon during the 10th COP.

Rationale for an International Regime

The demand for an International Regime emerged out of the increasing instances of biopiracy coming to light from the late 1990s. Historically genetic resources were accessed for free based on the world view that these were common heritage of humankind. But, with the increased emphasis on intellectual property rights and private ownerships of products of genetic resources, this view got changed and the CBD introduced a new legal framework where the sovereign rights of States over these resources are established. Nevertheless, the practice of the illegal access continued unabated. Patenting of the Philippine sea snail (Conus magus) in 1998 by Neurex, Inc., a US based pharmaceutical company, is among the many

cases of piracy of genetic resources. Neurex, with the help of scientists from the Marine Science Institute of the University of the Philippines (UP-MSI) and the University of Utah, extracted from the snail a toxin called SNX-111 (Ziconitide) which is reported to be 100 to 1000 times potent than morphine, a pain killer. The company got FDA approval in June 2000 for Ziconitide and during the first year of marketing the drug earned Neurex more than $ 80 million. Neurex owns three patents of the Philippine sea snail under US Patent numbers 5189020, 5559095 and 5587454 for the snail toxin treatment for victims of stroke[1]. Piracy has also been rampant on the derivatives of genetic resources. Peru, in its communication to the WTO, highlights the claims made on Camu Camu in the patent offices of Europe and Japan[2]. Camu Camu is a plant native to Peruvian Amazon and it has the highest level of ascorbic acid (vitamin C) compared with other natural sources such as lemon or acerola. Camu Camu has been used in Peru as an excellent flavouring for ice cream and also in the preparation of jams, jellies, wines, liquors and pie filings. The National Anti-Piracy Commission of Peru identified more than 50 claims in the Japanese patent office on food, cosmetics and skin preparations and one claim in European Patent office on antioxidant effect and stable whitening effect, whose active substances came from the extract of Camu Camu.

Biopiracy also involves TK associated with genetic resources. TK plays a crucial role in providing leads for the use of genetic resources at several stages, ranging from the initial stage of identification of the uses of the resource to sometimes information on the precise dosages and preparation of a particular product using the resource. TK plays an important role in bioprospecting, the process of searching for and extracting potential compounds having commercial value from biological resources. The originators and custodians of much of this knowledge are the indigenous groups who through years of consistent usage through trial and error and keen observation have developed wealth of a knowledge base.

The spurt in the trans-border movement of genetic resources adds another dimension to biopiracy. Samples for screening can be obtained from raw materials exported such as leaves, seeds, plants, roots, or products for fresh consumption like fruits, herbs, etc. and it is not necessary in all cases to go *in situ* for collecting samples. With economic liberalization and opening up of borders, the scope for transboundary movements of genetic resources and indigenous knowledge systems are greatly enhanced (Chaturvedi and Ravi, 2007). Richerzhagen (2010) finds that researchers in Germany and UK often source their materials for screening from traders.

Once extracted, there is no need to access the natural material again as its chemical structure can then be synthesized.

National laws to remedy biopiracy could not check piracy in the foreign territories. The scope of challenging illegal patents were limited as the patentability criteria in many jurisdictions do not recognize oral form of prior art, for example United States (Dhar and Anuradha, 2005). Indian Council for Scientific and Industrial Research (CSIR) could challenge the US patent on *turmeric* as India had documented evidence on its healing properties. It has also been very difficult for countries to identify the possible instances of biopiracy. Some patent offices allow access to their data base only in their language. The National Anti-Piracy Commission of Peru's attempts to identify possible cases of piracy were affected by the fact that the Japanese patent office allows access, in some cases, to original documents published only in Japanese. Wherever English translation was available, it was a literal translation of Japanese and this led to confusion and in some cases making the assessment impossible.[3] Moreover, challenging of patents involves huge financial implications.

This was the context in which the biodiversity rich developing countries demanded of an International Regime which would ensure that access to genetic resources or TK associated with such resources has been subject to PIC from competent national authority and mutually agreed terms (MAT) have been established. The Regime would also ensure that these countries obtain a fair and equitable share of benefits of the use of genetic resources originating from their territory by setting up a clear and transparent framework for access and benefit sharing. The idea of an International Regime came up during the World Summit on Sustainable Development in 2002 at Johannesburg. During the Summit, the Like Minded Megadiverse Countries (LMMC) supported by the Group of 77 succeeded in getting a decision to negotiate an International Regime, within the CBD framework, to promote and safeguard the fair and equitable sharing of benefits arising out of the use of genetic resources.[4]

The developing countries wanted the scope of the International Regime to include the derivatives of genetic resources apart from genetic resources. CBD provides only for genetic resources and does not recognize their derivatives under the definition of genetic resource. Derivatives are results of metabolism of genetic material and industry uses derivatives for creating new and commercially valuable products. It is estimated that out of the 877 small molecule new chemical entities introduced in world between 1981

and 2002, 535 (61 per cent) were traced to natural products. The 61% is constituted as follows - natural products (6 per cent), derivatives of natural products (27 per cent), synthetic compounds with natural product derived pharmacophores (5 per cent) and synthetic compounds designed on the basis of knowledge gained from natural product (23 per cent) (Newman, Cragg and Snader 2003). The biochemical compounds of genetic resources once identified can be chemically synthesized and would not require access to genetic resources again. These extracts or isolated material are the real marketable products of genetic resources and include all kinds of secondary metabolites such as gums, resins or latex (Nijar, 2011). The developing countries pressed so hard on derivatives because they were already constrained in getting a share in the benefits arising out of the use of genetic resources for agricultural purposes and did not want that to happen in other industries such as pharmaceuticals and cosmetics. Use of genetic resources for agricultural purposes is covered by the multilateral system of access and benefit sharing under the International Treaty on Plant Genetic Resources for Food and Agriculture.

It was the European Union (EU) which brought the issue of pathogens that are of particular public concern for health of humans, animals and plants into the negotiations on the International Regime. This proposal came in the context of hesitation expressed by Indonesia in sharing H5N1 avian flu virus samples for research and development of vaccines. Developing countries have been depositing pathogens to five collection centres of World Health Organization (WHO) and the WHO in turn grants access to these pathogens to industry which makes vaccines, patents them and supplies them mainly in the developed countries which can afford high prices. This proposal was introduced to preempt the outcome of the WHO negotiations (Nijar 2011). The major deliberations on the International Regime are discussed in the following section.

Deliberations on the International Regime

Access

CBD requires that access to genetic resources should be on 'mutually agreed terms' subject to 'prior informed consent' of the resource provider (Article 15.4/5). The competent authority in the country providing genetic resources is expected to grant access permit to the users. However, there is no mechanism to verify whether PIC and MAT requirements have been complied with. National law has limitation in ensuring compliance

when users are located in other jurisdictions. The fact that there have been a number of cases of misappropriation of genetic resources by firms based in the advanced countries, made a strong case for the demand of developing countries on the disclosure of origin. The developing countries wanted other Parties to have in place a mechanism wherein the users are required to disclose the origin of genetic resource and evidence for PIC and fair and equitable sharing. Patents being the juncture of transition into commercialization and benefit generation, the developing countries wanted the disclosure mechanism to be within the intellectual property system. This would require amending of the Trade Related aspects of Intellectual Property Rights (TRIPS) Agreement to incorporate the disclosure norms, which is known as linking of CBD and TRIPS.

A mandatory obligation on the patent applicant as part of the norms of disclosure would have the following advantages: (a) it would be an additional reason why the patent applicant would be encouraged to comply with the national laws on ABS; (b) the onus would be on the patent applicant, so member countries cannot raise the objection of higher administrative costs for the patent office; (c) it would enable patent offices to be more vigilant while examining patent applications that deal with a biological resource and associated TK; and (d) it would serve as a critical tool for biodiversity rich countries in tracking down applications based on bioresources and related TK, and enable adequate challenges to suspicious patents (Dhar, 2010).

