AGRO-BIODIVERSITY AND INTERNATIONAL LAW—A CONCEPTUAL FRAMEWORK

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This paper lays out the international legal framework currently governing agro-biodiversity management which emphasises private property rights and thus provides incentives for the private sector to participate in agriculture. We argue that the attendant commercialisation of agriculture has failed to protect the rights of local farmers and generally not contributed to meeting the food needs of every human being. Moreover, it has contributed to the erosion of the genetic base necessary for the further development of agro-biodiversity. We contend that the legal framework can only foster the fulfilment of everyone's food needs if agro-biodiversity is recognised as a common heritage of humankind.

1. Introduction

1.1 Agriculture and biodiversity

Biodiversity can be defined to mean the variety of genetically distinct populations and species of plants, animals, and micro-organisms with which human beings share the earth, and the variety of ecosystems of which they are functioning parts.[1] It comprises the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part. This includes diversity within species, between species and of ecosystems.[2] Agriculture, on its part, is defined as the science or practice of cultivating the soil and rearing animals.[3]

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[1] See P.R. Ehrlich and A.H. Ehrlich, 'The Value of Biodiversity', 21 *Ambio* 219 (1992). See also, United Nations, *Glossary of Environment Statistics* (UN Doc ST/ESA/STAT/SER F/67, 1997).

[2] Article 2, Convention on Biological Diversity, Rio de Janeiro, 5.6.92, reprinted in 31 ILM 818 (1992) [hereafter Biodiversity Convention].

[3] Concise Oxford Dictionary of Current English (9th edn, 1995).

1.1.1 Linkages between agriculture and biodiversity

Agriculture and biodiversity management are inextricably intertwined. Biodiversity resources constitute a primary input to agricultural production systems and the majority of existing agricultural products have evolved through selection and collection of plant and animal species.[4] Further, agricultural systems are highly dependent on ecosystem products and services,[5] and must be resilient to adjust to changes in the biophysical environment.

The erosion of biodiversity directly affects agricultural systems' production capacity because plant breeding activities are based on the range of genetic materials provided by close relatives of cultivated species, known as landraces.[6] This is reinforced by the fact that the potential utility for agricultural systems of a great number of plant species remains unknown to science.[7] Further, monocropping which reduces diversity within agricultural systems diminishes crops' resilience to pests and diseases.[8] Biodiversity resources are under increasing threat from a variety of sources with agricultural production constituting one of the major causes of erosion.[9] Agriculture is indeed the human activity affecting the largest proportion of the earth's surface and the single biggest user of freshwater worldwide. Other threats to biodiversity within and outside agricultural systems include urban and industrial growth and monocropping.[10]

The dependence of agriculture on biodiversity and the threat posed by agricultural systems to biological resources points to the need for more sustainable forms of agriculture. The main constraint to sustainable agriculture is the increasingly limited arable land available.[11] Thus, limiting the impacts of agriculture on biological resources implies the need for some form of intensification of agricultural production, such as small-scale irrigation or organic fertilisers. The erosion of biodiversity within agricultural systems can also be stemmed through inter-cropping. In each case, however, the trade-off between agricultural production and biodiversity conservation should be considered from a societal perspective.

1.1.2 Biotechnology in agriculture

While biotechnology is broadly considered to be modern, it refers strictly speaking to the manipulation of living organisms and is in fact ancient practice.[12] It can be

[4] See, for example, J.I. Cohen and C.S. Potter, 'Conservation of Biodiversity in Natural Habitats and the Concept of Genetic Potential' in C.S. Potter et al (eds), *Perspectives on Biodiversity: Case Studies of Genetic Resource Conservation and Development* (Washington, DC: AAAS, 1993), p xix.

[5] S. Pagiola and J. Kellenberg, *Mainstreaming Biodiversity in Agricultural Development—Toward Good Practice* (Washington, DC: World Bank, 1997).

[6] Decision IV/6, 'Agricultural Biological Diversity' in *Report of the Fourth Meeting of the Conference of the Parties to the Convention on Biological Diversity*, 4–15.5.98, Bratislava, UN Doc UNEP/CBD/COP/4/27.

[7] P. Rosenegger, 'Welcome to Participants' in M.S. Swaminathan (ed), *Agro-biodiversity and Farmers' Rights* (Delhi: Konark, 1996), p 31.

[8] See e.g., M.S. Swaminathan, 'Ethics and Equity in the Collection and Use of Plant Genetic Resources: Some Issues and Approaches' in *Ethics and Equity in Conservation and Use of Genetic Resources for Sustainable Food Security* (Rome: International Plant Genetic Resources Institute, 1997), p 7.

[9] See, S. Pagiola et al, 'Mainstreaming Biodiversity in Agricultural Development', 35 *Finance & Dev* 38 (1998).

[10] Pagiola and Kellenberg, supra n 5.

[11] Consultative Group on International Agricultural Research, *25 Years of Food and Agriculture Improvement in Developing Countries* (Washington, DC: CGIAR, 1996).

[12] S.R. Barnum, *Biotechnology—An Introduction* (Belmont, CA: Wadsworth, 1998).

defined as any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use.[13] It thus includes both bio-processing techniques such as fermentation, micropropagation and food processing technologies used to produce, for instance, beer, wine and cheese,[14] and all methods of genetic modification by recombinant DNA and cell fusion techniques, also known as genetic engineering.[15]

In agricultural systems, genetic engineering focuses, for instance, on herbicide resistant seeds.[16] It has the potential to boost food production by, for instance, producing plants that are resistant to diseases, insects and herbicides, raising the nutritional value of crops, having them produce their own nitrogen fertiliser, and enabling them to withstand harsh environmental stress such as temperature and salinity.[17] Indeed, some people contend that yield increases to meet world food needs can only be achieved through the application of novel genetic combinations employing where necessary, recombinant-DNA technologies.[18] In principle, genetic engineering can lead to higher yields. However it should not be looked at in isolation. More specifically, new varieties should not entail the loss of landraces which provide invaluable genetic diversity and in some cases are preferable for farming communities in developing countries, especially if they are better adapted to local conditions.[19]

1.2 Agro-biodiversity in context

1.2.1 The importance of agro-biodiversity

DEFINITION Agricultural biological diversity or agro-biodiversity is that part of biodiversity that feeds and nurtures people. It includes genetic resources for food and agriculture, such as harvested crop varieties, livestock breeds, fish species and non-domesticated resources within field, forest, rangeland and in aquatic ecosystems.[20] It also refers to activities in the fields of agriculture, animal husbandry, aquaculture and agroforestry including pests, microbial resources and the management of agro-ecosystems, wildlife and protected areas.[21] Agro-biodiversity exists because of the wide range of varying climates, habitats and farming practices found within the centres of diversity and the natural selection caused by the presence of different pests and diseases.[22]

[13] Article 2, Biodiversity Convention, supra n 2.

[14] D.W. Altman, 'Issues and Problems in the Transfer of Biotechnology' in D. Altman and K.N. Watanabe (eds), *Plant Biotechnology Transfer to Developing Countries* (Austin, TX: R.G. Landes, 1995), p 21.

[15] J.E. Smith, *Biotechnology*, 3rd edn (Cambridge: Cambridge University Press, 1996). See also, the definition given by the Crop Science Society of America, reproduced in Altman, supra n 14.

[16] S.M. Dunn, 'From Flav'r Sav'r to Environmental Saver? Biotechnology and the Future of Agriculture, International Trade, and the Environment', 9 *Col J Int Env LP* 145 (1998).

[17] See, M. Avramovic, *An Affordable Development? Biotechnology, Economics and the Implications for the Third World* (London: Zed, 1996).

[18] See, Swaminathan, supra n 8.

[19] See, 'Keystone Madras Dialogue 1990' in M.S. Swaminathan and S. Jana (eds), *Biodiversity—Implications for Global Food Security* (Madras: Macmillan, 1992), p 283.

[20] See, H. Shand, *Human Nature—Agricultural Biodiversity and Farm-Based Food Security* (Ottawa: RAFI, 1997).

[21] See e.g., Programme of Work on Agricultural Biological Diversity, Conference of the Parties to the Convention on Biological Diversity, Fourth Meeting, Bratislava, 4–15.5.98, UN Doc UNEP/CBD/COP/4/6.

