Legal Factors Driving Agrobiodiversity Loss

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1 Introduction

Despite leading a shadowy existence in the public biodiversity debate, the issue of the loss of agrobiodiversity is hotly debated in expert circles. A broad understanding of agrobiodiversity can be described as that part of biodiversity that contributes in the context of agriculture to nutrition, livelihoods and the maintenance of habitats. Its scope covers agricultural crops, productive livestock, raw materials, medical plants and animals used for transport. Agrobiodiversity is highly threatened mostly by the spread of modern agriculture and the globalisation of food markets. This article describes the problem, diagnosis and the causes identified. In particular, it will analyse how legal and institutional structures in the international, European and national realm contribute to the problem. The focus is on intellectual property rights, sovereignty regimes as well as on seed trade and livestock breeding regulations. Finally, chances for sustainable use and protection of agrobiodiversity in the future are discussed.

2 The concept of agrobiodiversity

The term agrobiodiversity has evolved only in recent years in the wake of the general biodiversity discourse, which really began in the 1980s.[1] Analogous to the term biodiversity, agrobiodiversity encompasses different levels. It relates to the diversity of agro-ecosystems as well as that of species of crops and farm animals, and to the genetic variance within populations, varieties and races.[2] In its broadest sense, agrobiodiversity also comprises soil organisms in cultivated areas, insects and fungi that promote good production, wild species from off-farm natural habitats as well as cultural and local knowledge of diversity and management forms as the basis of the exploitation of diversity.[3] This article focuses on species and genetic diversity.

Though the term agrobiodiversity emerged late, a wide intersection of the topic was already analysed under the term "genetic resources" in the 1960s when the Food and Agriculture Organisations (FAO) of the United Nations started to discuss the genetic foundations of plant breeding[4].

During the last three decades the understanding of agrobiodiversity has developed from the recognition of the importance of genetic diversity, particularly for crops and an emphasis on the *ex situ* conservation[5] of genetic resources in the 1970s, to the adoption of an *in situ*/on farm approach where plants and animals are kept in natural surroundings or used within agricultural production systems in the 1990s. Finally, agrobiodiversity thinking has become embedded in an integrated, holistic agro-ecosystem approach.[6]

The crucial difference between wild biodiversity and agrobiodiversity (for the most part) is characterised by the proximate interaction between natural 'material' and human action. The diversity of productive livestock and crops is the result of a century of human breeding efforts based on locally differentiated resources. It reflects the diversity of various agricultural production systems and their cultural

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1 The term "biodiversity" emerged in the context of two important conferences, the US Strategy Conference on Biological Diversity in 1981 and its follow-up in 1986 (Wilson 1988, see also Lovejoy 1980, Norse/McManus 1980).

2 Cf. the definition in Decision V/5 of the Convention on Biological Diversity: "Agricultural biodiversity is 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 agro-ecosystem: 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, in accordance with annex I of decision III/11 of the Conference of the Parties to the Convention on Biological Diversity." Agrobiodiversity includes aquatic and forest genetic resources, which, however, are not specifically addressed in this article.

3 Thrupp Cultivating Diversity: Agrobiodiversity and Food Security. World Resources Institute, Washington, 1998; Brookfield, Exploring Agrobiodiversity. New York, 2001.

4 Genetic resources for food and agriculture (GRFA), generally speaking, encompass the genetic material contained in (traditional and modern) plant varieties and farm animal species as well as well as in primitive and wild relatives that are used, or may be used, for the production of food and agriculture *See*, FAO Report on the State of the World's Plant Genetic Resources for food and agriculture, prepared for the International Technical Conference on Plant Genetic Resources Leipzig, Germany 17–23 June 1996. The term of agrogenetic resources therefore not only embraces diversity in actual use, but also that of potential use and value ("latent diversity", cf. Gollin/Smale, Valuing genetic diversity: Crop plants and agroecosystems. In: W. Collins/C. Qualset (ed.): Biodiversity in agroecosystems. Boca Raton, 1999, pp. 237–265.). They are the raw material from which new crop varieties and breeds are being developed. In the field of plant breeding, Plant Genetic Resources may consist of a plant breeder's own plant varieties and lines, the material of other breeders, accessions of used crops in national or international gene banks, landraces, primitive or wild forms of the species and relatives from a different plant species. The breeding value of the plant genetic resource decreases in this order (Röbbelen 2003: 28).

