BEYOND ACCESS AND BENEFIT-SHARING: LESSONS FROM THE LAW AND GOVERNANCE OF AGRICULTURAL BIODIVERSITY

Elsa Tsioumani

ERC Research Fellow, BeneLex project
Strathclyde Centre for Environmental Law and Governance
elsa.tsioumani@strath.ac.uk
elsa@iisd.org

Acknowledgement: This article is part of a research project titled 'BeneLex: Benefit-Sharing for an Equitable Transition to the Green Economy: The Role of Law,' funded by the European Research Council (November 2013–October 2018). Further information on BeneLex is available at <http://www.strath.ac.uk/research/strathclydecentreenvironmentallawgovernance/benelex/> [accessed on 15 April 2017]. The author is grateful to two anonymous reviewers, as well as Fabien Girard, Christine Frison, Elisa Morgera, Annalisa Savaresi and Saskia Vermeylen, for their insightful comments.

Elsa Tsioumani is currently an ERC Research Fellow at the Strathclyde Centre for Environmental Law and Governance, exploring applications of fair and equitable sharing of benefits in the areas of land, food and agriculture. She has been a team leader, writer and editor for IISD Reporting Services since December 1999, following international developments on biodiversity in a number of fora, including the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture. Elsa has been practicing law in the Bar of Thessaloniki, Greece, since 1998, and has been consulting for international organizations and NGOs on environmental and human rights issues. A member of the IUCN Specialist Group on access and benefit-sharing, she has authored extensively on international and European environmental law and policy, particularly with regard to biodiversity, genetic resource governance, and indigenous peoples' rights.

Beyond Access and Benefit-Sharing: Lessons from the Law and Governance of Agricultural Biodiversity

Abstract

The concept of fair and equitable benefit-sharing emerged in the early 90s as a corollary to the principle of national sovereignty over natural and genetic resources. In the context of agricultural biodiversity use, it can be conceptualized in three ways: as a defensive tool to balance the injustices enshrined in the intellectual property rights system; as a development tool to reap part of the benefits of the emerging biodiversity market; and as an incentive, to reward and enable farmers' continued contribution to conservation. This article seeks to assess the potential of the concept in operationalizing fairness and equity in agricultural biodiversity governance, in an increasingly complex legal and policy landscape of conflicting rights and policies. It briefly explains its emergence in the context of the evolving principles of governance of agricultural biodiversity; and analyses the structure and application of the Multilateral System of Access and Benefit-sharing established by the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) in the framework of intellectual property- and human rights-related processes. Identifying linkages, challenges and key lessons, which are useful for a wide range of processes within and beyond the international environmental law realm, it concludes that the concept falls short of its promises. It thus calls for imagining new dialogues and concepts to redefine the boundaries between what must remain in the public domain, what may be managed as a common and what may be privatized.

Keywords agricultural biodiversity; International Treaty on Plant Genetic Resources for Food and Agriculture; intellectual property; human rights; access; fair and equitable benefit-sharing

Agriculture in the 21st century faces multiple challenges. It needs to produce more food to feed a growing population and more feedstocks for a potentially huge bioenergy market, with a smaller rural labour force. It needs to contribute to overall development in many agriculture-dependent developing countries. It needs to adopt more efficient and sustainable production methods in the face of reduced resources and increased environmental pressures. It also needs to adapt to climate change (FAO, 2009). In other words, the world needs to produce more food, using fewer resources, in a more challenging environment and in a context of globalization, rapid urbanization, growing inequities and insecure land tenure (IAASTD, 2008, pp. 2-3). Never before has it been more important for humanity to generate, use fairly and share equitably the benefits of, agricultural production, technology and knowledge.

Agricultural biodiversity is the foundation of all agricultural production. The term is not defined in the Convention on Biological Diversity (CBD).[1] Subsequent decisions of the CBD Conference of the Parties however may be used to interpret the term (Brunnée, 2000). Agricultural biodiversity is therefore understood as:

> a broad term that includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems, also named agro-ecosystems: the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem, its structure and processes (CBD, 2000, Appendix).

Agricultural biodiversity is the outcome of interactions among genetic resources, the environment, and the knowledge, management systems and practices used by farmers. It represents an excellent example of the potential for positive interaction between humans and nature (Pimbert, 1999). It is inextricably linked both to the local environment and climate, and to human ingenuity and cultural preferences.

In the form of seeds or other plant propagating material, plant genetic resources for food and agriculture (PGRFA) are the necessary building blocks for crop improvement, and thus the world's agriculture and food production. PGRFA are used either by farmers on farm aiming at maintaining the quality and yield of their crops or by professional breeders in ex situ facilities. As such, they play a crucial role in farmers' livelihoods, agricultural development and world food security (FAO, 2010).

Crucially, unlike other natural resources, plant genetic resources are renewable, and usually a very small quantity is required for breeding, research and development. The economic benefit is largely linked to the information contained in the resource, rather than the resource

itself (Guneratne, 2012, p. 69). In addition, the final product can be used as propagating material and vice versa. Another characteristic of PGRFA is that conservation and use are linked: conservation is performed through use, and unless an agricultural variety is used, it cannot be conserved for more than a few decades before it eventually dies (FAO, 2012, pp. 29-35). Traditional crop varieties serve as reservoirs of agricultural biodiversity, providing a much required safety valve in the face of pests, diseases and environmental stresses. In addition, as modern varieties often rely on the traits of traditional ones, traditional varieties and the knowledge they embody are considered vital resources also for scientific agricultural research (Tsioumani et al, 2016, p. 14). PGRFA are thus important both as an immediate resource, as they each have particular characteristics which are used in plant breeding, and as an insurance against future needs and challenges.

The privatization of plant varieties through intellectual property rights resulted in rising justice-related concerns, which provided the context for the emergence of the principle of national sovereignty over natural and genetic resources. The principle of national sovereignty aimed to defend the rights of countries providing such resources. On this basis, a series of multilateral environmental agreements established legal systems of regulated access to genetic resources and fair and equitable sharing of the benefits arising from their use.

In an increasingly complex legal and policy landscape of conflicting rights and policies, this article assesses application of the concept of fair and equitable benefit-sharing (Tsioumani, 2014a; Morgera, 2016) in agricultural research and development, with focus on PGRFA. Consideration of animal and aquatic genetic resources or micro-organisms of relevance for food and agriculture is therefore excluded. First, the article briefly explains the emergence of the concept in the context of the evolving principles of governance of agricultural biodiversity. Second, it addresses the Multilateral System (MLS) for access to and fair and equitable benefit-sharing (ABS) from the use of plant genetic resources of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA),[2] which is arguably the most sophisticated ABS system in international law (Halewood et al, 2013b; Kamau and Winter, 2013; Guneratne, 2012; Biber-Klemm and Cottier, 2006; Chiarolla, 2012; Correa, 1999; Helfer, 2004; Raustiala and Victor, 2004; Oberthür et al, 2011; Oguamanam, 2006; Cabrera Medaglia et al, 2013; Chiarolla et al, 2013; Morgera et al, 2014). Third, it explores (lack of) benefit-sharing applications in intellectual property rights (IPR) instruments, and related human rights concerns. Identifying challenges and key lessons which can be useful for a wide range of processes within and beyond the international environmental law realm, it concludes that, despite promise and good intentions, the concept of fair and equitable benefit-sharing has failed

to inject fairness and justice in agricultural research and development, or promote agrobiodiversity conservation, including through ensuring the continued contribution of smallholder farmers.

2. THE EVOLUTION OF THE GLOBAL GOVERNANCE OF PLANT GENETIC RESOURCES

2.1 Informal seed systems and public agricultural research

Since the earliest crop domestications, agricultural development has been based on farmers' traditional varieties, developed through collective systems of innovation and conservation through seed saving, sharing and use (Halewood et al., 2013a). Exchanges were regulated on a customary basis, largely at the community level, and included both informal ones and more organized systems, such as seed fairs and community seed banks.