[22] See e.g., J.I. Cohen and C.S. Potter, 'Conservation of Biodiversity in Natural Habitats and the Concept of Genetic Potential' in C.S. Potter et al (eds), *Perspectives on Biodiversity: Case Studies of Genetic Resource Conservation and Development* (Washington, DC: AAAS, 1993), p xix.

Overall, crop diversity currently comprises at most a few thousand species,[23] albeit with significant intra-species diversity. Further, a mere hundred or so species account for 90% of the total supply of food crops by weight, calories, protein and fat for most of the world's countries. Of these, rice, wheat and maize account for 60% of the calories and 56% of the protein that people derive from plants.[24] It is noteworthy that genetic resources are very unevenly distributed around the world. As far as the major crops are concerned, most regions of the world mainly depend on resources originating from other areas. Only three of the ten main regions of crop diversity have indices of total dependence on imported genetic material below 50%.[25] North American and Australian agricultural production is, for instance, nearly completely based on plant genetic materials derived from other regions.[26] The high dependence ratio of most countries and regions has naturally made the issue of access to crop diversity extremely sensitive at the international level since it directly bears on food security.[27] The conflicting nature of negotiations pertaining to crop diversity is further heightened by the fact that it directly interests key economic players, both private and public.[28]

Historically, agro-biodiversity has been developed and nurtured by a variety of actors. Smallholder farmers, herders and artisanal fisherfolk have traditionally played the most crucial role in conserving and enhancing agro-biodiversity. They have, for instance, developed crop varieties and domestic animal breeds specifically suited to their diverse local environments.[29] More recently, however, agro-biodiversity enhancement and preservation has been undertaken on a larger scale and has become a major industrial activity.[30] In both cases, agro-biodiversity is not a strictly natural phenomenon but derives from human activities. Indeed, farmers make selections to enrich the biodiversity all the time.

THE DECLINE OF AGRO-BIODIVERSITY Agro-biodiversity has been declining in parallel with the demands of an increasing population and greater competition for natural resources. The underlying causes of the decline include the loss of biodiversity generally, the rapid expansion of commercial agriculture, intensive livestock production and industrial aquaculture. Further, increasing homogenisation of agricultural production has led to the widespread cultivation and rearing of fewer

[23] See, Roseneger, supra n 7.

[24] See, R. Prescott-Allen and C. Prescott-Allen, 'How Many Plants Feed the World?', 4 *Conservation Biology* 365 (1990).

[25] J.R. Kloppenburg Jr and D.L. Kleinman, 'Seeds of Controversy: National Property Versus Common Heritage' in J.R. Kloppenburg Jr (ed), *Seeds and Sovereignty—The Use and Control of Plant Genetic Resources* (Durham: Duke University Press, 1988), p 173.

[26] See e.g., J. Mugabe et al, *Managing Access to Genetic Resources: Towards Strategies for Benefit-Sharing* (Nairobi: ACTS, 1996). Sub-Saharan Africa is also dependent for about 87% of its supply of major food crop genetic diversity. See Kloppenburg, supra n 25.

[27] See e.g., H.L. Shands and A.K. Stoner, 'Agricultural Germplasm and Global Contributions' in K.E. Hoagland and A.Y. Rossman (eds), *Global Genetic Resources: Access, Ownership and Intellectual Property Rights* (Washington, DC: Association of Systematics Collections, 1997), p 97.

[28] See e.g., D.M. Witmeyer, 'The North-South Politics of Genetic Resources: Issues and Implications' in K.E. Hoagland and A.Y. Rossman (eds), *Global Genetic Resources: Access, Ownership and Intellectual Property Rights* (Washington, DC: Association of Systematics Collections, 1997), p 13.

[29] See, J. Esquinas-Alcázar, 'The Realisation of Farmer's Rights' in M.S. Swaminathan (ed), *Agro-biodiversity and Farmers' Rights* (Delhi: Konark, 1996), p 2.

[30] C.M. Correa, 'Access to Genetic Resources', 20/3 *World Competition—L Econ Rev* 57 (1997).

varieties and breeds for a more uniform, less diverse but more competitive global market.[31]

This has resulted in the marginalisation of small-scale, diverse food production systems that conserve farmers' varieties of crops and breeds of domestic animals, which form the genetic pool for food and agriculture in the future.[32] Moreover, land use changes caused largely by expanding agricultural systems have led to the loss of plant genetic resources (PGRs) of potential use to agriculture.[33] The adoption of high-yielding varieties has also led farmers to become increasingly dependent on industry-dominated markets and governments for agricultural inputs.[34]

AGRO-BIODIVERSITY AND BASIC NEEDS Agro-biodiversity contributes directly to the livelihood of a large segment of humankind. It constitutes, for instance, the basis for all human food consumption, for world food security and for sustainable agriculture.[35] Further, it is estimated that nearly 2.5 billion people rely on wild and traditionally cultivated plant species to meet their daily needs.[36] The need to foster agro-biodiversity is highlighted by the fact that more than 800 million human beings currently suffer from hunger and malnutrition. This is reinforced by the fact that meeting the needs of a growing world population will require an estimated 75% increase in food production by 2025. Limited arable land will constitute one of the main constraints to the achievement of this objective.

Some attempts to increase food production include the introduction of the Green Revolution in the mid-1960s. The Green Revolution entailed the introduction of so-called high-yielding varieties of rice and wheat whose success depended mainly on irrigation, chemical fertilisers and pesticides.[37] The aim was to achieve food sufficiency by raising yields per acre so as to reduce pressure on forest areas.[38] In retrospect, the Green Revolution helped countries, such as India, to achieve self-sufficiency in food production. However, it has contributed to serious deterioration of the environment, such as increased salinity and waterlogging.[39] Further, in many cases, the Green Revolution has had negative socio-economic impacts. A survey in the Philippines showed, for instance, that while farmers experienced a 70% increase in yields from rice varieties obtained from the International Rice Research Institute, this increase was offset by a 50% reduction in the sale price of rice and a 358% increase in farm expenses due to chemical inputs.

[31] The Crucible Group/International Development Research Centre, *People, Plants, and Patents—The Impacts of Intellectual Property on Biodiversity, Conservation, Trade, and Rural Society* (Ottawa: International Development Research Centre, 1994).

[32] Ibid.

[33] Plant genetic resources are defined as the germplasm of plants, animals and other organisms, containing useful characters of actual or potential value. See *Dictionary of Plant Genetic Resources* (Amsterdam: Elsevier, 1991).

[34] See, A. Kothari, *Conserving India's Agro-Biodiversity—Prospects and Policy Implications* (London: IIED, 1997).

[35] See e.g., Decision IV/6, supra n 6 and Article 1(1) of the Consolidated Negotiating Text of the revised International Undertaking on Plant Genetic Resources in *Report of the Fifth Extraordinary Session of the Commission on Genetic Resources for Food and Agriculture*, Rome, 8–12.6.98, Doc CGRFA-Ex5/98/REPORT.

[36] M.S. Swaminathan, 'Preface' in M.S. Swaminathan (ed), *Agro-biodiversity and Farmers' Rights* (Delhi: Konark, 1996), p v.

[37] See, G.R. Conway and E.B. Barbier, *After the Green Revolution—Sustainable Agriculture for Development* (London: Earthscan, 1990).

[38] M.S. Swaminathan, 'Foreword' in D. Altman and K.N. Watanabe (eds), *Plant Biotechnology Transfer to Developing Countries* (Austin, TX: R.G. Landes, 1995), p i.

[39] See, V. Shiva, *The Violence of the Green Revolution* (London: Zed, 1991).

The end result was thus a 52% drop in farm income.[40] To counter some of the negative effects of the Green Revolution while increasing production, genetic engineering has been proposed as an alternative strategy. The latter is believed, for instance, to reduce the need for chemical inputs.[41]

1.2.2 Agro-biodiversity: international context

Discussions on agro-biodiversity have been influenced to a significant extent by the apposition between genetic resources and genetically engineered products emanating from these resources.[42] Genetic resources have traditionally been made available on an unrestricted basis among breeders.[43] Indeed, the international exchange of genetic resources was facilitated by the fact that these resources were considered to be a common heritage of humankind. This is reflected in the mechanisms put in place under the Consultative Group on International Agricultural Research (CGIAR) through the network of International Agricultural Research Centres (IARCs) which provide for free access to their collections.[44] The rationale for the CGIAR system is to foster scientific research to raise the productivity of agriculture so as to meet food needs in a sustainable manner.[45]

While the availability of genetic resources remains unrestricted, a property rights regime, specifically intellectual property rights (IPRs), has been developed to provide incentives to the private sector to engage in research and development.[46] Thus, private corporations have been able to monopolise most of the financial and technological benefits emanating from the manipulation of genetic resources for which no similar rights obtain.