The biodiversity rich developing countries made several proposals in the World Trade Organization (WTO) to make necessary changes in the TRIPS Agreement to incorporate the disclosure requirement. In its submission to WTO in 1997 India pointed out that there is lack of any conditions on patent application (in Article 29 of the TRIPS Agreement) to mention the origin of biological/genetic resources and indigenous/traditional knowledge used in the biotechnological invention, and that provisions are absent in the TRIPS Agreement on PIC of the country of origin and the knowledge holder of the biological raw material meant for usage in a patentable invention.[5] India suggested that in order to overcome these contradictions, "TRIPS Agreement could incorporate an obligation on patent owners to execute TIAs (Transfer of Information Agreement) for any traditional or indigenous knowledge, which is already in the public domain or is a part of the recorded or otherwise publicly accessible knowledge, to be incorporated as a specific form of intellectual property in the Agreement". This step, according to India, would have given "a concrete shape to the

laudable objective of such benefit sharing incorporated in the CBD". In a subsequent submission India argued that a "material transfer agreement would be necessary where the inventor wishes to use the biological material and a transfer of information agreement would be necessary where the inventor bases himself on indigenous or traditional knowledge".[6] India also proposed that "such an obligation could be incorporated through inclusion of provisions in Article 29 of the TRIPS Agreement requiring a clear mention of the biological source material and the country of origin."

Other developing countries also, apart from India, made submission on the disclosure norms. In 2006, Brazil, India, Peru, Pakistan, Thailand and Tanzania proposed a new paragraph in article 29 *bis* of the TRIPS agreement which would incorporate disclosure of origin in addition to the current rules on disclosure requirements of an invention.[7] Further, the amendment of Article 27.3(b) of TRIPS has been proposed that "Members shall require that an applicant for a patent relating to biological materials or to traditional knowledge shall provide, as a condition to acquiring patent rights: (i) disclosure of the source and country of origin of the biological resource and of the relevant traditional knowledge used in the invention, (ii) evidence of PIC through approval of authorities under the national regimes; and (iii) evidence of fair and equitable benefit sharing under the relevant national regimes".[8] They held that patents system is the most effective and appropriate check point for verifying compliance. There had been a mixed response to these demands from developed countries and biotech industry.

Norway supported the demands of the developing countries and observed that "such a disclosure obligation would be a significant step towards giving effect to Article 16.5 of the CBD, which provides that the Contracting Parties should cooperate to ensure that intellectual property rights are supportive of and do not run counter to the objectives of the CBD". [9] But it expressed reservations on evidence for PIC and sanctions – sanctions on non-disclosure or wrong disclosure will be not within the patent system. The same has been the case with the EU. The EU however, proposed a CBD Clearing House Mechanism as the central body which will be linked to patent offices. Every time a patent examiner receives an application with a declaration, a notification should be sent to the Clearing House. US is not a party to the CBD; but on the disclosure proposals at WTO and WIPO it holds that "CBD's objectives on access to genetic resources and on benefit sharing can be best achieved through national legislation and contractual arrangements based on the legislation which

could include commitments on disclosing of any commercial applications of genetic resources and traditional knowledge".[10] The biotech industry is ferociously against the disclosure proposal. The American Bio Industry Alliance (ABIA) held that "mandatory disclosure of source and origin on genetic resources and/or related traditional knowledge have failed to provide positive incentives for stakeholders to engage in the ABS process".[11] The Biotechnology Industry Organization (BIO) and International Federation of Pharmaceuticals Manufacturers and Associations (IFPMA) in their joint submission to (IGC WIPO) stated that "these requirements would introduce significant uncertainties into the patent system and would thereby undermine the incentives of patents as a catalyst for innovation" .[12]

Developing countries also put forward the notion of an internationally recognized certificate of compliance. This proposal has been supported by the EU and Switzerland. However, some developed countries such as Canada and Australia wanted to make it voluntary and not mandatory. The biotech industry also opposed the notion of certificates in the negotiations. ABIA was concerned about the feasibility, complexity and cost of a certificate system. The biotech industry found merit only in access and benefit sharing related scientific and technical capacity building in the biodiversity rich countries and not in mandatory disclosure in advanced counties which will not only reduce the administrative burden in the patent office, but would facilitate accountability and transparency in the access and benefit sharing system.[13]

Evidence emerging from Norway after implementing access and benefit sharing legislation, very clearly indicate that without an International Regime on disclosure of origin, the objectives of CBD can never be realized. It has been observed that no patent application related to biotechnology has been received in Norwegian Patent Office after the amendment of its patent law in 2003 to incorporate disclosure of origin requirement. The reason for this has been that innovators have circumvent the disclosure provisions by filing internationally or through European Patent Office in Munich (Treso, 2008). National disclosure of origin has limited significance in countries which are members of the Patent Cooperation Treaty (PCT). Article 27(1) of PCT prohibits the application of national measures, which are not provided in the treaty, for international patent applications. Disclosure of origin of genetic resources is not an obligation under the PCT. National disclosure legislations will have only limited effectiveness because it applies only to patent applications that are made nationally. Switzerland has proposed a supplement to the PCT for enabling PCT Members to include in their

national laws a declaration of the source of genetic resources and traditional knowledge in the patent applications. The Swiss proposal leaves it open for Members to decide whether or not to include disclosure provisions in their national law. Moreover, disclosure of evidence for PIC is not considered mandatory. For them disclosure of origin is considered to be sufficient for enhancing transparency, and assisting in prior art search and improve confidence in the patent system. This has been the position of Switzerland in WIPO Intergovernmental Committee on Traditonal Knowledge, Folklore and Genetic Resources IGC, WIPO Working Group on Reform of PCT, the TRIPS Council and Ad Hoc Open Ended Working Group on ABS of the CBD (Treso 2008).

The developing countries also demanded the scope of the International Regime to include TK associated to genetic resources. This demand was met with mixed response from advanced countries. The EU and Canada held that the International Regime should focus only on genetic resources. Though Norway favoured the disclosure of associated TK, it does not insist on the disclosure of evidence for PIC. New Zealand and Australia took the view that WIPO IGC is a better body to deal with issues related to genetic resources and traditional knowledge.[14]

The Group of Latin American and Caribbean Countries (GRULAC), Like Minded Megadiverse Countries LMMC, the Like Minded Group of Asia Pacific countries (LMGAP) and the Central and Eastern European group proposed the addition of derivatives of genetic resources. Developed countries did not agree to this except for Norway. The EU, Canada and Australia did not want to use the term 'derivative'.

The issue of pathogens has been brought into deliberations on the International Regime in a different context. In 2006, some of the developing countries contributing viruses to WHO network laboratories realized that their contribution to public health purposes has been abused. There was shock that some of the laboratories were patenting gene sequences from viruses originating in Indonesia and other countries (such as China, Malaysia, Thailand, Vietnam and Panama), while the vaccine companies that accessed the virus strains were also sometimes patenting genetic material as well as the diagnostic kits and vaccines developed from the viruses. Indonesia and some other developing countries asserted their sovereign rights over biological resources including micro-organisms and invoked the CBD's third objective on fair and equitable benefit sharing. Thus, the issue of access and benefit sharing was thus pushed to the forefront at the WHO. The WHO Resolution 60.28 (in 2007) recognized the sovereign rights of Member States

and mandated the formulation of standard terms and conditions for virus sharing. The intergovernmental meeting in December 2008 brought out a document containing the elements for a framework for virus sharing and benefit sharing. It also contained a Standard Material Transfer Agreement (SMTA) intended for use when flu viruses are being transferred to the recipients. It was in this context that the EU introduced during the ninth Working Group meeting in July 2010 in Montreal, a new provision on access to genetic resources that are pathogens into the deliberations on the International Regime. Some developed countries like Canada proposed exclusion of human genetic material and Australia proposed the exclusion of human pathogens. The pharmaceutical industry is also keen to keep the medically relevant microorganisms out of CBD. The tenth COP had a huge challenge of finding a compromise out of the extreme positions. The provisions on Access provided under the Nagoya Protocol are discussed in a later section.

Benefit Sharing

CBD recognizes that access to and transfer of technology among Contracting Parties is essential elements in achieving the objectives of the Convention. It urges that access to and transfer of technology to developing countries should be facilitated under fair and most favourable terms, including on concessional and preferential terms (Article 16.2). CBD also requires each Contracting Party to take legislative, administrative or policy measures, as appropriate, with the aim that Contracting Parties, in particular those that are developing countries, which provide genetic resources, are provided access to and transfer of technology which makes use of those resources (Article 16.3). CBD calls for effective participation of developing countries which provide genetic resources for research in biotechnological research (Article 19.1). The convention also emphasizes that intellectual property rights should be supportive of and do not run counter to the objectives of the Convention (Article 16.5).