A series of historic events led to the transformation of agriculture and the global redistribution of plant genetic resources for food and agriculture (PGRFA). Colonization resulted in a vast flow of agricultural species from the Americas to Europe and from South to North. Botanic gardens and other ex situ facilities were established, mainly in the North, which stored samples of agricultural varieties coming mainly from developing countries, the centres of domestication of major agricultural crops. During the 20th century, the green revolution dramatically transformed agriculture through scientific and technological advances, including modern plant breeding. The professionalization of breeding and the emergence of the commercial seed sector had both environmental and social consequences. The uniformization promoted by the spread of commercial varieties led to erosion of agricultural biodiversity (i.e. the loss of genetic diversity) and thus the vulnerability of agricultural production in the face of threats such as pests, diseases and extreme environmental and climatic conditions (FAO, 1993; Moore and Tymowski, 2005, pp. 3-4). At the same time, customary farmer practices and varieties and traditional seed systems were marginalized in favour of scientific, public or corporate-led research, and in cases criminalized, following the emergence of varieties protected by intellectual property rights (IPRs) (Tsioumani et al, 2016; Chiarolla, 2012; De Schutter, 2009; Mooney, 1998). The generally high price of modern agricultural inputs, including seed, increased social inequalities regarding income and access to technology, and had impacts regarding land ownership and tenure (Griffin, 1974; Dahlberg, 1979; Glaeser, 1987). Access to markets was also limited due to stringent seed certification regulations, and marketing and food safety

standards (Le Courtois et al, 2011; Lee et al, 2010; Tsioumani, 2016b). These trends put at risk the livelihoods of smallholder farmers, in developing but also in developed countries.

The need for continued exchanges of material in the context of the green revolution and the realization of the risks of genetic erosion provided the basis for the international regulation of PGRFA and the establishment of the Consultative Group on International Agricultural Research (CGIAR) in 1971 (Tsioumani, 2016; Özgediz, 2012). The international agricultural research centres under the auspices of the CGIAR stored a large percentage of the world's agricultural germplasm (Fowler et al, 2000; Pistorius, 1997, p. 33; Fowler, 1994). At the time, international law was silent with respect to the conditions for access to and use of PGRFA, both in situ and in the CGIAR system. Similarly, most national legislations did not regulate access to PGRFA, either in situ or in genebanks. PGRFA were thus considered to be in the public domain, available to anyone for any purpose, without benefit-sharing or conservation obligations (Halewood et al, 2013a: 12). Still, most agricultural research at the time was conducted by public institutions, and the results of the work were shared (Rose 2004).

2.2 The privatization trend

The growing application of IPRs and the gradual privatization of agricultural research and development resulted in tensions that challenged the CGIAR practices. At the core of the tensions were perceived inequities concerning who bore the cost of conservation and who benefitted more from its use, arguably private companies in developed countries. Besides, concerns about the risk of the commodification of PGRFA intensified as a result of the case of *Diamond vs. Chakrabarty* in the US, which opened the way to the patenting of living organisms (Kevles, 1994; Carolan, 2010; Jasanoff, 2001).

IPRs are supposed to foster and reward creativity and innovation, including to address global challenges such as food security. The IPRs mainly in use in the field of agricultural development are plant breeders' rights (PBRs) and patents, and they have been widely criticized as designed to suit the needs of developed countries. They have been associated with reducing the developmental choices of developing countries, intensifying control by agrochemical companies, raising the cost of agricultural inputs, and risking the food security of vulnerable groups, including smallholder farmers (Correa, 1995; Dutfield, 2000; Commission on Intellectual Property Rights, 2002; Drahos and Braithwaite, 2002; Drahos, 1996). Farmers' varieties do not satisfy the criteria for protection and cannot be covered by either PBRs or patents, they were thus further marginalized.

Plant breeders' rights were established by the 1961 International Convention for the Protection of New Varieties of Plants (UPOV Convention), which promoted a system of private ownership 'with the aim of encouraging the development of new varieties of plants for the benefit of society' (UPOV Mission Statement). Standards adopted under the UPOV Convention, which was amended in 1972, 1978, and 1991, provide protection to novel (in terms of prior commercialization) and distinct, uniform and stable plant varieties. Farmers' varieties are deemed to lack novelty, following the assumption that farmers do not conduct on-farm seed improvement (although many do)[3] and are rarely uniform, thus they cannot satisfy the UPOV criteria for protection.

UPOV membership was boosted with the adoption of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) by the World Trade Organization (WTO) in 1994, as WTO Member States are required to provide for the protection of plant varieties either by patents or by an effective *sui generis* system[4]. Although countries are free to identify a system to suit their particular agricultural and socioeconomic conditions, UPOV, as a ready-made framework, is obviously an easy choice (Correa et al, 2015). Ratification seems to be promoted also by technical advice provided to developing countries (De Schutter, 2009). Furthermore, ratification of UPOV 1991 or adoption of complying legislation is promoted by developed countries through free trade agreements, while bilateral pressure is also exerted to introduce patent protection for plants, animals and biotechnological innovations, exceeding even the TRIPS standards (Heath and Kamperman Sanders, 2007; GRAIN, 2014; Correa, 2009; Brennan and Kilic, 2015). Developing country membership is thus constantly increasing.

Exceptions to PBRs, including the permitted use of protected varieties as the source material of further breeding (breeders' exception) and the re-use of saved seeds by farmers (farmers' privilege) have been gradually restricted in the subsequent revisions of the Convention. Similar exceptions aiming to protect farmers' and breeders' activities are more limited under patent law, as patents allow its holder to exercise the greatest control over the use of patented material.

Protecting plant-derived innovations under patent regimes requires an applicant to demonstrate novelty, an inventive step, and the potential for industrial application. At the moment, to the authors' knowledge, patents on conventional plant varieties are allowed in the United States, Japan, South Korea and Australia. With the breakthrough of modern biotechnology in the 1990s however, the patent subject matter expanded dramatically, with an ever-increasing number of patents to cover not only transgenic plants but also particular plant

traits and parts, components such as genes, plant breeding methodologies, and vectors and processes involved in the production of transgenic plants (Tsioumani et al, 2016). Geographical application also expanded, as transgenic plants became patentable in Europe (Crucible II Group, 2000; Dutfield, 2010).[5]

A vast literature examines ethical considerations and fairness- and equity-related concerns posed by IPRs granted for living organisms (Nuffield Council on Bioethics, 2002). These concerns are exacerbated by the (mis)application of the IPR system, dubbed as 'biopiracy'[6] (Mooney, 1998; Aoki, 1998). In addition, 'IPRs appear to slow the free flow of germplasm exchange, slow the diffusion of new knowledge, upset the balance between basic and applied research, and erode scientific integrity' (Hess, 1993, p. 128), posing obstacles to public research.

However, it was mainly the misappropriation and privatization of genetic resources and traditional knowledge that resulted in rising equity and justice-related concerns: farmers and governments in developing countries realized that the introduction of IPRs resulted in a major asymmetry, noting that 'their raw materials were to be exchanged freely while patents were to be placed upon the finished varieties' (Mooney, 1983, p. 24), restricting their availability. This was considered as unfair and inequitable or at least morally unjust from the perspective of provider countries and farmers. It was also a major attack to the previous treatment of PGRFA and related knowledge as public goods. Following the acknowledgment of the need for some form of legal arrangement regarding access to stored germplasm, the International Undertaking on Plant Genetic Resources for Food and Agriculture was adopted in 1983.

2.3 The attempt for a common heritage approach

The non-binding International Undertaking attempted to apply the principle of common heritage to PGRFA, declaring that 'plant genetic resources are a heritage of mankind and consequently should be available without restriction'.[7] Significantly, the principle of common heritage would cover all plant genetic resources, including 'newly developed varieties'.[8] The initial strategic and legal response was thus not to restrict access or share the benefits of PGRFA but make them freely accessible to farmers and breeders around the world (Kloppenburg, 2014; Aoki, 2009). This – retrospectively radical – approach can be explained in the light of the asymmetry introduced by IPRs: the main problem was not that seed companies were using PGRFA for free, but that they were restricting access to materials that, as a matter of reciprocity, ought to have been shared.