1.3 Relevant legal mechanisms for access to and control over agro-biodiversity

Access to, control over and ownership of agro-biodiversity have become more contentious in parallel to the decline of PGRs.[47] This decline has led to increased competition for these resources and an emphasis on economic valuation. Thus landraces are designated as valueless primitive cultivars and PGRs transformed in laboratories are characterised as elite varieties. In effect, both evolve through biotechnological processes but the latter are given more prominence. This characterisation reflects value judgements that translate into monetary gains to be derived therefrom. However, the skewed valuation scale does not indicate a continuum from the raw material to a transformed product. There is a marked dichotomy between the valueless raw germplasm and the commodified varieties that are processed in laboratories brought

[40] J. Bell and M. Pimbert, 'Introduction' in M. Baumann et al (eds), *The Life Industry—Biodiversity, People and Profits* (London: Intermediate Technology, 1996), p 1.

[41] OECD, *Biotechnology and Sustainable Agriculture: Lessons from India* (Paris: OECD, 1994).

[42] See, Mugabe, supra n 26.

[43] While farmers are also involved in plant breeding activities, the term 'plant breeder' usually refers to persons or entities involved in commercial plant breeding activities.

[44] See e.g., Articles 3 and 9, Agreement between IPGRI/INIBAP and FAO Placing Collections of Plant Germplasm under the Auspices of FAO, 26.10.94, on file with the authors.

[45] Lucerne Declaration and Action Programme, reprinted in *Renewal of the CGIAR—Sustainable Agriculture for Food Security in Developing Countries*, ministerial-level meeting, summary of Proceedings and Decisions (1995).

[46] M.S. Swaminathan and S. Jana (eds), *Biodiversity—Implications for Global Food Security* (Madras: Macmillan, 1992).

[47] Esquinas-Alcázar, supra n 29.

about by the perception that PGRs should be open access resources and thus freely available.[48]

To better understand the nature of this dichotomy, we need to look at relevant property rights regimes. The existence of property rights is predicated upon a limited supply of resources for which different users compete. Law then assigns property rights to regulate access to the resources.[49] Agro-biodiversity is, for instance, the subject of private, sovereign and common property rights regimes. Private property refers to exclusive rights over objects or information vested in a single legal entity. Individuals or corporations holding such rights can exclude others from the benefits of their property and regulate its use. Private rights include, for instance, IPRs. Common property also entails exclusive rights but the holder is a collective body.[50] Each member of the collective body has separate entitlements to the property but no one user has the right to abuse or dispose of the property.[51] Any dealing with the property has to take into account the entitlements of others and is subject to approval by the community. Users of common property share rights to the resource and are subject to rules and restrictions, embedded in cultural or religious customs, governing the use of those resources. Both private and common property offer incentives to the holders to make investment in the resources and manage them sustainably. In the context of agro-biodiversity, private rights have been given most prominence along with sovereign rights. Common property rights, on the other hand, have been sidelined and ignored.

1.3.1 Intellectual property rights

Intellectual property rights (IPRs) are usually granted for a limited period of time for innovations whose creator can be identified as a legal entity. Their allocation is premised on the notion that innovation is driven by profit. From a societal point of view, IPRs strive to balance the private interests of creators, by ensuring that they still have an incentive to create, against those of the society at large in having the information available for its use. Even though information does not diminish once it is shared, the role of IPRs is to ensure that information providers do not lose rights to the information by disclosing it, since such information can be used by an infinite number of persons simultaneously.[52] Indeed, one of the perceived philosophic underpinnings of IPRs is to ensure disclosure of the information while maintaining exclusive rights for the creator.

In the context of agro-biodiversity, it is first noteworthy that IPRs distinguish between the treatment given to human and nature's creations.[53] Thus nature's

[48] See e.g., V. Shiva, 'The Seed and the Earth: Biotechnology and the Colonisation of Regeneration' in V. Shiva (ed), *Close to Home—Women Reconnect Ecology, Health and Development* (London: Earthscan, 1994), p 128. Open access situations obtain where there are no property rights and the resources are accessed on a first-come, first-served basis.

[49] C. Biblowit, 'International Law and the Allocation of Property Rights in Common Resources', 4 *New York Int LR* 77 (1991).

[50] See, D.W. Bromley and M.M. Cernea, *The Management of Common Property Natural Resources—Some Conceptual and Operational Fallacies* (Washington, DC: World Bank, 1989).

[51] J. Vogler, *The Global Commons—A Regime Analysis* (Chichester: John Wiley, 1995).

[52] See e.g., K.W. Baer, 'A Theory of Intellectual Property and the Biodiversity Treaty', 21 *Syracuse J Int LC* 259 (1995); and W.M. Landes and R.A. Posner, 'An Economic Analysis of Copyright', 18 *J Legal Stud* 325 (1989).

[53] I. Walden, 'Preserving Biodiversity: The Role of Property Rights' in T. Swanson (ed), *Intellectual Property Rights and Biodiversity Conservation* (Cambridge: Cambridge University Press, 1995), p 176.

creation such as PGRs have traditionally been excluded from patentability.[54] However, there has been a progressive move towards the patenting of genetically engineered life forms, first concerning plants and more recently concerning animals. While IPRs could arguably be extended to cover agro-biodiversity, there has been opposition to this trend from different actors. The scientific and business communities on the one hand argue against the extension of IPRs to research undertaken outside laboratories.[55] On the other hand, there are concerns that IPRs which are geared towards providing economic rewards to a single creator are incapable of accommodating the contribution of communities of farmers.

One of the main shortcomings of IPRs in the context of agro-biodiversity is the focus on novelty as the determining factor for apportioning rights since this does not easily accommodate the knowledge that a community has developed and used over time in preserving and managing biodiversity.[56] An example of this problem is given by the treatment reserved to neem-based products under two different systems. While the Indian Central Insecticide Board did not register neem products under the 1968 Insecticides Act on the ground that they had been in extensive use for various purposes since time immemorial without any known deleterious effects, patent protection has been sought in the US for the development of similar products on an industrial basis.[57]

PATENTS Patents are granted for new, non-obvious and useful inventions and not for discoveries. An applicant for a patent must include in the application, a full written description of the invention and how to carry it out.[58] Recently, patents on biological materials have assumed prominence with increasing biotechnological activities by individuals and the private sector. The United States has been at the forefront of legal developments in this area and was the first country to allow the patenting of life forms.[59] American biotechnology companies have been arguing for the international recognition of such patents, a move that has been opposed by most developing countries. The European Union has historically been more hesitant to accept the patentability of life forms. It has, however, recently adopted a Directive on the legal protection of biotechnological inventions which affirms the patentability of products consisting of or containing biological material or processes by means of which biological material is produced, processed or used.[60]

PLANT BREEDERS' RIGHTS Plant Breeders' Rights (PBRs) constitute one particular kind of IPRs of relevance in the context of agro-biodiversity. For a plant variety to be

[54] See, R.S. Eisenberg, 'Proprietary Rights and the Norms of Science in Biotechnology Research', 97 *Yale LJ* 177 (1987).

[55] See e.g., J.H. Barton, 'The Biodiversity Convention and the Flow of Scientific Information' in K.E. Hoagland and A.Y. Rossman (eds), *Global Genetic Resources: Access, Ownership and Intellectual Property Rights* (Washington, DC: Association of Systematics Collections, 1997), p 51.

[56] Another problem that arises with respect to traditional biocultural knowledge is that it may be found in different locations in the world making it difficult to identify an owner as such since the exclusivity requirement is not satisfied. See generally, C.D. Jacoby and C. Weiss, 'Recognizing Property Rights in Traditional Biocultural Contribution', 16 *Stanford Env LJ* 74 (1997).

[57] See, US Patent No 5,885,600, *Natural Insect Repellent Formula and Method of Making Same*, issued 23.3.99.

[58] See generally, D. Campbell and S. Cotter (eds), *International Intellectual Property Law—Global Jurisdictions* (West Sussex: John Wiley, 1996).

[59] See e.g., *Diamond v Chakrabarty*, 447 US 303 (1980) and *Moore v Regents of UC*, 51 Cal 3d 120, 793 P 2d 479, 271 Cal Rptr 146 (1990).