5 Outside of natural habitats, i.e. in genebanks, botanic gardens, zoos etc.

6 Aarnink, W./Bunning, S./Collette, L./Mulvany, P., Sustaining Agricultural Biodiversity and Agroecosystem Functions. Opportunities, incentives and approaches for the conservation and sustainable use of agricultural biodiversity in agroecosystems and production systems. Report of an International Workshop, FAO Headquarters, Rome, 2-4 December 1998.

and social dependency. Maintenance of agrobiodiversity is inseparably linked to the use and utilisation by humans (unlike with wild biodiversity, protection in the sense of 'leaving it alone' does not suffice). These differences are broadened in the political discourse. While "general" biodiversity was made a central theme by nature protectionists, agrobiodiversity or plant and animal genetic resources were embraced as a topic by agriculturalists and breeders. Since agriculture has been, and still is, seen as one of the destructive factors for biodiversity, it somewhat stands to reason that agrobiodiversity was not on the agenda of nature protectionists. Therefore, also in the context of the Convention on Biological Diversity (CBD), agrobiodiversity was only explicitly addressed from 1996 onwards.[7]

3 Agrobiodiversity loss: from riches to risk

While in animal breeding genetic erosion is conceded by most relevant actors, with respect to plants the diagnosis of agrobiodiversity loss is not undisputed The plant breeding industry, e.g. stresses that "although the visible diversity in farmers' fields may have been reduced, the diversity of valuable genes has been increased by introgression of new materials"[8]. Not only does the analysis vary according to the level of diversity analysed (genetic, species, ecosystem), but also according to the measures of diversity and the methods of analysis employed. However, the following data and assessments can be considered reliable. In the report on the "State of the World's Plant Genetic Resources for Food and Agriculture (PGRFA)", the FAO describes as "substantial" the loss in diversity of plant genetic resources for food and agriculture (PGRFA)[9] including the disappearance of species, plant varieties and gene complexes ("genetic erosion").[10] World nutrition today is mainly based on a mere ten crops.[11] For Germany it is estimated that, compared to the first half of the twentieth century, 75 percent of cultivated plants in agriculture and horticulture have disappeared;[12] in some areas "genetic erosion" is even supposed to have reached over 90 percent.[13] Similar processes have been taking place globally from the mid nineteenth century onwards.[14] Concerning livestock, half of the breeds that existed in Europe at the turn of the century have become extinct; a third of the remaining 770 breeds are severely endangered. In Germany only 5 out of at least 35 indigenous breeds of cattle remain. The FAO predicts that worldwide 28 percent of livestock breeds are currently at risk of extinction.[15]

Why is this loss problematic? Firstly and most importantly, genetic resources, along with soil and water, constitute the foundation upon which agriculture and world food security are based.[16] Beyond the immediate uses of agrobiodiversity as described above (relevance to nutrition, livelihoods, habitats), agrobiodiversity is important to preserve possible future development paths. Genetic diversity found in domestic animal breeds and plant varieties allows farmers and breeders to select stocks or develop new breeds and varieties in response to changes in the environment, threats of disease, new knowledge of human nutrition requirements, changing market conditions and societal needs, all of which are largely unpredictable. The protection of landraces and indigenous livestock breeds is worthwhile despite their lower yields because they often possess valuable traits such as disease and pest resistance and are better adapted to harsh conditions and poor quality feed, which are qualities desirable for low-input, sustainable agriculture. On the other hand, agrobiodiversity also protects against vulnerability to e.g. climate stress, insect pests and diseases that can devastate a uniform crop, especially on large plantations. With farm animals, too, genetic diversity enables adaptation to diseases, parasites, or variations in the availability and quality of food. Thus, agrobiodiversity loss increases the risks for individual farmers, and can thus undermine the stability of agriculture.[17] This loss also accounts for further environmental damage. The reason for this link is that genetically homogenous varieties and

7 Third Conference of the Parties, Buenos Aires.

8 ASSINSEL: ASSINSEL Position on Maintenance of and Access to Plant Genetic Resources for Food and Agriculture (PGRFA), Adopted in May 1996.

9 FAO, Report on the State of the World's Plant Genetic Resources for food and agriculture, prepared for the International Technical Conference on Plant Genetic Resources Leipzig, Germany 17–23 June 1996.

10 While varieties can disappear without a corresponding loss in genetic diversity (the genes in a lost variety might still exist in other varieties), varieties as unique combinations of genes can have a particular value and immediate utility.