The framework established by the Undertaking sought to benefit humanity as a whole, and 'to support major increases in agricultural production, especially in developing countries'.[9] However, distribution of the benefits was left to national governments' responsibility,[10] and no mechanism was established to address the needs of specific fractions of humanity (i.e. most vulnerable or less equipped for agricultural research and development). An internationally coordinated network of centers, including the pre-existing CGIAR centers, would operate under the FAO auspices and assume the responsibility to hold PGRFA collections 'for the benefit of the international community and on the principle of unrestricted exchange'.[11] The absence of formal benefit-sharing arrangements lies in the strong belief that benefits would flow to developing countries in the form of distribution of PGRFA and related information, in light of the envisioned unrestricted exchanges of material and the CGIAR centre's open-access policy.

Noble in its intentions, the architecture seemed to ignore the global inequities regarding distribution of the infrastructures, knowledge and skills, which are necessary to make use of an open system such as the one created by the Undertaking (Louafi and Welch, 2014). It further revealed the central weakness of the common heritage approach in international law: that it is largely motivated by States' desire for access to resources rather than by genuine community interest in their protection (Brunnée, 2008).

The International Undertaking did not resolve the impasse between developed and developing countries largely associated with IPRs and equity-related concerns. Eight developed countries signed it with reservations,[12] reluctant to allow the principle of common heritage to apply to modern varieties, and giving priority to IPRs. Developing countries, in turn, considered impractical the attempt to apply the principle of common heritage against IPRs. Identifying themselves as providers and thus owners of genetic resources, they pushed for application of the principle of national sovereignty over natural and genetic resources, eventually embedded in the CBD.

2.4 The nationalization trend

If IPRs created a major enclosure to the previous systems of exchange, the principle of national sovereignty over natural and genetic resources aimed to defend the rights of countries providing such resources by creating a second, *defensive enclosure*. In the words of Halewood et al., 'if developed countries were able to exercise restrictive control over advanced biologically based technologies using intellectual property rights, developing countries could

exercise their sovereign rights to regulate and restrict access to the biological and genetic resources within their borders' (Halewood et al, 2013b, p. 6).

The CBD, a legally binding treaty, recognizes that the authority to determine access to genetic resources rests with national governments and is subject to national legislation. The Convention introduced the concepts of the prior informed consent of the country providing such resources and of the fair and equitable sharing of the benefits arising from their commercial or other utilization upon mutually agreed terms between the provider and the user.[13] Establishing a bilateral model of exchanges of genetic resources, it also refers prominently to fair and equitable benefit-sharing as its third objective.[14] Benefit-sharing is thus linked to the principle of national sovereignty, and appears to have a *balancing* function against the privatization of genetic resources via IPRs.

The shift in principles can be further justified due to the growing expectations of the commercial value of biodiversity (Petit et al, 2001; Batta Bjørnstad, 2004) and its potential use for development purposes (Raustiala and Victor, 2004). The emergence of the biotechnology industry in the 1990s and of a market for biodiversity-based products was at the centre of these expectations. Benefit-sharing in this sense would be linked not only to the commercialization of biodiversity-based products but also to the emergence of market-based approaches to biodiversity management, such as payments for ecosystem services (Morgera, 2016).

In conclusion, the concept of fair and equitable benefit-sharing in the context of agricultural biodiversity use can be conceptualized as following: linked to the principle of national sovereignty, as a defensive tool to balance the injustices enshrined in the IPR system; and linked to development purposes, as a tool to benefit from the emerging biodiversity market. A third conceptualization can be found under the ITPGRFA concept of farmers' rights,[15] which understands benefit-sharing as a tool to reward farmers and enable their continued contribution, thus linking it to conservation concerns and rural livelihoods.

Were developing countries accurate in their expectations? Adoption of the CBD was considered a victory for the developing world, but did adoption of the TRIPS Agreement mean that many of these gains were weakened (Aoki, 2009)? The next section will assess multilateral application of the benefit-sharing concept at the inter-State level, on the basis of a technical analysis of the MLS.

3. GOVERNANCE OF AGRICULTURAL BIODIVERSITY AND FAIR AND EQUITABLE BENEFIT-SHARING

The current picture of global governance of agricultural biodiversity, from conservation to use in research and development, is largely defined by the CBD, the ITPGRFA, and IPR-related instruments. While fair and equitable benefit-sharing is an objective of environmental treaties, the concept is not enshrined in the IPR instruments.

3.1 The ITPGRFA Multilateral System of Access and Benefit-Sharing

The shift in principles triggered by the CBD negotiations had an immediate influence on the FAO realm. With the adoption of the CBD, the Nairobi Final Act[16] recommended adjusting the International Undertaking in line with the CBD, providing the basis for the negotiations of the ITPGRFA.

The objectives of the ITPGRFA are the conservation and sustainable use of PGRFA and the fair and equitable sharing of the benefits arising out of their use, in harmony with the CBD, for sustainable agriculture and food security.[17] The core of the Treaty is the MLS, which facilitates access to, and exchange of, a specified list of crops in Annex I considered vital for food security and agricultural research. It also institutionalizes the sharing of the benefits arising from the utilization of these resources: the Treaty regulates both monetary and non-monetary benefit-sharing (i.e. exchange of information, access to and transfer of technology, and capacity building). In addition, facilitated access to PGRFA in Annex I is recognized as a benefit in itself (Tsioumani, 2004).[18]

The MLS aimed to respond to the specificities of agricultural biodiversity and the 'public good' nature of PGRFA and basic scientific research in general (Cooper et al, 1994; Halewood et al, 2013b), for which the CBD bilateral system of exchanges was considered unsuitable (Chiarolla et al, 2013). PGRFA exchange is indispensable for the continuation of agricultural research, as well as for the adaptation of key crops to the new conditions brought about by climate change, and plant pests and diseases. Moreover, when it comes to crop genetic resources, all countries are interdependent and identification of the country of origin is often difficult, given the millennia of agricultural history.[19]

Collections of Annex I crops that are under the management and control of Parties and in the public domain, as well as those held by the CGIAR centers and other international institutions that have signed agreements with the Treaty's Governing Body, are to be automatically included in the MLS and exchanged using the Standard Material Transfer Agreement (SMTA).[20] The SMTA is a standardized private law contract between a provider and recipient (user) of material.[21] Other holders, including the private sector, are *encouraged* to include such material in the system to achieve larger coverage. Their contributions are thus

voluntary. While providers are usually public or international genebanks, users can be organizations, private entities or individuals. In practice, mostly public-sector breeders use the MLS (López Noriega et al, 2013; ITPGRFA, 2015).

Monetary benefit-sharing is currently operated through the Benefit-sharing Fund (FAO, 2006). The original idea was that this fund would be replenished through user-based payments on the basis of the SMTA provisions, following commercialization of products developed from material accessed through the MLS. The SMTA provides for mandatory payments to the Benefit-sharing Fund according to two monetary benefit-sharing options:
- a default scheme, according to which a recipient that commercializes a plant product incorporating material from the MLS that is *not available to others for further research and breeding* (i.e. it is patented) will pay 1.1% of gross sales to the Treaty's Benefit-sharing Fund, less 30% (to cover expenses), i.e. 0.77%[22] (Moore and Goldberg, 2010); and
- an alternative scheme, whereby recipients pay 0.5% of gross sales on all products of the species they accessed from the MLS, regardless of whether the products incorporate the material accessed and regardless of whether or not the new products are available without restriction.[23]

Voluntary payments are encouraged when a recipient commercializes a plant product that incorporates material from the MLS if that product is *available without restriction* to others for further research and breeding.[24]

Under the direction of the Governing Body and through a project-based approach (FAO, 2007), the Benefit-sharing Fund would then allocate the acquired funds to particular activities designed to support farmers and breeders in adapting crops to changing needs and demands, farmers in developing countries in particular. A lack of conceptual clarity is observed: Monetary benefit-sharing refers both to the *accumulation* of monetary benefits through the SMTA (user-based benefit-sharing) and to the *distribution* of monetary benefits through the Benefit-sharing Fund.