[60] Article 3, Directive 98/44/EC, European Parliament and of the Council on the Legal Protection of Biotechnological Inventions, 6.7.98, 1998 OJ L213.

eligible for PBR protection, it must be clearly distinguishable from other protected varieties, homogenous or uniform and stable.[61] PBRs were first developed in the context of the International Convention for the Protection of New Varieties of Plants (UPOV Convention)[62] as an alternative to fully-fledged patent rights while stimulating plant breeding activities in the private sector.[63] In effect, PBRs are akin to weakened patents.[64]

The main motivation of PBRs is profit and they are thus designed to attract the private sector in plant breeding activities. More specifically, PBRs seek to give sufficient stimulus for research and development of new varieties of plants to the private sector and reward the creativity of successful plant breeders.[65] They have, for instance, been the main catalyst for the development of the seed industry. At the same time, they are designed to allow other plant breeders to use the protected plant for their own breeding activities and research as long as they refrain from selling the protected plant itself.[66] Further, new varieties derived from such breeding activities can be marketed.

PBRs suffer from the same conceptual problems that plague IPRs generally. By recognising only the last actor in a long chain of biological processes, they ignore local systems of knowledge even though local people make a significant contribution to plant breeding by providing much of the genetic stock for crop improvement. Further, they have the potential to contribute to the erosion of agro-biodiversity through the introduction of uniform, high yielding varieties which threaten diversity within agricultural systems.[67]

FARMERS' RIGHTS The concept of Farmers' Rights (FRs) arose as a result of international debates on the asymmetric benefits derived by the donors of germplasm and the donors of technology and the lower status ascribed to farmers' activities in contradistinction to plant breeders' activities. The latter generated returns through PBRs or other IPRs but there was no system of compensation or incentives for farmers.[68] The idea behind the arguments for FRs was thus to ensure the equitable sharing of benefits arising from genetic resources and to give farmers incentives to preserve genetic resources and share them with others.[69] More specifically, FRs were to ensure that the need for conservation was globally recognised and sufficient funds made available for this purpose, assist farmers in all regions of the world but especially those in regions of diversity of plant genetic resources in protecting and conserving their resources, and also allow farmers, their communities and countries to particip-

[61] UN Conference on Trade and Development, *Trade and Development Aspects and Implications of New and Emerging Technologies: The Case of Biotechnology* (1991).

[62] International Convention for the Protection of New Varieties of Plants, Paris, 2.12.61, as revised at Geneva, 10.11.72, 23.10.78 and 19.3.91 (UPOV Doc 221(E), 1996) [hereafter UPOV Convention].

[63] Swaminathan and Jana, supra n 46.

[64] See, K. Bosselmann, 'Plants and Politics: The International Legal Regime Concerning Biotechnology and Biodiversity', 7 *Colorado J Int Env LP* 111 (1996).

[65] See e.g., U. Menon, 'Designing a Regime of Access to Genetic Resources: Beyond the Popular Logic of Farmers' Rights and Breeders' Rights', *Ethics and Equity in Conservation and Use of Genetic Resources for Sustainable Food Security* (Rome: International Plant Genetic Resources Institute, 1997), p 98.

[66] Anonymous, supra n 19.

[67] See, G. Balakrishnan, 'The Development of PVP Legislation in India' in M.S. Swaminathan (ed), *Agro-biodiversity and Farmers' Rights* (Delhi: Konark, 1996), p 36.

[68] Esquinas-Alcázar, supra n 29.

[69] See, Mugabe, supra n 26.

ate fully in the benefits derived, at present and in future from the improved use of agro-biodiversity through plant breeding and other scientific methods.[70]

While it is in principle agreed that FRs, a kind of IPR, are necessary for the sustainable management of agro-biodiversity, the exact parameters of FRs have not been defined yet. There are differing views on the nature and holders of these rights.[71] The FAO, in its initial articulation of the concept, defined FRs as rights arising from the past, present and future contributions of farmers, particularly those in centres of origin and diversity, in conserving, improving and making plant genetic resources available. The rights are vested in the international community as trustee for present and future generations of farmers for the purpose of ensuring that full benefits accrue to farmers and support the continuation of their contributions.

In practice, FRs can take two forms. On the one hand, the contribution of a farmer identifying spontaneous mutants or making selections in field crops, tree or fruit species can be recognised in the same way as that of plant breeders. Alternatively FRs can be vested in communities of farmers as group rights assigned to the collective interests of those who have nurtured germplasm. In both cases, these rights entitle farmers to keep, use, exchange, share and market their seeds and plant reproductive material. They also include the right to reuse farm-saved seed known as the 'farmer's privilege', access by farmers to new technologies and other research achievements and the protection of local technologies, traditional cropping practices and other innovative systems.[72]

1.3.2 Sovereign rights

Permanent sovereignty over natural resources (PSNR) refers to the right to exploit and develop natural resources, including agro-biodiversity, according to each state's own policies. PSNR constitutes the basic principle for allocating rights and responsibilities in international law. States can, however, freely choose to restrict their sovereignty. In international environmental law, for instance, the ambit of permanent sovereignty has been redefined through the principle of common concern of humankind.[73] Thus, the conservation of biodiversity is recognised as a common concern of humankind, implying both a recognition of the global importance of biological diversity and a duty to cooperate in conserving and managing it. This principle seeks to facilitate and promote global cooperation for the conservation/management of in situ biological resources without forcing any given state to participate in this process. Reference to common concern is an acknowledgment that the management of a state's own environment and resources is a matter in respect of which all states have standing.[74] Insofar as ex situ biological resources are concerned, access is still governed by the principle of common heritage.

[70] See e.g., Res 5/89, 'Farmers' Rights', 29.11.89, *Report of the Conference of FAO*, 25th Session, Rome, 11–29.11.89, Doc C89/REP. See also, K.T. Kate and C.L. Diaz, 'The Undertaking Revisited—A Commentary on the Revision of the International Undertaking on Plant Genetic Resources for Food and Agriculture', 6 *RECIEL* 284 (1997).

[71] See, B. Greengrass, 'UPOV and Farmers' Rights' in M.S. Swaminathan (ed), *Agro-biodiversity and Farmers' Rights* (Delhi: Konark, 1996), p 50.

[72] See, K. Riley, 'Farmers' Rights, CGIAR and IPGRI' in M.S. Swaminathan (ed), *Agro-biodiversity and Farmers' Rights* (Delhi: Konark, 1996), p 57.

[73] See, Preamble, Biodiversity Convention, supra n 2.

[74] See, A.E. Boyle, 'The Convention on Biological Diversity' in L. Campiglio et al (eds), *The Environment After Rio—International Law and Economics* (London: Graham & Trotman, 1993), p 111.

Despite the international trend towards considering the management of biological resources as an issue of common concern, sovereignty is still an important basis for regulating access to these resources. The Andean Group's Decision on access to genetic resources, for instance, takes the view that states have permanent sovereignty over genetic resources and are the only authorised entities for facilitating and regulating access to genetic resources.[75] This is significant because access for the purposes of the Decision includes genetic resources both in situ and ex situ and their derivatives and intangible components.[76] The ambit of access under the Decision is thus broader than under the Biodiversity Convention.[77]

2. The Legal and Institutional Framework for the Regulation of Agro-Biodiversity

The legal and institutional framework for the regulation of agro-biodiversity is laid out in various international environmental agreements. The regime has been characterised by a marked dichotomy between instruments emphasising conservation of agro-biodiversity, such as the African Convention on the Conservation of Nature and Natural Resources,[78] and those emphasising exploitation, such as the UPOV Convention.[79] Conservation has traditionally been associated with nature preservation in pristine conditions which is perceived as being incompatible with any human subsistence activities. Exploitation for its part has been primarily identified with the extraction of agro-biodiversity resources driven by economic incentives. In recent years, however, the regime has been influenced by the concept of sustainability which specifically seeks to reconcile exploitation and conservation. With respect to agro-biodiversity, sustainability refers to the use of its components by present generations in such a way as to maintain its potential yield for future generations.[80] The Convention on Biological Diversity, for instance, includes conservation, exploitation and sustainable use among its objectives.[81] In practice, however, sustainability remains an elusive concept since the distinction with both conservation and exploitation is not always clear. Further, the regime has emphasised the contribution of plant breeders by granting them legal rights and ignored the role of farmers and local communities.