The "Bonn Guideline on Access to Genetic Resources and Fair and Equitable Sharing of the Benefits Arising Out of Their Utilization" adopted in 2002 gives clarity on the nature of benefits and mechanisms for sharing of the benefits. Benefits are of monetary and non-monetary in nature. Non-monetary benefits include sharing of results of R&D, institutional capacity building and joint ownership in IPRs among others. Benefits can be of near-term, medium-term and long-term including up-front payments, milestone payments and royalties. The Guidelines urges that

the benefits be shared fairly and equitably with all those who have been identified as having contributed to the resource management, scientific and/or commercial process pursuant to MAT established following PIC. Benefits should be directed in such a way as to promote conservation and sustainable use of biological diversity.

The developing countries wanted benefit sharing to be an integral part of the disclosure requirements in the International Regime. The developed countries objected to these demands on grounds discussed in the above subsection. However, there have been some consensus reached during the tenth COP and the following section is a discussion on the 'compromise deal', the Nagoya Protocol.

The Nagoya Protocol

After prolonged deliberations lasting over six years, the access and benefit sharing Protocol with regard to genetic resources, laying the foundation for the International Regime, was adopted during the tenth COP at Nagoya, Japan. The deal was made possible only when the EU with the blessing of Japan and Brazil, the leader of LMMC - the group which was most articulate about developing country demands, came to an understanding. This compromise is reflected in the change in the stance of Brazil from 'it is better to have no protocol than to conclude a weak or insignificant one' to 'not an ideal protocol, but a framework protocol' (Nijar 2011). To what extent did the developing countries succeed in getting their demands through?

Access

The Protocol includes an obligation on the provider country to issue a permit which would serve as evidence of the decision of a country to grant PIC and establish MAT. Once the permit is made available to the access and benefit sharing Clearing House, it would acquire the status of an international certificate. Article 5.2 of the Protocol imposes an obligation to establish clear rules and procedures for requiring PIC and establishing MAT. MAT may include dispute settlement clause, terms of benefit sharing, terms of subsequent third party use and terms of change of intent. Access to TK associated with genetic resources held by indigenous and local communities also requires PIC or approval and involvement of the indigenous and local communities and establishment of MAT in accordance with the domestic law (Article 5bis). Protocol requires the Parties to designate focal point and national competent authority. The focal point is obliged to make the information available on the procedures for obtaining PIC and MAT. The competent authority has also the same function. Parties should inform the

Secretariat of their designated focal points and national competent authority no later than the entry into force of the Protocol for the Party (Article 10).

Indigenous peoples have objected the clause 'in accordance with domestic law' saying that the domestic law and regulation need not always take into account the customary law. According to them the disclosure mechanism should ensure that genetic resources or associated knowledge held by indigenous peoples are accessed in accordance with their customary law (Intellectual Property Watch, 26 October 2010).

However, the Protocol does not provide for the protection of publicly available TK. Developing countries led by India and China had argued that publicly available TK was not freely accessible and PIC and MAT requirements should apply. Developed counties held that it was outside the scope of CBD as it dealt with indigenous and local communities (Nijar 2011). The developing countries where publicly available TK is not yet codified will now have to register and codify the knowledge to prevent misappropriation of them.

The Protocol calls for the cooperation among Parties where same genetic resources are found *in situ* within the territory of more than one party. In such cases, the Protocol requires the Parties to 'cooperate, as appropriate, with the involvement of indigenous and local communities concerned, where applicable, with a view to implementing this Protocol' (Article 8.1). Where the TK associated with genetic resources is shared by one or more indigenous and local communities in several Parties, those Parties 'shall endeavour to cooperate, as appropriate, with the involvement of the indigenous and local communities concerned, with a view to implementing the objective of this Protocol' (Article 8.2). The transboundary existence of genetic resources is an area where the cooperation of providing countries becomes very essential. Genetic resources may spread across a geographical area which consists of many countries. The diverse genetic resources within the Mesoamerican region from Mexico to Columbia are similar (Richerzhagen and Karin, 2005). The region consists of more than 15 countries and in many cases the access is not regulated. This enables the buyers to substitute one country with another with fewer restrictions on access. Though Costa Rica has approved more than 25 access agreements, it has not yet received any patent application that has made use of national genetic resource (Medaglia, 2010). It is very much possible that the users have gone to other locations in the region which has comparatively liberal or no legislation. Similar is the case with Brazil. As of March 2009, the Council for Management of Genetic Patrimony (CGEN) concluded 22

access contracts out of which only one was with a foreign institution (Velez, 2010). The ABIA has clearly stated that researchers will go to countries where the regulation is less stringent. When Brazil began to strictly regulate its access policies, ABIA commented that, "this has all but shut down both academic and commercial research in Brazil in favour of better operating environments in neighbouring states: Scientists say the rules are so stringent and overzealously enforced that it has become impossible to ship samples abroad for analysis, reducing research to a crawl and driving many scientists to move their research to Ecuador, Bolivia and Peru".[15]

Benefit Sharing

The Protocol does not make any provision for the disclosure of evidence for fair and equitable sharing of benefits. The checkpoints envisaged in the Protocol are not required to receive information on fair and equitable sharing of benefits. This was one of the major demands of developing countries. The Protocol, however, has accommodated the demand of indigenous and local communities on the sharing of benefits. Article 4.1*bis* requires Parties to take 'legislative, administrative or policy measures, as appropriate, with the aim of ensuring that benefits arising from the utilization of genetic resources that are held by indigenous and local communities, in accordance with domestic legislation regarding the established rights of these indigenous and local communities over these genetic resources, are shared in a fair and equitable way with the communities concerned, based on mutually agreed terms'. The indigenous and local communities have objected to making their rights subject to domestic law and had wanted making them Party to the CBD. There are genuine concerns in what the indigenous communities raise. In Costa Rica (which is having the most advanced ABS laws) INBio (agency responsible for carrying out bioprospecting agreements) has entered into more than 25 bioprospecting agreements. Bioprospecting in Costa Rica is taking place in protected areas where 12 out of the 24 indigenous territories exist. In these cases PIC has been granted by the state without the participation of indigenous peoples. The Ministry of Environment and Energy (MINAE) received $790649 between 1991 and 2000 on account of bioprospecting and the entire money was invested in the conservation activities in island of Coco, which is absolutely uninhibited (Richerzhagen, 2010). How will the indigenous communities whose knowledge has been relied upon, benefit so that they have the incentives for conservation?

Compliance

Compliance was at the core of the Protocol for the developing countries. Protocol requires each Party to take appropriate, effective and proportionate legislative, administrative or policy measures to provide that genetic resources utilized within its jurisdiction have been accessed in accordance with PIC and that MAT have been established, as required by the domestic access and benefit sharing legislation or regulatory requirements of the other Party (Article 12.1). It also requires Parties to 'take appropriate, effective and proportionate measures to address situations of non-compliance' (Article 12.2). The Protocol doesn't specify what the measures are. Further, Article 12.3 of the Protocol states that Parties shall, 'as far as possible and as appropriate, cooperate in cases of alleged violation of domestic access and benefit-sharing legislation or regulatory requirements' referred to in Article 12.1. The Protocol has been very lenient to non-compliance by expressing its sympathy to violators by saying 'as far as possible and as appropriate'.

In order to support compliance, Parties are expected to take measures, as appropriate, to monitor and to enhance transparency about the utilization of genetic resources. Such compliance measures may include 'one or more checkpoints' (Article 13.1). These checkpoints would collect relevant information related to PIC, to the source of the genetic resource, to the establishment of MAT, and/or to the utilization of genetic resources. Parties have the flexibility in designating checkpoints and it is for them to decide on whether to designate patent office as checkpoint. However, there is no requirement on the Parties to inform the Secretariat or the Clearing House of their designation of checkpoints, whereas the access granting countries are required to inform the Secretariat of the designated focal points and national competent authority. The compliance mechanism envisaged in the Protocol is very weak for following reasons: (a) the users are not required to disclose information on TK associated with genetic resources; (b) the requirement on the users disclose information at these checkpoints is not mandatory in nature due to the qualifier 'as appropriate and depending on the particular characteristics of a designated checkpoint';[16] (c) no sanction has been prescribed to remedy non-disclosure at designated checkpoints, and (d) possible effective check points have not been identified.