The projects funded through the Benefit-sharing Fund produce both improved genetic resources – which are to enrich the MLS – but also non-monetary benefits, such as information or training. Such non-monetary benefits are being generated and shared despite the fact that Parties' obligations to share non-monetary benefits are linked to other mechanisms and not to the Benefit-sharing Fund directly (Galluzzi et al, 2014), blurring the lines between monetary and non-monetary benefit-sharing and highlighting the close interlinkages between relevant mechanisms. The Global Information System for instance is the mechanism specifically built for information exchange (Ker et al, 2013).[25]

It can be argued that non-monetary benefit-sharing can be used to build the capacities required for facilitated access to, and use of, PGRFA, which could potentially result in commercialization and monetary benefit-sharing (Louafi, 2013). Non-monetary benefit-sharing, in the form of information exchange, technology transfer and capacity building, is thus instrumental in addressing the unequal capacities of countries and communities to benefit from the ITPGRFA, and thus bridging the capacity, fairness and equity gap in agrobiodiversity conservation and agricultural research and development.

A set of challenges have however arisen with regard to the ability of the MLS to generate and share monetary benefits (Frison et al, 2011). As a result, no user-based payments have been realized since the Treaty's entry into force. The Benefit-sharing Fund has been operating solely on the basis of donor country voluntary contributions (ITPGRFA, 2013; Tsioumani et al, 2017). The sub-sections below address legal and policy challenges related to the accumulation and the distribution of monetary benefits.

3.1.1 Accumulation of Benefits

The lengthy time-period required for research, development and commercialization partly explains the failure to generate and share commercial benefits from the SMTA (ITPGRFA, 2013). There is more than that though. The first challenge concerns the relationship between benefit-sharing and IPRs. Monetary benefit-sharing takes the form of *compensation* when material is taken out of the MLS, i.e. when there is a restriction in use associated with the patenting of PGRFA. Such restrictions are arguably incompatible with the open exchange systems needed for food security and agricultural biodiversity conservation (Louafi and Welch, 2014). This illustrates a *fundamental contradiction* inherent in the Treaty system: monetary benefit-sharing was designed as a central tool for revenue generation to fund the ITPGRFA goals; at the same time, monetary benefit-sharing is tied to restrictions in use, which threaten the very essence of the system and its goal of food security, by impoverishing its material base (Helfer, 2003; Frison, 2016). It may also be seen as an indication that Treaty drafters designed monetary benefit-sharing as a *disincentive* to patenting,[26] prioritizing continued unrestricted exchanges of PGRFA for research and breeding.

A series of additional factors greatly impact effectiveness of the system (Frison, 2016). First, coverage of the MLS is not comprehensive. It does not cover certain major crops, such as soybean, sugarcane, tomato and coffee. Notably, some of these crops attracted significant research effort resulting in patented material, and their inclusion could result in mandatory benefit-sharing payments according to the SMTA obligations. It is however precisely because of the high commercial interest that some developing countries excluded

these crops from the MLS, aiming for higher gains through bilateral transactions under the CBD terms. Second, as noted above, the MLS only covers public and CGIAR collections of Annex I PGRFA. This means that most material in the MLS is available elsewhere, and can be accessed without adherence to the benefit-sharing terms of the SMTA. Third, many Parties to date failed to notify the Secretariat of their PGRFA that are included in the MLS, thus making this material inaccessible to users due to lack of awareness. That said, ratification by the US in March 2017 is expected to close one of the major loopholes and allow for more comprehensive coverage, once the country's vast crop collections are notified to be included in the MLS.

On the user side, in practice most of the organizations that choose to take material from the MLS and incorporate it in new products do *not* restrict access to the improved material for further research and breeding purposes and are thus not obliged to share monetary benefits. Commercial users who would be more likely to trigger monetary benefit-sharing requirements have consistently chosen to access material from other sources, not the MLS (CGIAR, 2015).

A series of studies undertaken in the ITPGRFA framework has explored obstacles to the realization of monetary benefits and confirmed that projections of benefit flows will be 'moderate at best,' and will take even longer than expected (Moeller and Stannard, 2013). As a result, in 2013 the Governing Body established an intersessional process aiming to 'enhance the functioning the Multilateral System.' Consequently, a Working Group was specifically mandated to develop measures aiming to increase user-based payments and contributions to the Treaty's Benefit-sharing Fund, as a priority, as well as 'additional measures' to enhance the functioning of the Multilateral System. These 'additional measures' are understood as referring to a possible expansion of the Annex I list of crops. This item remains highly controversial. Developing countries consider the generation and sharing of tangible financial benefits on the basis of the current list a necessary prerequisite for any discussion on expanding coverage. For better or for worse, the underlying sentiment of biodiversity-rich countries is that expansion of the Annex I list of crops limits their possibilities to gain from their resources by striking bilateral agreements with users (Tsioumani, 2014b).

Research has suggested that upfront payments with no or low restrictions in use may be better suited to generate benefits, ensure continued exchanges and increase legal certainty (Seyoum and Welch, 2013). Indeed, the Working Group has agreed that the best way forward is to elaborate a subscription system for access to PGRFA in the MLS, meaning that subscribed users would need to pay *before* access (Tsioumani, 2015). The ITPGRFA

Governing Body then requested it to develop such a subscription system and incorporate it into a revised SMTA (FAO, 2016).

3.1.2 Distribution of Benefits

Distribution of monetary benefits is operated through the Benefit-sharing Fund via a project-based approach. The Benefit-sharing Fund is mandated to prioritize projects that support not only the conservation and sustainable use of agricultural biodiversity, but also the livelihoods of farmers and rural communities. According to the Treaty text,[27] benefits should flow primarily, directly and indirectly, to farmers, particularly farmers in developing countries who still conserve and sustainably utilize PGRFA in their fields.

Twenty-two projects were funded under the third cycle. Most of them are run by international and national agricultural research centers, two are run by NGOs, and one by an association of indigenous organizations.[28] Channelling benefits to farmers is easier said than done, given the limited capacities of most farmer communities and organizations to reach international funding through the complex Benefit-sharing Fund application and project execution procedures. While this project-based approach arguably combines elements of inter-state benefit-sharing regulation with implementation at the local level, its results illustrate the challenges that an international organization faces to reach directly communities on the ground, and vice versa.

An additional challenge lies in the diversity of the ITPGRFA system users. The Treaty serves a wide and diverse set of users in the entire spectrum of agricultural production, with different or contradictory needs: public research institutes, smallholder farmers, companies big and small, in developing and developed countries, actors engaged in commercial or non-commercial research, in formal and informal seed systems. The current realities of agricultural research and development, a sector characterized by high market concentration (Tsioumani et al, 2016), put at risk not only farmers' innovation but also public agricultural research. As a result, agricultural research centers in developing countries also compete for funding under the Treaty. The Treaty struggles to find and maintain a balance between modern scientific methods of identifying and developing new varieties on the basis of material in *ex situ* collections and farmers' traditional agro-ecological approaches. It remains a matter for consideration though whether the current approach serves well the objectives of sustainable agriculture and global food security (Swiss Government, 2015; Frison. 2016). It has been questioned for instance whether a competitive project-based approach is appropriate to meet challenges related to distributional equity, the public value of PGRFA and the

required cooperation among different States and actors to address food security concerns (Louafi, 2013).

3.2 IPR-related Instruments and Benefit-Sharing: UPOV and the TRIPS 'CBD Amendment'

Unlike the environmental treaties, there is no explicit requirement related to fair and equitable benefit-sharing in IPR instruments, the argument being that IP protection benefits society as a whole by promoting innovation. In the response of UPOV to the CBD Secretariat, requesting for contributions to the negotiations on access and benefit-sharing (UPOV, 2003; Cabrera Medaglia, 2010; Dutfield, 2011), UPOV highlights the importance of access to genetic resources to ensure progress in plant breeding and 'thereby to maximize the use of genetic resources for the benefit of society.' The breeder's exemption, whereby acts done for the purpose of breeding are not subject to any restriction, is considered to be an 'inherent benefit-sharing principle' (UPOV, 2003). Same goes for the compulsory exception to the breeder's right regarding acts done privately and for non-commercial purposes (which could apply to the activities of subsistence farmers) and the optional farmer's privilege to replant farm-saved seeds from a protected variety. The UPOV Council has expressed its concern over other benefit-sharing measures that could introduce barriers to progress in breeding.