11 Wheat, rice and maize cover half of the global energy need for nutrition from plants; seven further species (sorghum, millet, , potato, , yam, soybean , sugar cane and sugar beet) make up for most of the rest, cf. FAO (Food and Agricultural Organisation): Food Security. http://www.fao.org/biodiversity/sd/foodsecur.asp, September 2000.

12 UBA (Umweltbundesamt), Beiträge zur nachhaltigen Entwicklung. Nachhaltige Entwicklung in Deutschland. Die Zukunft dauerhaft umweltgerecht gestalten Berlin, 2002, p.403.

13 TAB (Büro für Technikfolgenabschätzung) Gentechnik, Züchtung und Biodiversität. TAB-Arbeitsbericht Nr. 55, Bonn, 1998.

14 GTZ (Gesellschaft für Technische Zusammenarbeit), Sicherung der Agrobiodiversität im ländlichen Raum. Homepage http://www.gtz.de/agrobiodiv/u-blick/u-blick.htm (July 2003).

15 FAO, Agrobiodiversity: the case for conserving domestic and related animals. FAO Fact sheet on the conservation of domestic animal genetic resources. http://www.fao.org/docrep/v1650t/v1650t0y.htm, 1993.

16 FAO, supra note 9, p. 6.

17 Thrupp, Lori Ann, Linking biodiversity and agriculture: Challenges and opportunities for sustainable food security. World Resources Institute, Washington D.C., 1997.

high performance animals are more vulnerable, often prone to diseases caused by breeding ("burn out syndrome") and dependent on high and stable inputs of fertilizers and pesticides in the case of plants, and food, energy, and pharmaceuticals in the case of animals.

4 Causes of agrobiodiversity loss

The causes of agrobiodiversity loss are manifold and interrelated. The spread of modern, commercial agriculture and intensive, high-input production systems features as the prime driver of diversity decrease, putting native varieties and breeds at risk.[18] Native varieties and breeds are substituted with high-yielding crops and breeds that no longer need to be adapted to natural (climate, soil etc.) conditions, since machinery, irrigation, fertilizers and pharmaceuticals homogenize habitats (in a both costly and environmentally harmful way). In developing countries, this process has been reinforced by a donor policy that has promoted the import of exotic breeds and crossbreeding and that threatens the survival of local breeds.[19] Both the markets for agricultural inputs and for agricultural outputs have been increasing in size, thus feeding into a globalising food market that demands goods in huge consignments. In order to process them industrially, those agricultural goods need to be homogenous. Therefore, apart from the yields it is the requirements of industrial cultivation,[20] husbandry[21] and processing[22] (and to some extent consumer demand) that determine the breeding objectives rather then improved adaptation to natural conditions.

Modern, highly selective breeding methods contribute to agrobiodiversity loss, too. In livestock breeding e.g. artificial insemination, multiple ovulation and embryo transfer are applied to reproduce only a few top performers; a huge number of other individuals are thus excluded from breeding and the genetic distance within populations is correspondingly reduced. Hybrid breeding, with both animals (e.g. poultry, pigs) and plants (e.g. corn, rice), and in the future cloning are methods used to reproduce genetically homogenous and high performing livestock and plant varieties. In the case of animals, impacts on the genetic pool are expected when traditional pure breeding gets replaced by the modern methods.[23] Also, since hybrid breeding produces infertile breeds and seed farmers cannot use the material to continue breeding/growing according to their own selection preferences,[24] they have to instead content themselves with commercially bred/grown livestock and seeds, which they even have to buy again every year. In plant breeding, 'Genetic Use Restriction Technologies' (GURTs) have the same effect.[25]

Besides these factors, legal regimes have contributed to agrobiodiversity loss. A selection of these factors is discussed in the following chapter.

5 The role of legal regimes and governance structures

The economic and technological developments described above were partly supported by policies and legal structures such as intellectual property rights and sovereignty regimes that regulate access to and control over genetic resources as well as seed and livestock breeding law. Those have intentionally, or as side effects, supported the orientation towards high output and homogenisation, thus also affecting the choice of plants and livestock in agricultural use.