The developed countries had a number of objections to the idea of making intellectual property offices as checkpoints. Canada did not agree to include intellectual property offices as checkpoints. To this, the developing countries proposed a compromise that if intellectual property officer are not explicitly mentioned in the Protocol, it should identify other effective

check points. Even this compromise proposal was refused by countries like Canada, Australia and Japan and the Protocol does not identify any checkpoints.

Derivatives and Pathogens

The demand of the developing countries to bring derivatives within the scope of the Protocol was one of the longest contestations during the negotiations. The developed countries were not at all willing to use the term 'derivatives' in the section dealing with the scope of the Protocol. Article 3 on the scope of the Protocol, does not use the term derivatives; however, utilization of genetic resources has been defined in such a way to include the derivatives. Article 3.1 reads 'this Protocol shall apply to genetic resources within the scope of Article 15 of the Convention and to the benefits arising from the utilization of such resources' and 'utilization of genetic resources' has been defined to mean the 'research and development on the genetic and/or biochemical composition of genetic resources, including through the application of biotechnology'. On the insistence of Africa Group and the Group of Latin American and Caribbean Countries (GRULAC), the Protocol has retained a definition of derivatives under Article 2 for the purpose of legal clarity.

The issue of pathogens was brought into the negotiation by the developed countries led by the EU. The EU proposal required national law to take measures in cases of 'present or imminent emergencies that threaten or damage human, animal or plant health, as determined nationally or internationally' (Nijar 2011, p 25). This would have obliged a country to permit immediate access to pathogens even when a single country declares emergency. Developing counties held that this issue should be addressed under a non-derogatory provision that permits Parties to develop and implement other specialized access and benefit sharing agreements provided they did not run counter to the objectives of the Protocol and CBD (Nijar 2011). The compromise deal watered down the original EU proposal. Article 6(b) of the Protocol requires each Party in the development and implementation of its access and benefit sharing legislation or regulatory requirements to 'pay due regard to cases of present or imminent emergencies that threaten or damage human, animal or plant health, as determined nationally or internationally. Parties may take into consideration the need for expeditious access to genetic resources and expeditious fair and equitable

sharing of benefits arising out of the use of such genetic resources, including access to affordable treatments by those in need, especially in developing countries'. The provision for the expeditious fair and equitable sharing of benefits and access to affordable medicines was proposed to balance the expeditious access provisions (Nijar 2011). It was the success of developing counties to soften the original EU proposal on the pathogens.

Conclusion – Where Are We Now?

The Nagoya Protocol has been a significant mile forward in the whole deliberations on an International Regime. However, the crucial demands of the developing countries have been significantly diluted in the process of reaching the Protocol. The demand for triple disclosure has been met with only partly – Protocol does not provide for the disclosure of origin of TK associated with genetic resources and evidence for fair and equitable sharing. No provision has been made for sanctions to remedy non-disclosure or wrong disclosure; amounting to dilution of the very provision itself. Further, the omission of making intellectual property offices as a designated checkpoint would severely undermine the scope of effectiveness of the compliance mechanism. However, developing countries may take it to their credit the provision for 'derivatives' within the scope of the Protocol by suitably defining the 'utilization of genetic resources' and the dilution of original EU proposal on expeditious access of pathogens in case of emergencies. Overall, the loss has been so huge that the developing counties are nowhere near where it wanted to be.

Endnotes

1 'Companies rush to patent wildlife of the Philippines', *The Earth Times*, January 15, 2001.

2 'Analysis of Potential Cases of Biopiracy', WTO Document IP/C/W/458, November 7, 2005.

3 Ibid.

4 LMMC comprises of 17 developing countries-Bolivia, Brazil, China, Colombia, Costa Rica, Democratic Republic of Congo, Ecuador, India, Indonesia, Kenya, Madagascar, Malaysia, Mexico, Peru, Philippines, South Africa, and Venezuela. Together, they hold 70 per cent of the world's biodiversity. This group was formed in February 2002 at a meeting in Cancun, Mexico.

5 'The Relationship Between The Trips Agreement And The Convention On Biodiversity', Communication from India, WTO Document WT/CTE/W/65, September 29, 1997.

6 'Proposals of IPR Issues' Communication from India, WTO document WT/GC/W/147, February 18, 1999.

7 'Doha Working Programme – the outstanding implementation issue on the relationship between the trips agreement and the convention on biological diversity', Communication from Brazil, India, Pakistan, Peru, Thailand and Tanzania, WTO Document WT/IP/C/W/474, July 5, 2006.

8 'Review of Article 27.3(b)', Communication from Brazil, November 24, 2000.

9 'The relationship between the TRIPS agreement, the convention on biological diversity and the protection of traditional knowledge: Amending the trips agreement to introduce an obligation to disclose the origin of genetic resources and traditional knowledge in patent applications', Communication from Norway, (WT/GC/W/566) on June 14, 2006.

10 www.wto.org

11 'Views pf the American BioIndustry Alliance (ABIA) in Response to CBD Notification SCBD/SEL/VN/GD/60541 to Provide Concrete Options on the Substantive items on the Agenda of the Fifth and Sixth Meetings of the Ad Hoc Open-Ended Working Group on Access and Benefit Sharing', accessed at http://www.abs-alliance.org/version02/files/CBD-ABIA-Submission-November-30-2007.doc *on 16th July 2010.*

12 'Policies, Measures and Experiences Regarding Intellectual Property and Genetic Resources: Submission by Biotechnology Industry Organizations (BIO) and the International Pharmaceutical manufacturers and Associations (IFMA)', WIPO, 16th Session (May 2-7, 2010), WIPO/GRTKF/IC/16/INF/21.

13 F.N 11.

14 The Columbian proposal prior to the conclusion of Patent Law Treaty in 2000, which aims at harmonizing of formal procedures in the patent law, on the protection of biological and genetic resources led to the establishment of IGC in 2000. Disclosure of origin is also discussed in the framework of revisions to the substantive patent law treaty.

15 F.N 11.

16 Article 13.1.

References

Chaturvedi, Sachin. 2007. "TRIPS, Indigenous Knowledge and Geographical Indications". *World Trade and Development Report*, RIS, New Delhi.

Dhar, Biswajit and Anuradha R.V. 2005. *Access, Benefit Sharing, Intellectual Property Rights: Establishing Linkages between the Agreement on TRIPS and the Convention on Biological Diversity*, available at http://wtocentre.iift.ac.in/Papers/2.pdf as on 27th November 2010.

Dhar, Biswajit. 2010. "Reconciling Convention on Biological Diversity and The Agreement on TRIPS: Issues and Concerns". Internal note circulated for comments, Research and Information System for Developing Countries, New Delhi.

Intellectual Property Watch. 2010. "Protocol on ABS Could Further Impoverish Indigenous Peoples, Groups Claim", http://www.ip-watch.org/weblog/2010/10/26/protocol-on-abs-could-further-impoverish-indigenous-peoples-groups-claim/

Medaglia, J. Cabrera. 2010. *Disclosure of Origin Requirements in Central America*. ICTSD, Natural Resources, International Trade and Sustainable Development - Issue Paper No. 3.

Newman, D.J., G.M. Cragg, and K.M Snader. 2003. "Natural Products as Sources of New Drugs over the Period 1981-2002". *Journal of Natural Products* 66(7) in Richerzhagen (2010).

Nijar, Gurdial Singh. 2011. *The Nagoya Protocol on Access and Benefit Sharing of Genetic Resources: An Analysis*. Cablaw brief.

Richerzhagen, Carmen. 2010. *Protecting Biological Diversity: The Effectiveness of Access and Benefit Sharing Regimes*. Routledge.

Richerzhagen, Carmen and Karin Holm-Mueller. 2005. "The Effectiveness of Access and Benefit Sharing in Costa Rica: Implications for National and International Regimes". *Ecological Economics*, 53, pp.445-460.

Treso, Gabriella. 2008. "Patent Disclosure of Origin for Genetic Resources: Options and Possible Solutions". Research paper, LLM in Intellectual Property, Turin University.