Exceptions to patent holders' rights are even more limited. They can be introduced under the TRIPS Agreement,[29] but practice varies among WTO Member States and the WTO dispute settlement bodies interpret the provision narrowly (Yamane, 2011). In addition, the TRIPS Agreement does not require disclosure of prior informed consent of the country of origin and of benefit-sharing in patent applications involving use of PGRFA. Therefore, foreign companies may obtain private rights derived from national genetic resources without having to adhere to the CBD principles (Commission on Intellectual Property Rights, 2002). Although it can be argued that such access to resources may not be legitimate, enforceability of CBD principles is weak unless mandated and monitored by national legislation. In addition, the validity of the patent would be assessed on the basis of the legislation of the country that granted it, not the country that provided the genetic resource used.

Many analysts have argued that unless the TRIPS Agreement is amended to ensure respect for the CBD principles in the intellectual property field, the implementation and enforceability of such principles would remain elusive (Chouchena-Rojas et al, 2005). Importantly, such an amendment would allow access to the WTO dispute settlement system for breaches of the CBD requirements, as, unlike the CBD, TRIPS rules are enforced through

mandatory adjudication and retaliatory sanctions.[30] Several developing countries have thus called for an amendment to TRIPS by introducing requirements to disclose the origin of genetic material and evidence of prior informed consent and benefit-sharing in patent applications. The original proposal was supported by 110 WTO Member States by 2008, when a strategic alliance was made with the EU and Switzerland calling for a procedural decision to negotiate in parallel the biodiversity amendment and geographical indications. No progress has been achieved since.

Similar calls take place under the Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore (IGC) of the World Intellectual Property Organization (WIPO). Since 2010, the IGC undertakes negotiations on new patent disclosure requirements, where the MLS could be disclosed as the source of PGRFA.[31] While the pace of negotiations is extremely slow, reaching agreement in the WIPO context would change the course in the IPR realm.

Ample literature highlights that implementation of UPOV and TRIPS may result in contraventions to human rights (UNDP, 2000; Correa and Yusuf, 1998). The Sub-Commission on the Promotion and Protection of Human Rights of the former UN Commission on Human Rights has declared that there are apparent conflicts between the IPR regime and international human rights law, in relation to the transfer of technology to developing countries, the consequences of PBRs and the patenting of genetically modified organisms for the enjoyment of the right to food, biopiracy, and the reduction of communities' control over their genetic and natural resources and cultural values, etc.[32] (Weissbrodt and Schoff, 2003).

Former UN Special Rapporteur on the Right to Food Olivier De Schutter has criticized UPOV for restricting farmers' privilege, highlighting concerns arising from the strengthening of breeders' rights regarding the right to food. He further pointed to obstacles in public research caused by the intensification of IPRs, and to the need for a broad interpretation of the limitations that can be imposed to the patent rights-holder (De Schutter, 2009). Former UN Special Rapporteur on cultural rights Farida Shaheed also stressed tensions between IPRs and the right to benefit from scientific progress (Shaheed, 2012).

Finally, the presumption that innovation benefits society as a whole fails to acknowledge the well-documented fact that technologies 'such as high-yielding crop varieties, agrochemicals and mechanization have primarily benefited the better-resourced groups in society and transnational corporations, rather than the most vulnerable ones' (IAASTD, 2008, p. 23). It further ignores the question of distributing the benefits of

innovation to the most vulnerable groups of society, including smallholder farmers. De Schutter for instance has argued that the human rights framework requires investigating primarily *who benefits* from any technological advance, with the needs of the most vulnerable groups at the centre of attention (De Schutter, 2009).

4. CONCLUDING REMARKS

Fifteen years ago already, the Sub-Commission on Human Rights drew attention to the primacy of human rights obligations over economic policies and agreements, and requested the TRIPS Council to take fully into account existing State obligations under international human rights instruments. In the meantime, the international community seems to be taking the opposite direction. The WTO dispute settlement system is being used at full speed to enforce implementation of multilateral trade agreements, often against developing countries' efforts to provide food security for local populations; the activities of multinational companies remain largely outside the scope of international law (De Jonge, 2011); while a complex web of bilateral and regional trade and investment treaties build a WTO-plus global legal order enforced through arbitration tribunals, which limit national governments' regulatory choices outside whichever guarantees of equity and legitimacy multilateralism provides (Cotula, 2014). Trade and investment-oriented policies, including IPRs, are gaining a *de facto* supremacy over human rights and environmental treaties, because of their enforcement potential and the underlying power of actors and interests involved. At the same time, the dramatic extent of patent expansion and market concentration mean that enforcement of IPRs is not even needed, as 'the dominant oligopolists are in a position to dictate to farmers the very conditions of access to seed' (Kloppenburg, 2014, p. 1229), making at the same time public research on novel technologies virtually impossible (Tsioumani et al, 2016).

The concept of fair and equitable benefit-sharing was born in international biodiversity law in the early 90s with noble intent. In the meantime, however, the policy and legal landscape changed dramatically, first with the establishment of the WTO and adoption of the TRIPS Agreement and second through the intensification of neoliberal policies via bilateral and regional trade and investment agreements. Does the concept remain promising now, as it was at the times of its inception? Has it injected any fairness and justice in research and development sphere? Has it come up with a workable defence against IPRs?

Entered into force almost a decade after the CBD, the ITPGRFA has developed a highly sophisticated system to operationalize benefit-sharing at the inter-state level. However, while it has introduced a complex web of technical requirements to the exchange of PGRFA, it has not succeeded in legally enforcing user-based benefit-sharing (Kloppenburg, 2014).

To be fair, the MLS is a success in many ways. It has facilitated hundreds of thousands of exchanges of PGRFA, mainly to enable public agricultural research; it has further provided valuable support to build the capacities required for PGRFA utilization. It is thus instrumental in building endogenously-defined needs and capacities of countries and communities, and in reintroducing a sharing ethos in agricultural research and development by creating a global community. These successes however have been overshadowed by expectations for monetary benefits, in the context of growing inequities due to trade policies described above.

Should genetic resources, as renewable and non-rivalrous goods, be treated more like knowledge than like non-renewable and rivalrous natural resources? Governance of knowledge faces similar characteristics and similar challenges: governance is a global public good, the exchange of which would support solutions to global challenges, which however faces various IPR- and access-related restrictions. Opening a dialogue between the two sectors seems timely, particularly given the increasing 'dematerialization' of genetic resources, which risks undermining current benefit-sharing obligations and making the ITPGRFA and the CBD Nagoya Protocol on ABS[33] obsolete: synthetic biology techniques currently make possible the reconstruction of a genetic resource on the basis of its genetic information, which can easily be transferred electronically without physical access to the resource itself.

At this stage, sharing is in direct conflict with a political and economic system that is increasingly transforming genetic resources and knowledge into commodities. Two fundamental assumptions seem to collide. Does IP protection contribute to technological innovation and technology transfer as the TRIPS Agreement proclaims? Or does it hamper innovation as ample research suggests? Is there a way to bypass the IPR issue to promote biodiversity conservation and sustainable use, and transfer technology to that end? And does the currently highly proprietary environment allow us to even imagine the creation and protection of a global commons of plant genetic resources (Halewood, 2013)?

Ostrom distinguishes common property regimes from open-access systems: whereas in open-access systems no one has the legal right to exclude anyone from using a resource, in common property regimes the members of a clearly demarcated group have a legal right to

exclude non-members from using a resource (Hess and Ostrom, 2007). Can ideas arising from the commons literature, particularly the knowledge commons, be applied in the field of agricultural research (Frison, 2016)? While the picture of international law appears rather gloom at the moment, examples from the grassroots offer rays of hope. The seed inspires: moving away from the farmer archetype, new communities are being created, on the basis of values, not profit, and engage with exchanges of seeds and preservation of agricultural biodiversity. Inspired by the successful experience in the software realm, others partner to experiment with the open source development model. While such grassroots initiatives remain in an informal and largely unregulated sphere, their impact can be seen in the policy realm, with the CGIAR now changing its discourse to talk about research *for* development, and increasingly engaging in participatory plant breeding initiatives (Vernooy et al, 2015). Discussing and redefining the boundaries between what must remain in the public domain, what may be managed as a commons, and what can be privatized is now more than ever a critical issue for regulators and academics alike.