On another level, the regime remains unclear as to the ownership of agro-biodiversity resources. While states in principle insist on their sovereign rights over all their natural resources, these rights have been qualified in some respects. The notion of common concern of humankind embodied in the Biodiversity Convention, for instance, constitutes one such qualification. The uncertainty as to the precise content of the principle of permanent sovereignty over natural resources makes it difficult to determine what duties states have vis-à-vis agro-biodiversity resources.

[75] See, Articles 5 and 32, Common Regime on Access to Genetic Resources, Decision 391, Andean Group, 2.7.96, Caracas [hereafter Decision 391].
[76] See, Article 1, Decision 391, supra n 75.
[77] Cf, Article 15, Biodiversity Convention, supra n 2.
[78] See, African Convention on the Conservation of Nature and Natural Resource, Algiers, 15.9.68, 1001 UNTS 3.
[79] See, UPOV Convention, supra n 62.
[80] See, United Nations, supra n 1.
[81] Article 1, Biodiversity Convention, supra n 2.

2.1 The international undertaking on plant genetic resources

The International Undertaking on Plant Genetic Resources (IU) was adopted by the FAO Conference in 1983.[82] Its main objective was to ensure that PGRs are explored, preserved, evaluated and made available for plant breeding and scientific purposes. It relates to PGRs of all species of economic and/or social interest, particularly for agriculture, and refers particularly to food crops.[83] It accepted the principle that PGRs are a heritage of humankind which should be made available without restriction.[84] The emphasis on the free availability of PGRs spelt out in the 1983 version of the IU proved to be unacceptable to some developed countries. The reason for this was that the IU included within the ambit of free availability not only traditional cultivars and wild species but also varieties developed by scientists in the North. In fact, the implementation of the International Fund for Plant Genetic Resources established by the FAO to facilitate the implementation of the IU proved to be very difficult. Broader acceptance of the Undertaking was only achieved after interpretative resolutions were passed by the Conference of the FAO in 1989 and 1991.[85] These resolutions affirmed the sovereign rights of countries over their PGRs and qualified the principle of free availability by recognising plant breeders' rights (PBRs) (protected, for instance, under the UPOV Convention) and farmers' rights.[86] The recognition of property rights implies the right to compensation for access to PGRs and associated products.[87]

Further revision of the IU has been prompted by the growing importance of PGRs at the international level and the coming into force of the Biodiversity Convention which raised the need to harmonise relevant provisions of the two regimes.[88] Negotiations that are currently underway for a comprehensive revision have been characterised by divergent positions of different groups of countries. Indeed, while the Conference of the FAO called for a revision of the IU as early as 1993, it is only in 1997 that serious negotiations started on substantive issues. In the negotiations, a lot of attention has been devoted to the extremely sensitive Articles 11 and 12 of the IU which deal with access to genetic resources and farmers' rights. The proposed Article 11 of the IU currently entitled 'Access to plant genetic resources for food and agriculture' is partly modelled on Article 15 of the Biodiversity Convention. The proposal explicitly links the two instruments by indicating that parties shall facilitate access to Plant Genetic Resources for Food and Agriculture (PGRFA) without imposing restrictions that run counter to the Convention.[89]

[82] International Undertaking for Plant Genetic Resource, Res 8/83, *Report of the Conference of FAO*, 22nd Session, Rome, 5–23.11.83, Doc C83/REP [hereafter International Undertaking].

[83] Article 2(2), International Undertaking, supra n 82.

[84] Article 1, International Undertaking, supra n 82.

[85] Agreed Interpretation of the International Undertaking, Res 4/89, *Report of the Conference of the FAO*, 25th Session, Rome, 11–29.11.89, Doc C89/REP and Annex 3 to the International Undertaking on Plant Genetic Resources, Res 3/91, *Report of the Conference of the FAO*, 26th Session, Rome, 9–27.11.91, Doc C91/REP.

[86] See, Res 4/89 and Res 3/91, supra n 85.

[87] See e.g., Revision of the International Undertaking Mandate, Context, Background and Proposed Process, Commission on Plant Genetic Resources, First Extraordinary Session, Rome, 7–11.11.94, Doc CPGR-Ex1/94/3.

[88] See e.g., Preamble to the Resolution 7/93, Revision of the International Undertaking on Plant Genetic Resources, *Report of the Conference of FAO*, 27th Session, Rome 6–24.11.93, Doc C93/REP.

[89] See, Revision of the International Undertaking on Plant Genetic Resources–Consolidated Negotiating Text Resulting from the Deliberations During the Fifth Extraordinary Session of the Commission on Genetic Resources for Food and Agriculture, Doc CGRFA/IUND/CNT/Rev 1.

The call for easier and faster access to genetic resources has been matched by calls for strengthening private rights. Since the scope and content of PBRs has already been defined in the UPOV context, the FAO has mainly concentrated on farmers' rights. Discussions on the recognition and formulation of farmers' rights have proceeded very slowly and an agreement on the definition of farmers' rights is yet to be reached.

2.2 The International Convention for the Protection of New Varieties of Plants

The International Convention for the Protection of New Varieties of Plants (UPOV Convention) was adopted in 1961 and its standards were developed until recently mainly among a small group of OECD countries. Membership has increased significantly over the past few years and now includes a number of eastern European and Latin American countries. The Convention recognises the rights of individual plant breeders who have developed or discovered plant varieties which are new, distinct, uniform and stable.[90] It seeks to protect new varieties of plants both in the interest of agricultural development and of plant breeders. The 1978 and 1991 revisions set out the minimum scope of protection that states must grant. The former expanded the number of criteria that a plant variety must meet in order to qualify for PBRs. These include an element of distinctness, homogeneity, stability, commercial novelty and the submission of an acceptable denomination. The latter provides that parties are free to protect plant varieties by PBRs or other types of IPRs such as patents. States may also grant simultaneous protection to the same plant variety by more than one type of IPRs.[91] Further, it extends breeders' rights to all production and reproduction of their varieties, to species and specific plant varieties. The remaining exceptions to commodification include acts done privately and for non-commercial purposes, experiments, and breeding and exploitation of other varieties.[92] The successive revisions of the UPOV Convention have blurred the line between patents and PBRs, the latter being now almost similar to patents.[93] Breeders are granted exclusive rights to harvested materials and the distinction between discovery and development of varieties has been eliminated.[94]

2.3 International trade in agro-biodiversity

Historically trade in agricultural products was not included in the General Agreement on Tariffs and Trade as food self-sufficiency was usually considered to be a matter of national security.[95] Intensified competition between the US and the EU

[90] See, Article 5, UPOV Convention, supra n 62.

[91] See, B. Greengrass, 'The 1991 Act of the UPOV Convention', 13 *Eur Int Prop Rev* 466 (1991).

[92] 'Keystone Dialogue: Oslo Report, 1991' in M.S. Swaminathan and S. Jana (eds), *Biodiversity—Implications for Global Food Security* (Madras: Macmillan, 1992).

[93] See, Greengrass, supra n 91.

[94] See e.g., G.S. Nijar and C.Y. Ling, 'The Implications of the Intellectual Property Rights Regime of the Convention on Biological Diversity and GATT on Biodiversity Conservation: A Third World Perspective' in A.F. Krattiger et al (eds), *Widening Perspectives on Biodiversity* (Geneva: International Academy of the Environment, 1994), p 277.

[95] See, J.J. Steinle, 'The Problem Child of World Trade: Reform School for Agriculture', 4 *Minnesota J Global Trade* 333 (1995).

for exports markets in agricultural products and the mounting costs of farm subsidies led the two main players in world agricultural trade to see the need for a different strategy. As a result, agricultural trade was included in the Uruguay Round negotiations and the GATT 1994 Agreement includes an Agreement on Agriculture which seeks to bring agricultural products within the purview of the world trade regime.[96] More specifically, it treats agricultural products more similarly to manufactured products and forces member states to reduce tariffs on agricultural products. It also endeavours to limit and reduce domestic and export subsidies.[97]

One of the significant implications of GATT 1994 for international trade is the strengthening and harmonisation of IPRs through the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS).[98] The TRIPS Agreement was the result of an initiative by developed countries to introduce more stringent IPR rules in trade to extend the security offered to the private sector through IPRs on an international level. In the case of patents, member states must now, for instance, extend protection to products and processes in all fields of technology.[99]

2.4 The Convention on Biological Diversity

The Biodiversity Convention seeks to promote the conservation of biodiversity, the sustainable use of its components and the fair and equitable sharing of benefits arising from the use of the resources, including appropriate access to genetic resources and transfer of relevant technologies.[100] The Convention also recognises the sovereign rights of states to the resources found within their territories and private/individual rights to biological resources and products emanating therefrom.[101] This implies identifying sources of genetic materials which is a virtually impossible task for most modern high yielding varieties that incorporate genetic materials from numerous sources.[102]

At a general level states are responsible for conserving their biological resources in a sustainable manner utilising both in situ and ex situ conservation measures.[103] Secondly, states have both sovereign rights over and authority to determine access to genetic resources found within their boundaries.[104] Article 15 deals specifically with access to genetic resources and provides that the authority to determine access to genetic resources rests with national governments and is subject to national legislation. It also provides that the state concerned should facilitate access to those

[96] 'Agreement on Agriculture' in *General Agreement on Tariffs and Trade: Multilateral Trade Negotiations Final Act Embodying the Results of the Uruguay Round of Trade Negotiations*, Annex 1A, Marrakech, 15.4.94, reprinted in 33 ILM 1125 (1994). See also, N. Grimwade, *International Trade Policy—A Contemporary Analysis* (London: Routledge, 1996).