Velez, Eduardo. 2010). *Brazil's Practical Experience with Access and benefit Sharing and the Protection of Traditional Knowledge*. ICTSD Project on Genetic Resources, Policy Brief No 8.

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Perspective: Biotechnologies, Mertonian Communism and Schizophrenic Intellectual Property Policies

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Abstract: This paper explores recent episodes in the field of biotechnology research as regards intellectual property rights. It argues that public research institutes develop schizophrenic intellectual property policies. On the one hand, they are aimed at combating poverty through the development of freely accessible knowledge and biotechnologies, but, on the other hand, they perform a policy in which patents are regarded as a crucial tool for acquiring research contracts, safeguard a top position in research rankings and to boost income. The paper concludes that there are fascinating initiatives that try to break through the entanglement of patents, for instance, open source models. Although these initiatives are less relevant in structural terms, i.e. their power is significantly smaller than this one of those who wish to preserve proprietary exclusivity-they are, nevertheless, appropriate frameworks to deal with biotechnological outputs, such as genome sequences or their functional characterization which should be considered as communal goods.

Keywords: Biotechnologies, Mertonian communism, patents, open source biotechnology, schizophrenic intellectual property policies.

In the 1940s, the sociology of science described science outcomes as, what they thought was a communal possession. Robert K. Merton (2001) highlighted the values and norms that form the ethos of science through the 'cudos' norms. One of these norms is communism (the other three being 'universalism', 'disinterestedness' and 'organized skepticism') according to which the discoveries of scientists are shared rather than hidden (that is, kept exclusively to themselves); these discoveries are a product of social collaboration and are assigned to the community (Sztompka 1996, Merton 2001). Merton argues that 'property rights in science are whittled down to a bare minimum by the rationale of the scientific ethic' (Sztompka, 1996). However, Mertonian scientific communism was inverted in the 1970s and 1980s in the field of biotechnologies[1] by the concentration

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of knowledge and technological capacities around some countries and specially around some companies (Hope 2008, Puente-Rodríguez 2010). This privatization tendency within biology provoked not only the crack of scientific communism, but also the extension of the boundaries about what can be patented. An important moment of this trend was the decision of the US Supreme Court on 16th June, 1980 in the case *Diamond vs. Chakrabarty* which allowed the patentability of a micro-organism as such. Ananda L. Chakrabarty, a researcher at the General Electric, discovered the plasmids that, when inserted into a bacterium, could break down the components of petrol, and patented his invention as an agent for use in the fight against pollution. This decision was seen by industry as a sign to jump into the biotech sector. Since then the relevant distinction was not between living and inanimate things, but between products of nature and human-made inventions; patentable subject matter included 'anything under the sun that is made by' human beings, including living organisms produced using genetic technology (Hope 2008). Through a series of judicial decisions the domain of 'patentable subject matter' was further enlarged and extended in subsequent years to include computer software, and methods of surgery, in addition to genetically modified organisms and gene sequences (Hope 2008, Belt 2008) (see Box 1).

In Europe, it took ten years of negotiations before the European Directive for the protection of biotechnological inventions, which codified the patentability of genes among other things, was finally passed in 1998 (Belt 2008). Strong objections have been placed against these extensions on the patentability of living matters. Some have argued that 'life itself' is being patented. Others like the British genome researcher and Nobel Prize winner John Sulston frames the criticism in a different way:

> *"The European Patent Directive, approved by the European Parliament in 1998, accepts that a sequence or partial sequence is eligible for a 'composition of matter' patent once it has been replicated outside the human body – say, copied in bacteria as we do for sequencing. This argument has always seemed to me absurd. The essence of a gene is the information – the sequence – and copying it into another format makes no difference. It is as though I took a hardback book that you had written, published it in a paperback, and called it mine because the binding is different" (Sulston and Ferry 2002).*

Box 1.: The Unbearable Absurdity of Patenting Living-beings

A notorious case that shows the absurdity of patenting living things is the legal conflict between the biotech company Monsanto and the canola farmer Percy Schemeiser from the Canadian province of Saskatchewan. In this case, the Canadian Supreme Court decided (21 May, 2004) that a farmer can be sued for patent infringement even if a (patented) plant shoot up inadvertently into a farmer's field through contamination in purchased seeds, cross-fertilization with pollen form neighbouring or more remote fields that has been dispersed by wind or insects, or just through loss of transgenic seed from passing trucks. During the proceedings Schmeiser's lawyer formulated the legal absurdity in the following terms: 'Had [Monsanto] maintained control over its invention, it may have maintained it exclusive rights. However, inventions do not usually spread themselves around. They do not normally replicate and invade the property and land of others…[Monsanto] cannot on the one hand unleash self-propagating matter uncontrolled into the environment and then claim exclusivity whereas it invades' (Defence brief, par. 170, quoted in Lezaun 2004).

The rupture of the communist understanding of scientific knowledge has been described, for instance, by John Sulston and Ferry (2002) in the book *The Common Thread: A Story of Science, Politics, Ethics, and the Human Genome*. In this book, they portray the commercial environment that was emerging around the genome, just before the race between public and private sectors started to map the human genome. A case in point is the public-versus-private drama over breast cancer genes. In the summer of 1994, the Cancer Genome group was leading a team at the Institute of Cancer Research (ICR) in Sutton, Surrey (UK) which found a gene that place women at high risk of developing breast cancer. It became known as BRCA2, and is located in chromosome 13. The private company Myriad Genetics, based in Salt Lake City, Utah (USA), was also looking for those types of genes and it was collaborating with the public cancer research institute in the UK. Sulston's institute, the Sanger Centre, was asked by the ICR to make a clone map covering the region of the genome where they knew the gene lay. Due to the Sanger Centre policy to release data as soon as the sequence is complete it would be publicly released. This might have helped ICR competitors.

Within two weeks of the sequence being available the ICR team found several mutations of the BRCA2 gene which gave them the security to have found the gene . ICR moved fast to publish the discovery in the prestigious scientific journal *Nature*, trying in the meantime to keep it secret (ibid.). But despite these efforts, enough information about the discovery reached Myriad Genetics, to enable the company to locate the gene and bang in a patent application – the day before the ICR paper came out in *Nature* (ibid).

At the same time, ICR understood the importance of patenting. They took a patent on the first mutation as soon as they discovered one and another later covering more mutations – this has been called as 'defensive patent license'. Myriad Genetics patent applications claimed rights to the whole gene. They also own patents on another gene, BRCA1. They set up a commercial diagnostic centre in the USA and, once the patents were granted, threatened legal challenges to any lab elsewhere in the USA that was using either gene to carry out breast cancer screening. All such screenings henceforth had to be done at their own centre, at a cost of around $2,500 per patient. 'Having accepted massive financial investments, the company now has no alternative but to market its goods as aggressively as possible' (ibid.: 142). Only ICR's patents was standing on their way, 'but as a body largely funded by coins dropped in the tins rattled by Cancer Research Campaign volunteers, ICR cannot justify spending the huge sums on lawyers that would be needed to fight Myriad through the courts' (ibid.).

Mutations on BRCA1 and BRCA2 are responsible for most hereditary breast and ovarian cancers. According to the company, a woman who tests positive on Myriad's BRCA test has on an average 83 per cent risk of developing breast cancer in her lifetime and a 44 per cent risk of developing ovarian cancer (Wadman 2010). The patents, which Myriad Genetics has actively enforced, grant the company the exclusive right to perform diagnostic test on the two genes (ibid.). In 2009, Myriad's revenues from molecular diagnostics grew by 47 per cent to $326.5 million. BRAC analysis accounts for the lion's share of those revenues.

So far, the answer to the question whether naturally occurring genes can be patented, Was, in this case, a straightforward 'yes'. However, at the beginning of 2010, a US District Court has ruled that claims in seven patents supporting the aforementioned widely used genetic test (for inherited breast and ovarian cancer susceptibility) are invalid (Wadman 2010). The decision is likely to be challenged in a legal appeal by Myriad Genetics, and the University of Utah Research Foundation, which hold the patents

on BRCA1 and BRCA2 – but if upheld, it could have huge implications for the industrial biotechnology sector (Wadman 2010). It also contradicts the decision of the appeals board of the European Patent Office, in 2008, which supported the patents (Abbott 2008).