Notes

[1] UN Convention on Biological Diversity (CBD) 1992, 1760 UNTS 79.

[2] International Treaty on Plant Genetic Resources for Food and Agriculture 2001, S. Treaty Doc. No. 110-19

[3] I am grateful to the anonymous reviewer who drew my attention to this point.

[4] TRIPS Agreement Article 27(3)(b).

[5] Directive 98/44/EC of the European Parliament and of the Council of 6 July 1998 on the legal protection of biotechnological inventions, *OJ L 213*, 30.7.1998, p. 13–21.

[6] Biopiracy, a term originally coined by civil society organization ETC Group, refers to the appropriation of the knowledge and genetic resources of farming and indigenous communities by individuals or institutions that seek exclusive monopoly control (patents or IP) over these resources and knowledge.

[7] International Undertaking Art. 1.

[8] Art. 2(1).

[9] International Undertaking, Article 7(h)(ii).

[10] International Undertaking, Preamble.

[11] International Undertaking, Art. 7(a).

[12] Canada, France, Germany, Japan, New Zealand, Switzerland, the United Kingdom, and the United States.

[13] CBD Article 15.

[14] CBD Article 1.

[15] ITPGRFA Article 9.

[16] 1992 Nairobi Final Act of the Conference for the Adoption of the Agreed Text of the Convention on Biological Diversity, Resolution 3.

[17] ITPGRFA Article 1.

[18] ITPGRFA Articles 10-13.

[19] ITPGRFA Preamble.

[20] ITPGRFA Articles 11(2) and (5). In addition, the Governing Body has consistently endorsed use of the SMTA by the CGIAR centers for transfer of non-Annex I material collected before the Treaty's entry into force.

[21] ITPGRFA Governing Body Resolution 2/2006 (2006).

[22] SMTA Article 6(7) and Annex 2.

[23] SMTA Article 6(11).

[24] SMTA Article 6(8).

[25] ITPGRFA Articles 13(2)(a) and 17.

[26] I am grateful to former ITPGRFA Secretary Shakeel Bhatti for drawing my attention to this point.

[27] ITPGRFA Articles 13(3) and 18(5).

[28] The list of approved projects is available at http://www.planttreaty.org/sites/default/files/files/Third%20Call%20for%20Proposals-%20Projects%20approved%20for%20funding-for%20web.pdf (last visited 1 June 2016).

[29] Article 30 on Exceptions to Rights Conferred.

[30] WTO Agreement Annex 2, Understanding on rules and procedures governing the settlement of disputes.

[31] I am grateful to Claudio Chiarolla for drawing my attention to this point.

[32] Sub-Commission on the Promotion and Protection of Human Rights Resolution 2000/7, UN Doc. E/CN.4/Sub.2/2000/7.

[33] Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity 2010.

REFERENCES

Aoki, K. (1998). Neocolonialism, Anticommons Property, and Biopiracy in the (Not-so-Brave) New World Order of International Intellectual Property Protection. *Indiana Journal of Global Legal Studies*, 6(1), 11-58.

Aoki, K. (2009). "Free Seeds, not Free Beer": Participatory Plant Breeding, Open Source Seeds, and Acknowledging User Innovation in Agriculture. *Fordham Law Review*, 77(5), 2275-2310.

Batta Bjørnstad, S.-I. (2004). *A Breakthrough for 'the South'?: An Analysis of the Recognition of Farmers' Rights in the International Treaty on Plant Genetic Resources for Food and Agriculture*. FNI Report 13/2004, Lysaker: Fridtjof Nansen Institute.

Biber-Klemm, S., & Cottier, I. (eds) (2006). *Rights to Plant Genetic Resources and Traditional Knowledge: Basic Issues and Perspectives*. Wallingford: CABI.

Brennan, H. and Kilic, B. (2015). Freeing Trade at the Expense of Local Crop Markets? A Look at the Trans-Pacific Partnership's New Plant-Related Intellectual Property Rights from a Human Rights Perspective. *Harvard Human Rights Journal Online*, April 2015, 1-8.

Brunnée, J. & Toope, S. J. (2000). International Law and Constructivism: Elements of an International Theory of International Law. *Columbia Journal of Transnational Law*, 39(1), 19-74.

Brunnée, J. (2008). Common Areas, Common Heritage, and Common Concern. In Bodansky, D., Brunnée, J., & Hey, E. (eds). *The Oxford Handbook of International Environmental Law*. Oxford: Oxford University Press.

Cabrera Medaglia, J. (2010). The Relationship between the Access and Benefit Sharing International Regime and other International Instruments: the World Trade Organization and the International Union for the Protection of New Varieties of Plants. *Sustainable Development Law and Policy*, 10(3), 24-53.

Cabrera Medaglia, J., Tvedt, M.W., Frederic Perron-Welch, F., Jørem A. & Phillips, F.-K. (2013). *The Interface between the Nagoya Protocol on ABS and the ITPGRFA at the International Level*. FNI Report 1/2013, Lysaker: Fridtjof Nansen Institute.

Carolan, M.S. (2010). The Mutability of Biotechnology Patents. *Theory, Culture and Society*, (27)1, 110-29.

CBD Decision V/5 (2000). Agricultural biological diversity: review of phase I of the programme of work and adoption of a multi-year work programme, Appendix.

Chiarolla, C. (2012). *Intellectual Property, Agriculture and Global Food Security: the*

privatization of crop diversity. Cheltenham: Edward Elgar.

Chiarolla, C., Louafi, S., & Schloen, M. (2013). An Analysis of the Relationship between the Nagoya Protocol and Instruments related to Genetic Resources for Food and Agriculture and Farmers' Rights. In Morgera, E., Buck. M., & Tsioumani, E. (eds). *The 2010 Nagoya Protocol on Access and Benefit-sharing in Perspective: Implications for International Law and Implementation Challenges*, Leiden; Boston: M. Nijhoff.

CGIAR (2015). *Comments from the CGIAR Consortium and its 11 CGIAR Centers Hosting International 'In trust' Crop and Forage Collections (CGIAR) on Options Considered by the Ad Hoc Open-ended Working Group to Enhance the Functioning of the Multilateral System of Access and Benefit-sharing*. Available online at: https://library.cgiar.org/bitstream/handle/10947/3861/CGIAR%20paper%20on%20options%20considered%20by%20WG-EFMLS%20%28final%29.pdf?sequence=1 [Accessed on 15 September 2017].

Chouchena-Rojas, M., Muller, M.R., Vivas D. & Winkler, S. (2005). *Disclosure Requirements: Ensuring Mutual Supportiveness between the WTO TRIPS Agreement and the CBD*. Gland; Cambridge; Geneva: IUCN.

Commission on Intellectual Property Rights (2002). *Integrating Intellectual Property Rights and Development Policy*. Report of the Commission on Intellectual Property Rights. London: Commission on Intellectual Property Rights.

Cooper, D., Engels, J., & Frison, E. (1994). *A multilateral system for plant genetic resources: imperatives, achievements and challenges*. Issues in Genetic Resources No. 2, Rome: International Plant Genetic Resources Institute.

Correa, C. (1995). Sovereign and Property Rights over Plant Genetic Resources. *Agriculture and Human Values*, 12(4), 58-79.

Correa, C. (1999). *Access to Plant Genetic Resources and Intellectual Property Rights*, Background Study Paper no 8, Rome: FAO.

Correa, C. (2009). *Negotiation of a Free Trade Agreement European Union-India: Will India Accept TRIPS-Plus Protection?*. Berlin: Oxfam Deutschland.

Correa, C., Shashikant, S. & Meienberg, F. (2015). *Plant Variety Protection in Developing Countries: a Tool for Designing a Sui Generis Plant Variety Protection System: an Alternative to UPOV 1991*. Alfter: APBREBES.

Correa, C. & Yusuf, A. (eds) (2016). *Intellectual Property and International Trade: The TRIPS Agreement* (3rd edn.). Alphen aan den Rijn: Wolters Kluwer.