5.1 The regulation of access and control

Access to and control of plant and farm animal genetic resources is regulated by Intellectual Property Rights (IPRs) in the realm of private law and, in the context of public (international) law by sovereign rights of states.[26]

5.1.1 Intellectual Property Regimes

Breeding, particularly of plants, heavily relies on Intellectual Property Rights.[27] The background of

18 FAO, supra note 9, p. 13.

19 Ellen Geerlings / Evelyn Mathias /Ilse Köhler-Rollefson, Securing tomorrow's food. Promoting the sustainable use of farm animal genetic resources. Published by the League of Pastoral People, Ober-Ramstadt, 2003, p.6.

20 E.g. resistance to toxic pesticides, response to chemical fertilizers.

21 I.e. the conditions of modern livestock production: the selection for the intensive production of meat, milk or eggs ("single purpose animals": layers vs. broilers, dairy cows vs. beef cattle) at high feeding levels in highly controlled conditions (e.g. caging).

22 E.g. suitability of wheat for processing in mills.

23 Frank Wetterich, Biological Diversity of Livestock and Crops: Useful Classification and Appropriate Agri-environmental Indicators. In: OECD (ed): Agriculture and Biological Diversity: Developing Indicators for Policy Analysis. Proceedings from an OECD Expert Meeting. Zurich/Switzerland, November 2001, p. 45.

24 With hybrid seeds (so called HYVs/high-yielding varieties or HRVs/high-response varieties), farmers de facto cannot even re-sow material from the previous harvest because the seeds lose general agronomic value when being replanted.

25 These genetic technologies either render the harvested seeds sterile ("Varietal" or "V-GURTs", popularly dubbed "Terminator technology") or "turn off" certain agronomically valuable traits in a plant when it is re-planted ("Trait-related" or "T-GURTs", partly dubbed "Traitor technology"). Here, too, further adaptation through the farmer is rendered impossible. Farmers are thus pushed further into a dependency from agribusiness: in no way can they re-use the seeds, and mostly they have to purchase chemical inputs from the same company in order to stimulate the plants to reach the promised yields.

26 Annie Kameri-Mbote,/Philippe Cullet, Agro-biodiversity and international law – a conceptual framework. In: Journal of Environmental Law, Vol. 11 (2) 1999, pp. 257-279.

27 IPRs provide breeders with the exclusive right to commercialise his or her creation for a limited time. This includes the authority to decide about the products utilisation and, in the case of patents, the right to exclude third

this can be found in the specialised nature of agricultural production and the fact that breeding involves a high amount of work as well as intellectual and financial efforts. Especially for new plant varieties (not so much for animals),[28] breeders' returns are endangered by the biological possibility that farmers would reproduce the seeds. Without breeders' efforts, on the other hand, it is argued that the supply of agricultural production with high quality seeds would suffer.[29] Against this backdrop, in the early twentieth century intellectual property rights that originally applied to industrial inventions were merely extended to living matter to compensate breeders' efforts.

Two major IPR regimes can be distinguished that impact on agrobiodiversity in varying degrees: plant variety protection (PVP), applying only to plants, and patents.

Plant Variety Protection (PVP)

PVP systems have emerged in Europe from the late 1920s onwards. At the core of PVP are the so-called Plant Breeders' Rights (PBR), a specific form of Intellectual Property Right, which provides an exclusive right over the variety a breeder has developed. The main difference from patent protection lies in the restriction of PBRs to the concrete variety as a marketable product, while patents provide generic protection. In the 1960s an international harmonisation of national plant protection laws took place and the International Union for the Protection of New Varieties of Plants (UPOV) was founded. Today, with 53 member states (increasingly from the developing world, too) the UPOV Convention has become the international reference system for PVP.

Plant Breeders Rights require that anybody who (re -) produces, conditions, offers for sale, markets or imports/exports propagating material of the protected variety needs the authorization of the breeder, which the breeder may subject to conditions (usually royalties) and limitations (Art. 14 UPOV Convention). The breeders rights are restricted by the so-called breeders' exemption and the farmers' privilege (Art. 15.1, 15.2), both of which were cut back in 1991. The breeder's exemption constitutes the right to use protected varieties for the breeding of other varieties and for experimental purposes, while the farmer's privilege refers to the farmer's right to save and re-use (formerly also to sell) harvested material.[30] Depending on national implementation, the plant variety protection may cover all plant varieties and needs to last a minimum of twenty years[31] (Art. 3, 19 UPOV Convention).