Recently, *Nature* news reported (Wadman 2010) that the plaintiffs in the case included individual physicians and patients as well as the Association for Molecular Pathology and the American College of Medical Genetics; they were represented by the American Civil Liberties Union (ACLU) and the New York-based Public Patent Foundation. The American Society of Human Genetics and the American Medical Association also field briefs in support of the plaintiffs' challenge to the patents. The plaintiffs called the patents illegal on the basis that they restrict both scientific research and patients' access to medical care and that patents on human genes violate patent law because genes are 'products of nature'. In his written opinion, the US District Court for the Southern District of New York, reports *Nature*, excluded from consideration the plaintiffs' arguments on the stifling of research and patient access. But it nonetheless ruled that both Myriad's composition and method claims are invalid under the law, disagreeing, for instance, with Myriad's argument that the purification of a natural product like a gene necessarily renders it patentable. An argument, we might say, worthy of the old Mertonian school.

There are, nevertheless, a lot of law cases that support the patentability of genes. If this North American court decision is maintained, then a lot of biotech companies and some of their technologies might be at risk – for instance, although 16 of Myriad's 23 patents on BRCA remain valid, in trading before the opening of the NASDAQ stock market on 30 March 2010, shares of Myriad Genetics declined 9.2 per cent (ibid.). One answer of industry has taken the form of an open letter to the Secretary of the US Department of Agriculture, Mr. Tom Vilsack. The letter is signed by the President of the Biotechnology Industry Organization and 15 other Presidents and CEO's of key companies within the agro-biotechnology business (e.g. Syngenta, Pioneer-DuPont Business, Monsanto, Bayer CropScience, Dow AgroSciences). They argue that 'if the Department of Justice fails to support the patent eligibility of DNA sequences […], the United States could become the only industrialized nation that does not permit such patents – thus, abdicating our role as the world leader in this field, undermining U.S economic competitiveness, and potentially closing the door on those future innovations that can help the United States and the

rest of the world address some of the greatest challenges of the 21st century.'[2] The open letter is written in a kind of 'universalistic' way as it speaks up for global problems…but, in Merton's terminology, this argument could be better characterized as 'particularistic' because it places the economic interest of the USA before those of humanity. Moreover, one might argue, the top managers of these companies are certainly far from 'communism' or 'disinterestedness'.

No matter how dramatic the state of affairs could get for industry, the biotechnology is, nevertheless, an organic and, therefore, fast evolving and adaptable world. As we will see later on new communal frameworks both of production, and for sharing (bio) knowledge and (bio) technology are already emerging which go beyond the actual IPR entanglement. Before addressing these communal (Mertonian) frameworks, we will, first, briefly explore the dualism (schizophrenia) in which public research institutes are dealing with biotechnologies because of their contradictory objectives as regards the production and share of knowledge and technologies.

The Schizophrenic Position of Public Funded Research Centres

Universities, one could argue, are the type of organizations that could best (should) follow the ethos of science, as defined by Merton in the 'cudos' norms, as they are mainly financed with revenues originated from taxes and are thought to serve the public good. However, the constant accumulation of knowledge accomplished by these organizations and the subsequent spillover into productive capacity of, for instance, technological innovations, brings universities to a schizophrenic[3] position. In this context, the formulation of an intellectual property rights policy (as regards patents, the share of knowledge, or inter-institutional collaborations) attuned to the public good objectives of universities is not an easy task.

As an illustration, we have, for instance, the challenges faced by the Wageningen University and Research Centre (WUR) – the Netherlands – which is an international reference knowledge centre in relation to innovations within the agrarian sector. Heselmans, de Jonge, Vroom and Louwaars (2008) report on a symposium ('Reconsidering Intellectual Property Policies in Public Research'[4]) in which these issues were addressed. They argue that, 'intellectual property protection, in Wageningen and elsewhere, is caught in between the need for valorisation of research outcomes, and the wide availability of these outcomes.' For example, the argument continues, 'biotechnologists regard patents as a crucial tool in

acquiring research contracts. Added to that, they can help safeguard a top position in research rankings and may boost income.' Using patents as *currency* – to remain attractive for market parties – is a worldwide trend, and it is very difficult not to go along with it, because governmental research funding bodies, including the Dutch, currently promote patenting of research results. For instance, those governmental bodies funding the Wageningen Centre for BioSystems Genomics[5] (CBSG) have set a target of obtaining 25 patents, 20 licenses, and two spin-offs – all in the coming five years (ibid.). The centre was established in 2002 as a Centre of Excellence (working on potato, tomato, Arabidopsis, and Brassica) under the auspices of the 'Netherlands Genomics Initiative' with a total research budget of 53 Million €. In 2008, the CBSG entered its second five year phase with an equivalent budget. The centre is a public private partnership in plant genomics. Therefore, here we have a common situation in which (totally or partially) public funded research centres are aimed at obtaining patented type of knowledge and technologies.

However, as a public organization, Wageningen University and Research (WUR) Centre has also the mission to contribute to poverty alleviation through the development of knowledge and technologies for resource-poor agrarian systems. This aim might be jeopardized by the fast growing number of patents granted to the WUR. In the closing debate of the aforementioned symposium, Martin Kropff, WUR's rector, formulated the dilemma in these terms: 'The millennium goals are important for us, they are part of our strategy, and technology has to be available for developing countries. But we also have to follow the current system of IPR, for instance because we want to generate spin-out companies' (ibid.).

This schizophrenic Northern policy for producing and protecting knowledge and technologies has consequences for Southern regions which could employ these innovations to strengthen, for instance, local agrarian systems. Marc Ghislain, who is a biotechnology advisor at the International Potato Centre (Peru) of the Consultative Group on International Agricultural Research,[6] claimed in that symposium (ibid.) that 'today, the transfer of proprietary (bio) technology from the private sector (…) has never been so difficult, not to say impossible.' Public institutes, he said, are still transferring proprietary technology, but are encountering increasing difficulties. He gave the example of potatoes bred at CIP using a parent with engineered PLRV[7] resistance. This technology could not be provided to India due to lack of response form the technology holder.

Professor S.G. Hughes, co-director of the ESRC[8] Centre for Genomics in Society (Egenis) – at the University of Exeter – of the ESRC Genomics Network (UK)[9] argued at the symposium in Wageningen that American universities are disappointed because of the low revenues they receive from their patenting strategy: only 0.56 per cent of their total revenues come from licensing and royalties (Heselmans, de Jonge, *et al*., 2008). He suggested that patenting no longer fits the current 'network' character of genomics research, i.e. a highly interconnected network of dozens of research groups will be more productive if there are many soft ties rather than hard property rights. The patenting system does not mesh with the latest ideas about innovation either. In the new innovation strategies, all stakeholders (institutional, professional and individual, including farmers and peasants) 'co-generate' knowledge and innovation. In such a learning and interactive network, patents can be very unproductive (ibid.).

The socio-technological system of biotechnologies is a complex one. It can happen that a technology, e.g. a molecular marker,[10] can be, for whichever reason, freely accessible. In this case, nevertheless, the set of technologies that are required to adapt and/or reproduce that original technology into a local practical application in low income labs, in the Third World, is very difficult. Moreover, some enabling technologies, such as reagents, could also be patented constraining or impeding the utilization of that, in principle, freely accessible technology – here, a molecular marker. For example, a good number of the applications of molecular markers and of genomics are based on the technique Polymerase Chain Reaction (PCR).[11] The PCR is used to amplify specific regions (i.e. to make multiple copies) of a DNA strand. This can be a single gene, just a part of a gene, or a non-coding sequence. A key element for performing the PCR is the polymerase enzyme which is used to synthesize a DNA copy of the region to be amplified. One particular polymerase, from the *themophilic bacterium*, *Thermus aquaticus* (Taq, pronounced 'tack') is of vital commercial importance. The thermo-stability of Taq DNA polymerase is the critical feature that facilitated the development of the PCR and ensured its commercial success. The PCR was patented by the Cetus Corporation (the inventor of the engine) in 1983. The Taq polymerase enzyme was also covered by patents. The pharmaceutical company Hoffmann-La Roche purchased the rights to the patents in 1993 and currently holds those that are still protected. A related patent battle between Roche and another company (Promega) over the Taq polymerase enzyme was still going on in several countries. Somewhat ironically perhaps, it seems that legal arguments have extended well beyond the life of the

original PCR and Taq polymerase patents, which expired on March 28, 2005 (Zemlo 2006).