[97] Articles 3(1), 6 and 8 of the Agreement on Agriculture, supra n 96.

[98] 'Agreement on Trade-Related Aspects of Intellectual Property Rights' in *General Agreement on Tariffs and Trade: Multilateral Trade Negotiations Final Act Embodying the Results of the Uruguay Round of Trade Negotiations*, Annex 1C, Marrakech, 15.4.94, reprinted in 33 ILM 1125 (1994) [hereafter TRIPS Agreement].

[99] Article 27, TRIPS Agreement, supra n 98.

[100] Article 1, Biodiversity Convention, supra n 2

[101] See generally, Articles 15 and 16, Biodiversity Convention, supra n 2.

[102] See e.g., J.A. McNeely, 'How the Convention on Biological Diversity can Promote Ethics and Equity in the Conservation of Genetic Resources' in *Ethics and Equity in Conservation and Use of Genetic Resources for Sustainable Food Security* (Rome: International Plant Genetic Resources Institute, 1997), p 51.

[103] Articles 8 and 9, Biodiversity Convention, supra n 2.

[104] See, Article 15, Biodiversity Convention, supra n 2.

resources for environmentally sound uses by other contracting parties. It further seeks to ensure the enjoyment of the benefits accruing from the use of the resources to the state providing them.

Beyond states and private individuals, the Convention recognises both the dependence of local communities on biological resources and the roles that these communities play in the conservation and sustainable use of the resources. It further points to the need for equitable sharing of benefits arising from the use of their traditional knowledge, innovations and practices, relevant to the conservation of biodiversity and the sustainable use of its components.[105]

With reference to agro-biodiversity, the Convention recognises the critical importance of facilitating access to genetic resources and technologies to ensure that the food, health and other needs of a growing world population are met.[106] Further, the Biodiversity secretariat has established a programme on agro-biodiversity. It aims, first, at promoting the positive effects and mitigating the negative impacts of agricultural practices on biological diversity in agricultural ecosystems and their interface with other ecosystems. Secondly, it seeks to promote the conservation and sustainable use of genetic resources of actual or potential value for food and agriculture. Finally, it promotes the fair and equitable sharing of benefits arising out of the utilisation of genetic resources.[107] In seeking to operationalise this programme, the fourth Conference of Parties called upon states, funding agencies, the private sector and non-governmental organisations to join efforts in identifying and promoting sustainable agricultural practices, integrated management of agriculture and natural areas, as well as appropriate farming systems to reduce possible negative impacts of agricultural practices on biological diversity and enhance the ecological functions provided by biological diversity to agriculture.[108]

2.5 The Consultative Group on International Agricultural Research

The Consultative Group on International Agricultural Research (CGIAR) was established in 1971 and was renewed in 1995 with the mission to contribute to 'increasing and protecting agricultural productivity, safeguarding natural resources, and helping to achieve people-centered policies for environmentally sustainable development'.[109] More specifically, it aims at alleviating poverty, achieving food security and assuring sustainable use of natural resources.[110] The rationale for the existence of the CGIAR is that agricultural research has a positive impact on food security, income and employment generation, conservation of natural resources and the environment and

[105] Preamble §12 and Article 8(j), Biodiversity Convention, supra n 2.

[106] Para 20, Preamble, Biodiversity Convention, supra n 2. See also, Resolution 3, 'The Interrelationship Between the Convention on Biological Diversity and the Promotion of Sustainable Agriculture', 22.5.92, in *Nairobi Final Act of the Conference for the Adoption of the Agreed Text of the Convention on Biological Diversity* (1992).

[107] See, Decision III/11, 'Conservation and Sustainable Use of Agricultural Biological Diversity' in *Report of the Third Meeting of Conference of the Parties to the Convention on Biological Diversity*, Buenos Aires, 4–15.11.96, UN Doc UNEP/CBD/COP/3/38.

[108] See, Decision IV/6, supra n 6.

[109] See, Lucerne Declaration and Action Programme, supra n 45.

[110] Declaration and Plan of Action for Global Partnership in Agricultural Research adopted by the Consultative Group on International Agricultural Research, 31.10.96, at http://www.cgiar.org/gforum/globfor.htm (visited 31.3.99).

should therefore be enjoyed by all.[111] The CGIAR has indirectly become an important player in the conservation of genetic resources through its network of PGR collections in CGIAR Centres.[112] In recent years, the CGIAR has reinforced its collaboration with other institutions active in the field of PGRs. Thus, in a bid to contribute to the practical implementation of the Biodiversity Convention, it set up in 1994 a System-Wide Genetic Resources Programme. This Programme aims at enhancing the efficiency, effectiveness and transparency of CGIAR contribution to the Biodiversity Convention and Agenda 21 through scientific, technical and policy research, the development of information systems, and institution and capacity strengthening.[113]

3. Critique of the Existing Legal Framework

Agro-biodiversity is dealt with in numerous contexts. A number of instruments, such as the Biodiversity Convention or the UPOV Convention are of direct relevance to its management, while a number of international institutions, from the FAO to the CGIAR, have important stakes there. The sectoral mandates of each of these institutions and instruments ensures that no comprehensive strategy for addressing the loss of agro-biodiversity and its sustainable management has been adopted. This also leads to tensions between the different regimes in place. This has, for instance, been the case with the Biodiversity Convention and the International Undertaking.

3.1 Over-emphasis on private property rights regimes in agro-biodiversity management

Current property rights regimes concerned with the management of agro-biodiversity fail to foster their sustainable use and conservation. They favour exploitation modes which focus on the commercial potential of the resources and neglect their use to satisfy basic subsistence needs. They thus concentrate on commercial agriculture and overlook the contribution of local managers of agro-biodiversity such as farmers. More specifically, it is apparent that the emphasis on private rights and the more stringent protection they receive at both the domestic and international levels constitute a major impediment to the sustainability of agro-biodiversity management. It has, for instance, been noted that current IPR systems reinforce the tendency of plant breeding to decrease genetic diversity as these systems encourage the production and dissemination of new varieties which often replace the more diverse landraces.[114]

[111] Consultative Group on International Agricultural Research, *Annual Report 1996* (1997).

[112] W.B. Lacy, 'The Global Plant Genetic Resources System: A Competition—Cooperation Paradox', 35 *Crop Science* 335 (1995).

[113] See e.g., International Agricultural Research Centres of the Consultative Group on International Agricultural Research, CGIAR, Doc ICW/97/08.

[114] See e.g., D. Leskien and M. Flitner, *Intellectual Property Rights and Plant Genetic Resources: Options for a* Sui Generis *System* (Rome: International Plant Genetic Resources Institute, 1997), p 68 stating that: 'IPR are certainly not an effective instrument to conserve biological diversity or promote its sustainable use.' See also, 'Keystone Madras Dialogue 1990' in M.S. Swaminathan and S. Jana (eds), *Biodiversity—Implications for Global Food Security* (Madras: Macmillan, 1992).