Cotula, L. (2014). Do Investment Treaties Unduly Constrain Regulatory Space?. *Questions of International Law, Zoom-in* 9, 19-31.

Dahlberg, K.A. (1979). *Beyond the Green Revolution. The Ecology and Politics of Global Agricultural Development*. New York; London: Plenum Press.

De Jonge, A. (2011). Transnational Corporations and International Law: Bringing TNCs out of the Accountability Vacuum. *Critical Perspectives on International Business*, 7(1), 66-89.

De Schutter, O., UN Special Rapporteur on the Right to Food (2009). *Seed Policies and the Right to Food: Enhancing Agrobiodiversity and Encouraging Innovation*. UN Doc A/64/170.

Drahos, P. (1996). *A Philosophy of Intellectual Property*. Aldershot: Dartmouth.

Drahos, P. & Braithwaite, J. (2002). *Information Feudalism: Who Owns the Knowledge Economy?*. London: Earthscan.

Dutfield, G. (2000). *Intellectual Property Rights, Trade and Biodiversity: seeds and plant varieties*. London: Earthscan for IUCN.

Dutfield, G. (2011). *Food, Biological Diversity and Intellectual Property: The Role of the International Union for the Protection of New Varieties of Plants (UPOV)*. Intellectual Property Issue Paper Number 9. Geneva; New York: Quaker United Nations Office.

FAO (1993). *Harvesting Nature's Diversity*, Rome: FAO.

FAO (2006). *Report of the First Session of the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture*. FAO Doc IT/GB01/06/Report.

FAO (2007). *Report of the Second Session of the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture*. FAO Doc IT/GB-2/07/Report.

FAO (2009). *Global Agriculture towards 2050*. Rome: FAO.

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

FAO (2012). *Conservation and Sustainable Use under the International Treaty*. Available online at: http://www.fao.org/docrep/016/i2579e/i2579e.pdf [Accessed on 10 September 2017].

FAO (2016). *Report of the Sixth Session of the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture*. FAO Doc IT/GB-6/16/Report.

Fowler, C. (1994). *Unnatural Selection: Technology, Politics and Plant Evolution*, Yverdon: Gordon and Breach.

Fowler, C. Smale, M., & Gaiji, S. (2000). *Germplasm Flows between Developing Countries*

and the CGIAR: An Initial Assessment, Dresden: Global Forum on Agricultural Research Technical Report.

Frison C. (2016). *Towards Redesigning the Plant Commons: A Critical Assessment of the Multilateral System of Access and Benefit-Sharing of the International Treaty on Plant Genetic Resources for Food and Agriculture*. PhD Thesis. Leuven: UCLouvain / KU Leuven.

Frison C., López F., & Esquinas-Alcázar J., T. (eds) (2011). *Plant Genetic Resources and Food Security: Stakeholder Perspectives on the International Treaty on Plant Genetic Resources for Food and Agriculture*. Issues in Agricultural Biodiversity. Washington, DC: Routledge/Earthscan, FAO and Bioversity International.

Galluzzi, G., López Noriega, I. & Halewood, M. (2014). *Non-monetary benefit sharing mechanisms within the projects funded by the Benefit Sharing Fund*. Research Study 6, Rome: FAO.

Glaeser, B. (ed.) (1987). *The Green Revolution Revisited: Critique and Alternatives*. London: Allen and Unwin.

GRAIN (2014). *Trade Agreements Privatising Biodiversity*. Update of November 2014. Available online at: https://www.grain.org/attachments/3247/download [Accessed on 10 September 2017].

Griffin, K. (1974). *The Political Economy of Agrarian Change: an essay on the green revolution*. London: Palgrave; United Nations Research Institute for Social Development.

Guneratne, C. (2012). *Genetic Resources, Equity and International Law*. Cheltenham: Edward Elgar.

Halewood, M. (2013). What kind of goods are plant genetic resources for food and agriculture? Towards the identification and development of a new global commons. *International Journal of the Commons*, 7(2), 278-312.

Halewood, M., López Noriega, I., & Louafi, S. (eds) (2013a). *Crop Genetic Resources as a Global Commons*. Oxon: Routledge.

Halewood, M., Andrieux, E., Crisson, L., Gapusi, J.R., Mulumba, J.W., Kouablan Koffi, E., Dorji, T.Y., Bhatta, M.R. & Balma, D. (2013b). Implementing "Mutually Supportive" Access and Benefit Sharing Mechanisms under the Plant Treaty, Convention on Biological Diversity, and Nagoya Protocol. *Law Environment and Development Journal*, 9(1), 68-96.

Heath, C. & Kamperman Sanders, A. (eds) (2007). *Intellectual Property and Free Trade*

Agreements. Oxford: Hart.

Helfer, L.R. (2003). Intellectual Property Rights and the International Treaty on Plant Genetic Resources for Food and Agriculture. *Proceedings of the Annual Meeting of the American Society of International Law*, 97, 33-35.

Helfer, L.R. (2004). *Intellectual Property Rights in Plant Varieties: International legal regimes and policy options for national governments*. FAO Legislative Study 85. Rome: FAO.

Hess, C. (1993). Intellectual Property Rights: Protection of Plant Materials Public Research Agendas. In Baenziger, P.S., Kleese, R.A., & Barnes R.F. (eds). *Intellectual Property Rights: Protection of Plant Materials*. Madison, WI: CSSA Special Publication.

Hess, C. and Ostrom, E. (2007). Introduction: An Overview of the Knowledge Commons. In Hess, C., and Ostrom, E. (eds). *Understanding Knowledge as a Commons: From Theory to Practice*. Cambridge, Mass.; London: MIT Press.

International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) (2008). *Agriculture at a Crossroads. Global Summary for Decision Makers*. Available online at: http://www.weltagrarbericht.de/fileadmin/files/weltagrarbericht/IAASTDBerichte/GlobalSDM.pdf [Accessed on 10 September 2017].

ITPGRFA (2013). *Report on the Implementation of the Multilateral System of Access and Benefit Sharing*. FAO Doc IT/GB-5/13/5.

ITPGRFA (2015). *Typology of Users of the Multilateral System and their Regional Distribution, including PGRFA under Development*. FAO Doc IT/OWG-EFMLS-3/15/Inf.9.

Jasanoff, S. (2001). Ordering Life: Law and the Normalization of Biotechnology. *Notizie di Politeia*, 17(62), 34-50.

Kamau, E.C. & Winter, G. (2013). *Common Pools of Genetic Resources: Equity and innovation in international biodiversity law*. Abingdon; Oxon: Routledge.

Ker, C., Louafi, S. & Sanou, M. (2013). Building a Global Information System in Support of the International Treaty on Plant Genetic Resources for Food and Agriculture. In Halewood, M., Lopez Noriega, I., & Louafi, S. (eds). *Crop Genetic Resources as a Global Commons: Challenges in International Governance and Law*. Oxon: Routledge.

Kevles, D.J. (1994). Ananda Chakrabarty Wins a Patent: Biotechnology, Law, and Society. *Historical Studies in the Physical and Biological Sciences*, 25(1), 111-35.

Kloppenburg, J. (2014). Re-purposing the Master's Tools: The Open Source Seed initiative and the struggle for seed sovereignty. *The Journal of Peasant Studies*, 41(6), 1225-46.

Le Courtois, E., with Gálvez-Nogales, E., Santacoloma, P., & Tartanac, F. (2011). *Enhancing Farmers' Access to Markets for Certified Products: A comparative analysis using a business model approach*. FAO Agricultural Management, Marketing and Finance Working Document 28. Rome: FAO.

Lee, J., Gereffi, G. & Beauvais, J. (2012). Global Value Chains and Agrifood Standards: Challenges and possibilities for smallholders in developing countries. *Proceedings of the National Academy of Sciences* 109 (31) 12326.

López Noriega, I. Wambugu, P. & Mejías, A. (2013). Assessment of Progress to Make the Multilateral System Functional. In Halewood, M., Lopez Noriega, I., & Louafi, S. (eds). *Crop Genetic Resources as a Global Commons: Challenges in International Governance and Law*. Oxon: Routledge.