When Roche acquired the patent for the PCR, they interpreted their exclusive rights to this technique as applying to all thermo-stable polymerases. At that time, molecular biologists were all using these enzymes on a large scale in their sequencing reactions, and Roche's prices became prohibitively expensive for them. The Nobel Prize winner, John Sulston argued on this topic:

> "*So we started preparing our own enzyme, hoping that we would be protected by research exemption. We soon started receiving legal advice to the contrary. The situation was eventually resolved when another company challenged Roche on the breadth of the patent, and won the right to market its own enzyme. One of the great problems is that granting patents is relatively cheap, but opposing them is very costly and beyond the means of non-profit organizations. The exact limits of the research exemption still need clarification' (Sulston 2006)*".

If those are the problems faced in the industrially developed world by Nobel Prize winners, we can imagine how these same problems may be amplified in the resource-scarce world – once again a schizophrenic position emerges, we might say, but from a different perspective.

Importantly for genomics strategies, performing PCR, and-therefore biotechnologies, is not a straightforward activity, and creative strategies have to be sought after for circumvent ownership regimes. Until now, the strategy of research institutes has been to produce their own polymerase. They could use, for instance, some cloned form of Taq DNA polymerase to produce this enzyme in an *E.coli bacterium*. The produced enzyme can be recovered with a precipitation protocol. By following this protocol, only a partially purified Taq polymerase is obtained. Therefore, this enzyme cannot currently be used in protocols where a highly purified Taq is required, such as for molecular markers like AFLP, RAPDs, or ISSRs. But it is good enough for microsatellites molecular markers–which are highly reproducible in low income labs and, therefore, commonly used in the so-called developing world. This strategy allows some research institutes with low economic capacities to break through one of the socio-material constraints – this one constructed around intellectual property rights – for the deployment of the molecular markers. The new socio-technical rearrangement thus facilitates the path for the further deployment of microsatellites, but leaves it constrained for other types of molecular markers (Puente-Rodríguez 2010).

Similar problems (placing some attention also to the proprietary constrictions) are outlined in a recent review of the implementation of plant genomics in West Africa. Richards *et al*. argue that 'in Ghana (as in Benin) actual usage of laboratory facilities, however, is limited by staffing levels and lack of funds to cover running costs. In addition to the high costs of trained labour and modern equipment, the consumable materials needed for molecular analyses are expensive. Analysis requires very pure and complex chemical compounds produced under patent protection in the Western world. These are often expensive and hard to obtain by customers in West Africa. A major issue concerns basic infrastructure taken for granted in other regions of the world. A well-equipped lab is nothing without clean water and a steady power supply. In many West African countries power outage is relatively frequent, and when it happens, the consequences for molecular analysis are serious. A standby generator is an important facility if loss of material is to be avoided' (Richards, Bruin-Hoekzema, Hughes *et al*., 2009).

Who is Regulating What?

Merton explained his communal understanding of scientific knowledge production by reflecting on how difficult (impossible) it is to arrive to new discoveries without standing 'on the shoulders of giants' who have been looking to the same type of problems before us (Merton 1965). For example, the findings of Myriad Genetics on BRCA2 depended on the earlier work of the ICR indeed – no matter how, the fact is that the privatization and commodification of science has been extended ever since.

Researchers of the public and especially private sector today employ biotechnological tools, such as genomic technologies, to search for interesting genetic information and materials within natural resources worldwide for their commercial and investigatory practices – this activity is known as bioprospection. No matter how logical this activity might appear, the privatization and ownership tendencies evolving together with biotechnological technologies make of this activity a controversial one (see Box 2).

Box 2.: Bioprospection or Biopiracy?

In his most recent book '*Global Biopiracy*', Ikechi Mgbeoji (2006) uses the term 'biopiracy' to describe the process by which industrialised countries appropriate knowledge about the use of plants built up over centuries by farmers in the poor third world and appropriate

Box 2 continued

Box 2 continued

the genetically wealthy position from the South by building up their own stores of genetic material. Mgbeoji argues that this process operates in three main levels. Firstly, it operates at a socio-cultural level. This is expounded in discursive Foucaultian terms with the 'denigration and denial of the intellectual input of traditional farmers and breeders, particularly women, in the improvement of plants' (by the scientific discourse). Secondly, it works at the institutional level by the systematic collection of plant materials from the South and the setting up of an international system of gene banks strategically situated in the centres of genetic diversity (like the International Potato Centre in Peru). These centres have been sponsored by the North and their materials have flowed in the opposite direction to the financing. Thirdly, there is a legal operation level of biopiracy. This has been made possible by 'a deliberate lowering of the threshold for patentability and several other forms of judicial and legislative intervention in the patent law system that have resulted in serving the ever-expanding interests of Western corporate seed merchants and pharmaceutical and biotechnological companies'.

The discussions around bioprospecting and biopirating have been fanned by the entanglement of bioprospecting and patenting tendencies between the rich in genetic resources South, and the North which is poor on biodiversity but powerful in technological, economic and political terms. One of the most representative cases of this entanglement has been the US patent No. 5304718 aimed at granting the Colorado State University professors Duane Johnson and Ward the exclusive monopoly and control over the traditional Bolivian variety of Quinoa (*Chemopodium quinoa*)[12] 'Apelawa'. Apelawa is a type of quinoa named after the farmers of a Bolivian town with the same name near the Titicaca Lake. The patent covered not only the single Hybrid, but it was extended to every quinoa hybrid derived from the male sterile cytoplasm (Apelawa). The patent, issued in 1994 might have been valid until 2011, but it was finally abandoned because of the pressure of some NGOs, and farmer's organizations. For instance, the Bolivia's National Association of Quinoa Producers – ANAPQUI – placed the case for the UN as a crime against humanity because this variety has been traditionally grown by Quechua and Aymara people and forms an important element of their nutritional patrons.

Biotechnologies have produced a huge amount of data on crop genetic resources during the last decades. To be able to make sense of this data, strategic partnerships (including public-private) have been developed for sharing or claiming what now is known as pre-competitive knowledge.[13] The understanding of this knowledge and partnerships evolves together with technological advances (like the increasingly ease of genome sequencing) and agreements and disagreements about regulatory frameworks. The mechanisms for claiming intellectual property rights within plant science have several forms: patents, plant variety protection certificates, plant breeders' rights, and trade secrets (Fears 2007), which are regulated within different and even contradictory international regulatory frameworks (e.g. Convention of Biological Diversity – CBD, Trade-Related Aspects of Intellectual Property Rights – TRIPS, and the International Treaty on Plant Genetic Resources for Food and Agriculture).The criteria for eligibility for protection vary between countries according to cultural, historical and economic factors.[14] There is not such a thing as an international patent, gaining patent rights in the USA confers no intellectual property rights in China (Pardey and Beintema 2001). However, as poor countries are increasingly committed with their loyalties to the agreements within the World Trade Organization, then the relevance of patents also increases in these regions.

Science and Technology Communalism

There are some interesting initiatives that are trying to creatively transcend intellectual property barriers. For example, the Public Intellectual Property Resources for Agriculture (PIPRA)[15] aimed at brokering technologies by supporting access to IPR databases or patented material for humanitarian purposes. Certainly biotechnology research is a long-term process which requires continued heavy investments in R&D, and multidisciplinary expertise; this type of initiatives could help low income research institutes or organizations to tap into relevant knowledge and technologies. Another example is CAMBIA[16] that provides open source licensing to a pool of technologies on the condition that any improvement of these technologies or any discovery produced with the accessed technologies should be kept in the public domain. Lately, they have also developed the 'patent lens'[17] which is a digital infrastructure that can be used to navigate through the international knowledge-sea of patents.

There are also some interesting developments within industry. For instance, the drug company GlaxoSmithKline launched a pool last year,

in which the company would make patents for some of its drugs and manufacturing processes freely available and with no-cost licenses (for infectious diseases of the poor such as malaria) (Nordlin, 2010). Many hoped that the move would boost research into neglected diseases. Yet, there was little initial response to the pool — few joined it and few made use of it. But on the 5 May 2010 came what some have seen as a 'landmark' announcement because the first government agency was joining the pool — South Africa's Technology Innovation Agency (TIA); and, also the first university was as well joining — the prestigious Massachusetts Institute of Technology (MIT) in the United States of America (ibid.).