Further, the current IPR regime may have other negative consequences. Firstly, IPRs entail restrictions on access to agro-biodiversity which may reduce the overall flow of innovation and improvement.[115] Secondly, they may widen the gap between nations and individuals which can compete in agricultural trade and the vast majority of farmers who do not benefit from an IPR regime and operate mainly on the basis of sharing of knowledge.[116] Finally, the protection afforded by IPRs currently excludes genetic resources. This is premised on the need to keep access to genetic resources free to ensure that scientific research is not stifled by the erection of barriers such as property rights and the attendant requirement to pay for those resources.[117] It is however remarkable that the 'non-protection' only applies to resources harnessed by non-commercial actors, such as farmers, and therefore implies that farmers in developing countries subsidise the commercial agricultural sector which appropriates most benefits deriving from the resources.[118]

The overemphasis on private property rights is even more significant because the current international legal regime tends to completely overlook the rights of local communities and more generally of groups in agro-biodiversity management. While international law in general tends to sideline groups, the omission in the context of agro-biodiversity is noteworthy because the contribution of a given individual to the development of new varieties is often difficult to assess. Finally, and as a consequence of the emphasis on private rights, the current regime overlooks the issue of benefit sharing. At present, most benefits are channelled to the holders of IPRs while the farmers who create and maintain landraces are left out. It is clear that the sustainability of agro-biodiversity management necessitates the recognition of the immense role played by the multitude of actors around the world who create, maintain and manage agro-biodiversity directly.

3.2 Limitations of private property rights regimes in agro-biodiversity management

Current property rights regimes in agro-biodiversity management emphasise the roles played by individuals, the private sector and states. The Biodiversity Convention reaffirms the sovereign rights of states to their natural resources while establishing that the management of biodiversity is a common concern of humankind. Common concern is also based on state sovereignty. Both have however failed to engender sustainable management of agro-biodiversity resources. This is due to the fact that state monopoly over natural resources does not ensure equal access for all and in some cases is used as a medium for facilitating the transfer of the resources to private enterprises.[119]

Private property rights, specifically IPRs, have been suggested as an alternative to state ownership. As noted above, the main rationale for IPRs in agro-biodiversity

[115] Esquinas-Alcázar, supra n 29.
[116] See, G.K. Veeresh (discussant), 'Discussion' in M.S. Swaminathan (ed), *Agro-biodiversity and Farmers' Rights* (Delhi: Konark, 1996), p 63.
[117] See, Barton, supra n 55.
[118] See, Balakrishnan, supra n 67.
[119] See, C. Singh, *Common Property and Common Poverty—India's Forests, Forest Dwellers and the Law* (Delhi: Oxford University Press, 1986).

is to encourage the involvement of the private sector in agriculture. The focus on novelty, exclusivity and individual contribution excludes the collective work of local communities and farmers from being the basis for IPRs and being acknowledged. IPRs are incapable of recognising incremental improvements or innovations by farmers. Further, given that the grant of IPRs is premised on exclusivity, they cannot by definition reward the work of groups. This is, for instance, illustrated by the case of a patent granted for a composition of neem, citronella and cedarwood oils with insect repellent properties.[120] More generally, the extension of private rights such as IPRs to agro-biodiversity in the absence of a framework for the equitable sharing of benefits and compensation to countries that have conserved and nurtured it could result in the erection of formidable barriers to accessing these resources. Indeed, if the patent system is applied universally to living matter including plants and animals, and their genetic resources, the principle of unrestricted access will be severely eroded.

The strengthening of IPRs in recent international agreements such as the Biodiversity Convention, the TRIPS Agreement and the UPOV Convention is likely to have significant impacts on the sustainable management of agro-biodiversity. For instance, even though Article 8 of the TRIPS Agreement provides that member states can adopt measures to protect public health and nutrition, they still have to comply with the TRIPS regime which seeks to promote effective and adequate protection of IPRs globally. Further, new developments like the invention of the so-called terminator technology may also dramatically change farmers' agricultural practices. Through this technology, seed companies can control the viability of progeny seed without harming the crop by genetically altering the seed so that it does not germinate if replanted a second time.[121] Widespread use of such technology would mean greater dependence of farmers on the commercial seed market and could result in the diminution of their age-old right to save seed from their harvest.

In response to widespread criticism of IPRs, a number of proposals have been suggested to either make IPRs more responsive to the contribution of different actors in a process of discovery or to create alternative systems which reward farmers, local communities or indigenous peoples.[122] Farmers' rights are, for instance, being considered in this context. They focus on the individual and collective contributions of farmers in the management of agro-biodiversity. In one sense, FRs thus constitute a kind of IPR recognising different conceptions of novelty and a broader set of actors.[123] The rationale for FRs is to give farmers rights that are similar in nature to those of commercial plant breeders. The main shortcoming of such proposals, even when couched as FRs, is that they do not recognise that IPRs are fundamentally incapable of valuing the contribution of diffuse groups such as farmers.

[120] US Patent No 5,885,600, *Natural Insect Repellent Formula and Method of Making Same*, issued 23.3.99.
[121] See, US Patent 5,723,765, *Control of Plant Gene Expression*, issued 3.3.98.
[122] See, Jacoby and Weiss, supra n 56.
[123] See, V. Shiva, 'Agricultural Biodiversity, Intellectual Property Rights and Farmers' Rights', XXXI/25 *Econ Pol Wkly* 1621 (22.6.96).

3.3 Limited purview of biotechnology

The current legal framework for the regulation of agro-biodiversity defines biotechnology in narrow terms and does not recognise farmers' breeding activities as biotechnology. This has significant implications for agro-biodiversity activities in developing countries which are unlikely to widely apply the biotechnologies currently recognised because of the high inputs of finance and skilled work forces required.[124] A wider definition of biotechnology as consisting of a wide range of techniques involving living organisms, or substances from those organisms as a means of production should be adopted. More specifically, biotechnology should not be equated with genetic engineering but should be perceived as an enabling technology whose techniques are used to make or modify a product, to improve plants or animals or to develop micro-organisms for specific uses such as acting on the environment.[125] Such a broader definition would include both the work of farmers and genetic engineering. Indeed, both have the potential to make significant contributions to the development of both food and cash crops. In the latter case, yield enhancement through biotechnology is of great importance to countries whose economic development is heavily dependent on export earnings from a few commodity crops.[126]

3.4 The dominance of commercial interests

One of the main shortcomings of the legal framework currently regulating agro-biodiversity is its emphasis on commercial breeding activities and its neglect of the activities of farmers and local communities. The emphasis on private sector activities has progressively steered the regime away from concerns to satisfy basic human needs and towards the promotion of commercial interests and high-technology agriculture. Commercial agro-biodiversity activities are secured through IPRs which provide incentives for private sector involvement in agriculture driven primarily by profit motivation rather than by the search for ways to improve food yields for humankind. The harmonisation of IPR regimes across the globe under TRIPS also benefits commercial agro-biodiversity activities. In the US, for instance, seed corporations have tried to stop farmers from saving or reselling proprietary seeds by using intellectual property laws that make it illegal for farmers to reuse or sell harvested seeds for reproductive purposes.[127]

Such trends reduce the autonomy of both farmers and nation state governments around the world and makes them more dependent on industry-owned biotechnology.[128] For instance, with the opening up of trade in agriculture under GATT 1994, the room for governments, especially in developing countries, to intervene and control agro-biodiversity activities is greatly circumscribed while facilitating the entry into local markets of crop and livestock varieties owned by agri-

[124] See, Smith, supra n 15.
[125] See, Avramovic, supra n 17.
[126] See, Altman, supra n 14.
[127] See, Plant Variety Protection Act, 7 USC §2541 and *Asgrow Seed Company v Denny Winterboer and Becky Winterboer*, 115 S Ct 788 (1995).
[128] See, Kothari, supra n 34 concerning India.

businesses. These varieties are likely to displace traditional varieties and lead to further homogenisation and erode the genetic base on which scientists depend for continuous improvement of crops and livestock. This trend is not sustainable in long run because traditional varieties provide the genetic stock for most high yielding varieties.