Louafi, S. (2013). Reflections on the Resource Allocation Strategy of the Benefit Sharing Fund. *Policy Brief*. Bern: Swiss Federal Office for Agriculture.

Louafi, S. & Welch, E. (2014). Open Systems Versus Strong Intellectual Property Rights: Disentangling the Debate on Open Access for Meeting Global Challenges in Life Science. In Grosclaude, J.Y., Tubiana, L., & Pachauri, R.K. (eds). *A Planet for Life 2014: Innovation for Sustainable Development*. Delhi: TERI.

Moeller, N.I. & Stannard, C. (eds) (2013). *Identifying Benefit Flows: Studies on the Potential Monetary and Non-Monetary Benefits Arising from the International Treaty on Plant Genetic Resources for Food and Agriculture*. Rome: FAO.

Mooney, P. (1983). The Law of the Seed: Another Development and Plant Genetic Resources. *Development Dialogue*, 1-2(21), 1-172.

Mooney, P. (1998). *The Parts of Life. Agricultural Biodiversity, Indigenous Knowledge and the Role of the Third System*. Uppsala: Dag Hammarskjöld Foundation.

Moore, G. & Goldberg, E. (eds) (2010). *The International Treaty on Plant Genetic Resources for Food and Agriculture: Implementing the Multilateral System. Learning Module*. Available online at: http://treatylearningmodule.bioversityinternational.org/ [Accessed on 10 September 2017].

Moore, G. & Tymowski, W. (2005). *Explanatory Guide to the International Treaty on Plant Genetic Resources for Food and Agriculture*. IUCN Environmental Policy and Law Paper No. 57. Gland; Cambridge: IUCN.

Morgera, E. (2016). The Need for an International Legal Concept of Fair and Equitable

Benefit Sharing. *European Journal of International Law*, 27(2), 353-83.

Morgera, E., Tsioumani, E. & Buck, M. (2014). *Unraveling the Nagoya Protocol: A Commentary on the Nagoya Protocol on Access and Benefit-sharing to the Convention on Biological Diversity*. Leiden: Brill.

Nuffield Council on Bioethics (2002). *The Ethics of Patenting DNA. A discussion paper*. London: Nuffield Council on Bioethics.

Oberthür, S., Gerstetter, C., Lucha, C., McGlade, K., Pozarowska, J. Rabitz, F. & Tedsen, E. (2011). *Intellectual Property Rights on Genetic Resources and the Fight against Poverty*. European Parliament. Available online at: http://www.europarl.europa.eu/RegData/etudes/etudes/join/2011/457063/EXPO-DEVE_ET(2011)457063_EN.pdf [Accessed on 10 September 2017].

Oguamanam, C. (2006). Regime Tension in the Intellectual Property Rights Arena: Farmers' Rights and Post-TRIPS Counter Regime Trends. *Dalhousie Law Journal*, 29(2), 413-54.

Özgediz, S. (2012). *The CGIAR at 40: Institutional Evolution of the World's Premier Agricultural Research Network*. Washington: CGIAR Fund Office.

Petit, M., Fowler, C., Collins, W., Correa, C. & Thornström, C.-G. (2001). *Why Governments Can't Make Policy: The Case of Plant Genetic Resources in the International Arena*. Lima: CIP.

Pimbert, M. (1999). Sustaining the Multiple Functions of Agricultural Biodiversity: Agricultural Biodiversity. FAO Background Paper 1. Rome: FAO.

Pistorius, R. (1997). *Scientists, Plants and Politics: A History of the Plant Genetic Resources Movement*. Rome: International Plant Genetic Resources Institute.

Raustiala, K. & Victor, D.G. (2004). The Regime Complex for Plant Genetic Resources. *International Organization*, 58(2), 277-309.

Rose, G.L. (2004). The International Undertaking on Plant Genetic Resources for Food and Agriculture: Will the Paper be Worth the Trees?. In Stoianoff, N.P. (ed.). *Accessing Biological Resources: Complying with the Convention on Biological Diversity*. The Hague; London: Kluwer Law International.

Seyoum, A. & Welch, E. (2013). Trading off Use Restrictions and Benefit-Sharing for Genetic Materials for Food and Agriculture with an Emphasis on Upfront Payments. *Paper presentation at the 53rd Annual Conference of the German Society of Economic and Social Sciences in Agriculture*. Berlin: GEWISOLA.

Shaheed, F., UN Special Rapporteur in the Field of Cultural Rights (2012). *Report on the*

Right to Enjoy the Benefits of Scientific Progress and its Applications. UN Doc A/HRC/20/26.

Swiss Government (2015). *Report of Multi-stakeholder Workshop Organized by Switzerland – The International Treaty on Plant Genetic Resources for Food and Agriculture: What Investment Strategy for the Benefit-Sharing Fund?*. FAO Doc. IT/GB-6/15/Inf.13.

Tsioumani, E. (2004). International Treaty on Plant Genetic Resources for Food and Agriculture: Legal and Policy Questions from Adoption to Implementation. *Yearbook of International Environmental Law*, 15(1), 119-44.

Tsioumani, E. (2014a). Exploring Benefit-Sharing from the Lab to the Land (Part I): Agricultural Research and Development in the Context of Conservation and Sustainable Use of Agricultural Biodiversity. *Edinburgh School of Law Research Paper No. 2014/44.* Available online at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2524337 [Accessed on 10 September 2017].

Tsioumani, E. (2014b). Plant Treaty Governing Body Identifies Need to Enhance Multilateral System of Access and Benefit-sharing. BeneLex Blog. Available online at: http://www.benelexblog.law.ed.ac.uk/2014/02/19/plant-treaty-governing-body-identifies-need-to-enhance-multilateral-system-of-access-and-benefit-sharing/ [Accessed on 4 August 2017].

Tsioumani, E. (2015). The Plant Treaty at a Crossroads: Reflections on the Sixth Session of the ITPGR Governing Body. BeneLex Blog. Available online at: http://www.benelexblog.law.ed.ac.uk/2015/12/18/sixth-session-of-the-itpgr-governing-body/ [Accessed on 3 August 2017]

Tsioumani, E. (2016). Beyond Access and Benefit-Sharing: Lessons from the Law and Governance of Agricultural Biodiversity', *Edinburgh School of Law Research Paper No. 2016/18*. Available online at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2796658 [Accessed on 10 September 2017].

Tsioumani, E., Muzurakis, M., Ieropoulos, Y., & Tsioumanis, A. (2016). Following the Open Source Trail outside the Digital World: Open Source Applications in Agricultural Research and Development. *TripleC: Communication, Capitalism & Critique* 14(1), 145-62.

Tsioumani, E., Finnegan, L. & Tsioumanis, A (2017). Summary and Analysis of the Sixth

Meeting of the Working Group to Enhance the Functioning of the Multilateral System of the International Treaty on Plant Genetic Resources for Food and Agriculture', *Earth Negotiations Bulletin (ENB)* 09(685), 20 March 2017. Available online at: http://enb.iisd.org/biodiv/itpgrfa/owg-efmls-6/ [Accessed on 10 September 2017].

UN Development Programme (UNDP) (2000). *Human Development Report 2000: Human development and human rights*. New York: Oxford University Press. Available online at: http://hdr.undp.org/sites/default/files/reports/261/hdr_2000_en.pdf [Accessed on 10 September 2017].

UPOV (2003). *Access to Genetic Resources and Benefit-sharing*. Available online at: http://www.upov.int/export/sites/upov/news/en/2003/pdf/cbd_response_oct232003.pdf [Accessed on 10 September 2017].

Vernooy, R., Shrestha P. & Sthapit, B. (eds). (2015) *Community Seed Banks: Origins, Evolution and Prospects*. Oxon: Routledge.

Weissbrodt, D. & Schoff, K. (2003). Human Rights Approach to Intellectual Property Protection: The Genesis and Application of Sub-Commission Resolution 2000/7. *Minnesota Intellectual Property Review*, 5, 1-46.

Yamane, H. (2011). *Interpreting TRIPS: Globalisation of Intellectual Property Rights and Access to Medicines*. Oxford: Hart.