There is a growing demand for *open source* models of biotechnology that follow the open source path sketched within the realm of information and communication technologies (Hope 2008, Deibel 2006). However, these authors and others (Fears, 2007) argue that the main bottlenecks for such a structural shift are that: Firstly, the investments required for biotechnological developments (e.g. genomics) are much more higher than those required to write software, meaning that in the actual context large profits are required to pay back investments (ibid.). Secondly, although there are very interesting loose initiatives (e.g. Cambia) the structural power of 'those who wish to preserve or strengthen proprietary exclusivity' is significantly larger (Hope, 2008).

Conclusion

Protecting intellectual property rights might strengthen the expensive R&D activities around biotechnologies, and might also reveal knowledge that will be otherwise kept secret. Whilst at the same time, it can hinder the participation of public research and start-up companies in the cumulative activity of agrarian or health related research since the key biotechnologies protected are highly concentrated in the hands of a small number of large multinationals based on North America and Western Europe (Fears 2007). But it is also true that the outputs coming out the fascinating realm of biotechnology research are of communal (global) value. Therefore, biotechnological outputs such as genome sequences or their functional characterization as well as some technologies which might facilitate the application of this knowledge to address neglected diseases of the poor or strengthen peasant' agrarian systems should be considered as international freely accessible public goods.

Endnotes

1 'Biotechnology' here refers to technologies ranging from traditional fermentation processes to the latest applications of genomics.

2 The letter can be found at: http://bio.org/ip/genepat/documents/20100909.pdf Accessed 9 November, 2010.

3 Here, rather than to refer to a psychiatric and psychological diagnostic, *schizophrenia* has the informal meaning of any condition in which disparate or mutually exclusive activities coexist.

4 This symposium took place in Wageningen on 11 April 2008.

5 www.cbsg.nl

6 The Consultative Group on International Agricultural Research is an alliance of countries, international and regional organizations, and private foundations supporting fifteen international agricultural centres, which work with national agricultural research systems and civil society organizations, including the private sector. The alliance aims to mobilizes agricultural science in order to reduce poverty (www.cgiar.org).

7 PLRV stands for potato leafroll virus.

8 ESRC stands for Economic and Social Research Council.

9 www.genomicsnetwork.ac.uk

10 Molecular markers are identifiable DNA sequences found at specific locations of the genome, and transmitted through the standard laws of inheritance from one generation to the next. They can be identified by DNA assays, in contrast to morphological markers, based on visible traits, and biochemical markers, based on protein produced by genes (FAO 2003). The presence of a particular marker in a plant might indicate the presence of the particular trait associated with this marker. In addition, molecular markers can be detected at almost any stage of development of new varieties (Peleman and Voort 2003). This is why they are currently used to assist plant breeding research – i.e. Marker Assisted Breeding.

11 This argument on the polymerase is written on the basis of research published in Puente-Rodríguez 2010: pp. 128-131.

12 The grain-like *quinoa* originated in the dry and highlands of the Andes, and it is an important crop for food security and sovereignty of local communities.

13 This is not without consequences. For instance, within the health care sector the expansion of the concept of shared pre-competitive knowledge has extended the concept 'downstream' form the most basic of research towards potential areas of application (Fears 2007).

14 A comprehensive analysis of the IPR issues in food and agriculture can be found at Louwaars (2007), Tansey and Rajotte (2008), and the *Asian Biotechnology and Development Review* (Vol. 10 No. 3 – July 2008) special issue on 'access and benefit sharing'.

15 www.pipra.org

16 www.cambia.org

17 www.patentlens.net

References

Abbott, A. 2008. "Europe to Pay Royalties for Cancer Gene." *Naturenews*, 2 December, 2008. www.nature.com/news/2008/081202/full/456556a.html Accessed 9 November, 2010

Belt, H. v. d. 2008. "Philosophy of Biotechnology" in Meijers, A. (ed.) *Handbook Philosophy of Technology and Engineering Sciences*. Amsterdam: Elsevier. Pp. 1301-1340

Deibel, E. 2009. Common Genomes: On Open Source in Biology and Critical Theory Beyond the Patent. (PhD) Amsterdam: Ridderprint offsetdrukkerij B.V.

FAO 2003. *Molecular Marker Assisted Selection as a Potential Tool for Genetic Improvement of Crops, Forest Trees, Livestock and Fish in Developing Countries*. Rome: FAO.

Fears, R. 2007. *Genomics and Genetic Resurces for Foor and Agriculture*. Rome: FAO.

Heselmans, M., Jonge, B. de, Vroom, W., Louwaars, N.P. 2008. Increasing Access to Biotechnology Results: Report on the "Reconsidering Intellectual Property Policies (IPP) in Public Research." Nijmegen : CSG.

Hope, J. 2008. *Biobazaar: The Open Source Revolution and Biotechnology*. Cambridge & London: Harbard University Press.

Lezaun, J. 2004. "Pollution and the Use of Patents: A Reading Fo Monsanto V. Schmeiser," in Stehr, N (ed.) *Biotechnology: Between Commerce and Civil Society*. New Brunswick: Transaction Publishers. Pp. 134-158.

Louwaars, N. 2007. Seeds of Confusion; the Impact of Policies on Seed Systems. (PhD) Wageningen: Wageningen University and Research Centre.

Merton, R. K. 1965. *On the Shoulders of Giants: A Shandean Postscript*. New York: The Free Press.

Merton, R. K. 2001. *Science, Technology & Society in Seventeenth-Century England*. New York: Howard Fertig.

Mgbeoji, I. 2006. *Global Biopiracy; Patents, Plants and Indigenous knowledge*. New York: Cornell Univeristy Press/UBC Press.

Nordling, L. 2010. "Patent Pool Starts to Attract Interest." www.Scidev.net; May 10, 2010.

Pardey, P. G. and Beintema, N. M. 2001. "Slow Magic: Agricultural R&D a Century after Mendel." International Food Policy Research Institute.

Peleman, J. D. and Voort, J. R. V. D. 2003. "The challenges in Marker Assisted Breeding," in Hintum, T. J. L. V., Lebeda, A., Pink, D. A. & Schut, J. W. (eds.) *Eucarpia Leafy Vegetables 2003*. Noordwijkerhout, The Netherlands: Centre for Genetic Resources, Wageningen University.

Puente-Rodríguez, D. 2010. Redesigning Genomics – Reconstructing Societies: Local Sustainable Biotechnological Developments. (PhD) Zutphen, the Netherlands: Daniel Puente Rodríguez. http://dare.ubvu.vu.nl/bitstream/1871/15887/1/dissertation.pdf

Richards, P., Bruin-Hoekzema, M. D., Hughes, S. G., Kudadjie-Freeman, C. & Offei, S. K. 2009. "Seed Systems for African Food Security: Linking Molecular Genetic Analysis and Cultivator Knowledge in West Africa." *International Journal of Technology management*, 45 (1/2): 196-214.

Sulston, J. 2006. "Staking Claims in the Biotechnology Klondike." *Bulletin of the World Health Organization*, Vol 38 (5): 412-413.

Sulston, J., and Ferry, G. 2002. *The Common Thread: A History of Science, Politics, Ethics and the Human Genome*. London: Corgi Books.

Sztompka, P (1996) (Ed) On Social Structure and Science (author R.K.Merton) Chicago: University of Chicago Press

Tansey, G., and Rajotte, T. (eds.). 2008. *The Future Control of Food: A Guide to International Negotiations and Rules on Intellectual Property, Biodiversity and Food Security*. Earthscan.

Wadman, M. 2010. "Breast Cancer Gene Patents Judged Invalid." *Naturenews*, 30 March, 2010. www.nature.com/news/2010/100330/full/news.2010.160.html Accessed 9 November, 2010.

Zemlo, T. R. 2006. "Advice on How to Survive the Taq Wars: Insights on Purchasing Preferences & Analysis of Price Sensitivity and Elasticity of Demand." *GEN: Genetic Engineering & Biotechnology News*, 26 (9), 1 May 2006.

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