4. The Way Ahead

4.1 Towards sustainable management of agro-biodiversity

4.1.1 Sustainability and food needs

While the loss of biodiversity in the wild has been recognised as a major problem facing the world today and solutions sought to stem the problem, the loss of diversity within agricultural systems through monocropping, for instance, has been given less prominence. This may be partly due to the persistence of a conservation ethic that perceives agriculture as inimical to biodiversity preservation. While there is undoubtedly a case to be made for biodiversity preservation, agro-biodiversity also needs to be preserved and nurtured. Further, it is noteworthy that agro-biodiversity is on-farm biodiversity and has to be considered in computing the general erosion of biodiversity. For instance, genetic erosion occurs when local farmers abandon local varieties for high yielding varieties or when intensive farming of monocultures displaces diverse crop species.[129]

Stemming the erosion of agro-biodiversity calls for, among other things, using sustainable agricultural strategies such as shifting cultivation, agro-ecosystems incorporating fallow periods, mixed-cropping systems and pastoral forms of agriculture. All the crops we use today exist largely as a result of breeding efforts within these systems.[130] Sustainable agricultural strategies generally aim at maintaining or regenerating the environment and its natural resource base and have thus essentially similar objectives as 'ecological agriculture'.[131] To cope with environmental stresses and changes in the environment, they use both genetic diversity between crop species and genetic diversity within species namely, landraces.[132]

It is noteworthy that, sustainability in the management of agro-biodiversity cannot be dissociated from human food needs. Indeed, sustainable management of agro-biodiversity has to be principally guided by the need to meet world food needs.[133] The emphasis on commercial agriculture to the detriment of local agro-biodiversity management strategies does not generally address these concerns. Similarly, the growth of international trade in agriculture primarily driven by the

[129] See, Bosselmann, supra n 64. See also, Consultative Group on International Agricultural Research, supra n 111.

[130] See e.g., M. Van Montagu, 'Plant Biotechnology: Historical Perspective, Recent Developments and Future Possibilities' in S. Sterckx (ed), *Biotechnology, Patents and Morality* (Aldershot: Ashgate, 1997), p 55.

[131] J.J. Hardon, 'Ethical Issues in Plant Breeding, Biotechnology and Conservation: A Review' in *Ethics and Equity in Conservation and Use of Genetic Resources for Sustainable Food Security* (Rome: International Plant Genetic Resources Institute, 1997), p 43.

[132] Kothari, supra n 34.

[133] As recognised by Article 1, Decision 391, supra n 75.

need to maximise profits does not necessarily imply that all humankind has access to food. For instance, lower commodity prices tend to force farmers to extend the area devoted to cash crops which directly translates into a diminution of the area devoted to food crops.[134]

4.1.1 The need for more research in agriculture

Agricultural research should receive more attention than at present, given that it is intrinsically linked to the fulfilment of basic human food needs. In the genetic engineering sector, for instance, health related research has been much more actively pursued than in the agricultural sector. While the meeting of basic food needs for all, which can be fostered through improved agricultural techniques, constitutes one of the best strategies to combat a number of health problems, research budgets do not seem to follow such strategies.

A second reason to emphasise agricultural research is the important environmental impacts of agricultural activities overall. As noted, agriculture constitutes one of the prime causes of biodiversity loss upon which it relies for its long-term sustainability. More research should thus aim at reconciling sustainable agro-biodiversity and biodiversity management.

4.2 Towards new forms of property rights for agro-biodiversity

4.2.1 Beyond conventional property rights

We noted above the emphasis on private property and sovereign rights in agro-biodiversity management. Given the involvement of farmers and local communities in the management of agro-biodiversity, it is important to devise ownership regimes that recognise their contribution as well as provide them with the necessary incentives to continue nurturing agro-biodiversity. It is imperative that we separate their rights to land from their rights to the work of their hands and intellect. With respect to the latter, the rights to be granted to farmers should be tailored to suit the organisation of the farmers' communities. More specifically, farmers' and local communities' rights should not be grafted onto existing IPR regimes which are inherently incapable of protecting these rights. This necessitates changes in perceptions of farmers and local communities as a distinct group of breeders with rights to their innovations.

Different kinds of rights for farmers and local communities have been proposed. Some authors recommend 'traditional resource rights' comprising a bundle of rights which protect, conserve and compensate for knowledge and resources of local communities.[135] Others propose community intellectual rights which reward whole communities who are awarded ownership of their inventions. Recognition is here given to the incremental and dynamic nature of their work, without ignoring past, present and future contributions.[136] While these proposals focus on the

[134] See, M. Mazoyer and L. Roudart, 'L'asphyxie des économies paysannes du Sud', 523 *Monde diplomatique* 19 (1997).

[135] See, D.A. Posey and G. Dutfield, *Beyond Intellectual Property—Toward Traditional Resource Rights for Indigenous Peoples and Local Communities* (Ottawa: International Development Research Centre, 1996).

[136] M. Baumann et al, 'Choices' in M. Baumann et al (eds), *The Life Industry: Biodiversity, People and Profits* (London: Intermediate Technology, 1996).

extension of ownership rights to farmers and local communities, they also emphasise monetary compensation as a way of operationalising the rights.

All these recommendations lean heavily on developments in private rights, especially IPRs and consequently suffer from the same general shortcomings. They are conceptually based on the idea of treating agro-biodiversity as tradable commodities and restricting access of non-owners to the resources. Alternative solutions based on commonality of interests at international and local levels should be pursued.

4.2.2 Common heritage: A solution for the future?

The failure of current regimes for the management of agro-biodiversity to foster sustainability calls, however, for the development of new mechanisms. As recognised in the IU, agro-biodiversity is in essence a common heritage of humankind. Agro-biodiversity is a common good on which humankind depends to meet its basic needs for survival. Further, most areas of the world are dependent to a high level on genetic material obtained from other countries and continents for their main crops. Allocating rights equitably to agro-biodiversity would thus be a monumental task because separate developments on similar crops are carried out at the same time in different areas. Indeed, the contribution of any given farmer, scientist or country in the development of a given variety is extremely difficult to assess.[137]

Moreover, since the primary aim of the international legal regime should be to meet the food needs of every individual, areas that are well-endowed in natural resources should not be allowed to restrict the flows of agro-biodiversity resources. The notion of common heritage in this regard implies that the resources are not owned by a single entity and are available on an unrestricted basis to all. Thus the principle of solidarity which has been recognised as a basic tenet of international law should form the basis for assigning rights to agro-biodiversity resources. More specifically, we contend that granting individual farmers PBRs or other IPRs does not address these concerns and further that FRs being weaker than PBRs, do not constitute an appropriate solution and would at most disrupt sustainable agricultural management systems by drawing farmers and local communities into the PBR and IPR net.

Common heritage status, however, does not imply open access. Rights to the resources need to be defined and must benefit all the actors in agro-biodiversity since they all have the capacity to contribute to solving the food deficit problem. Primary stakeholders include, for instance, farmers and commercial breeders. Our contention here being that all users should have free access to the existing pool of knowledge, there is no need to define either individual or group rights.

Farmers constitute a diffuse community in both spatial and temporal terms. First, farmers in different parts of the world may be actively involved in breeding activities on similar crops, given that most major food crops are today present in more than one area. Second, farmers' knowledge represents past and present contributions and constitutes the basis for work by future generations. Con-

[137] See e.g., Commission on Genetic Resources for Food and Agriculture, Possible Formulas for the Sharing of Benefits Based on Different Benefit-Indicators, Rome, 8th Session, Rome, 19-23.4.99, Doc CGRFA-8/99/8.

sequently, inter- and intra-generational equity cannot be adequately addressed through the allocation of private rights.

In our view, instead of extending forms of property rights, such as IPRs, which seek to restrict the flows of knowledge and agro-biodiversity resources, the international legal framework should rather foster free exchange and unrestricted access. This would both be consistent with the fact that individual contributions are difficult to assess and with the idea which still informs the IARCs' work that free availability of existing materials to researchers and farmers constitutes the best way to solve the food deficit problem at local and international levels. Further, we emphasise that for the principle of common heritage of humankind to apply equitably, it should cover both the resources got from farmers and the resultant technologies developed by commercial breeders. This is essential for the promotion of food security even though it may remove incentives for private sector involvement in agriculture.

5. Conclusions

The international legal framework currently governing agro-biodiversity management emphasises private property rights. While it has provided incentives for the private sector to participate in agriculture and thus catalysed a commercial seed industry, it has failed to promote the work of local managers of agro-biodiversity, namely local farmers and communities. The emphasis on commercial biotechnology has promoted trade in agricultural products but generally not contributed to meeting the food needs of every human being. Further, it has contributed to the erosion of the genetic base necessary for the further development of agro-biodiversity.

The legal framework can only foster the fulfilment of everyone's food needs if it transcends conventional property rights and recognises the rights of all actors involved in the management of agro-biodiversity. The recognition of agro-biodiversity as a common heritage of humankind to be freely exchanged and accessed on an unrestricted basis would go a long way towards meeting these goals. The principle of common heritage of humankind should apply equally to the resources and techniques got from farmers and to the resultant technologies developed by commercial breeders.