Effects on agrobiodiversity

In two senses the plant variety protection system of UPOV can be seen as harmful to agrobiodiversity. Firstly, the criteria for variety protection – the so called "DUS requirements" on Distinctness, Uniformity/Homogeneity and Stability of new plant varieties – impact on plant variability. Secondly, it is argued that Plant Breeders Rights, like other IPRs restricting access to genetic resources, have indirect effects on agrobiodiversity.

Within the DUS requirements it is particularly the uniformity criterion (Art. 5 (1) iii, Art. 8 UPOV Convention) that meets with criticism. It aims at restricting genetic diversity within a plant variety, because in order to apply a Plant Breeder's Right it is necessary to unequivocally distinguish the variety from other varieties. This presupposes physical distinctiveness and uniformity, which disappear at the expense of significant genetic variability.[32] In the field, uniform varieties are less able to buffer stress (diseases, lack of growth factors) without suffering major qualitative and quantitative losses.[33] At the same time, the uniformity criterion precludes the protection of old landraces, which are frequently rich in genetic diversity within a variety.[34] From a broader perspective, the uniformity criterion is identified as a factor that makes PVP biased towards plant breeding for industrial agriculture.[35]

parties from using it. In Europe, this instrument to protect breeders from abuse through farmers is complemented by seed laws which in turn aim at protecting farmers as the consumers of seed from abuse through breeder.

28 With animals, breeders do not develop new races (as the taxonomic equivalent to plant varieties) but rather attempt to 'optimise' *individuals*. The question of IPRs therefore has not the same relevance as with plant breeding.

29 Franz Wuesthoff,/Herbert Leßmann,/Gert Würtenberger Handbuch zum deutschen und europäischen Sortenschutz. Weinheim, 1999, p. 96.

30 Today, UPOV exempts from the breeder's rights only the re-use of seeds from a farmer's harvest on his own holdings and the non-commercial exchange, though a wider version of the farmer's privilege may be codified at the national level ("within reasonable limits" and subject to the "legitimate interests of the breeder"). Among others, this revision hade made necessary an amendment of the FAO International Undertaking (IU) on Plant Genetic Resources for Food and Agriculture. The IU was still based on a wide conception of the farmers rights that included the right to also sell propagating material (as opposed to only exchange it non-commercially).

31 Respectively 25 years in the case of trees and vines.

32 Crucible Group, People, plants and patents. The impact of intellectual property on biodiversity, conservation, trade and rural society. Ottawa: IDRC, 1994. Thus, the uniformity criterion does not lead back to quality assurance but rather to the applicability of IPRs.

33 J. Léon, Zuchtmethodik bei Getreide. In: Steinberger, J., WorkshopZüchtung für den Ökolandbau am 10. und 11. Juni 2002 in Hannover – Kurzfassung der Vorträge und Stellungnahmen sowie Zusammenfassung der Ergebnisse. Herausgeber Bundessortenamt, 2002, pp. 30-31.

34 Graham Dutfield, Intellectual Property Rights, Trade and Biodiversity. London, 2000.

35 GRAIN, Plant variety protection to feed Africa? In: Seedling, December 1999.

Compliance with the criterion inclines breeders to develop varieties that have low adaptability and are highly adjusted to monocultural production systems for large markets. Contrary to this rationale, it is also argued that PBRs enhance genetic diversity because the introduction of PVP regimes has boosted the growing number and registration of new varieties.[36] However, linking the number of licensed varieties and the degree of genetic diversity neglects the issue of genetic distance or the degree of relationship between varieties. Phenotypical diversity does not give evidence of the genetic diversity of a plant variety.[37]

The indirect impacts of PVP on agrobiodiversity result from the restricted access they determine. The breeders' authorisation to (re-) produce, condition or market propagating material means that the material is not freely (i.e. free of charge) accessible. For the breeder, the right, in the first place, increases the incentive for commercial plant breeding. Secondly, it promotes the development of varieties with the largest market potential. This leads to the predominance of major crops that are widely adapted across large areas and that feature characteristics that best meet the needs of commercial farmers and the marketing or processing industries.[38] This impedes diversity.[39] Therefore, the strengthening of PBRs in the 1991 UPOV revision is to be seen critically. PBRs have been strengthened with respect to the object of protection (extension to all plant genera and species), to the scope of protection (extension to 'essentially derived' varieties[40] and to harvested material[41]) as well as to the possibility for member states to grant patents on top of breeders' rights ('double protection'). At the same time, the Breeder's exemption was restricted.[42] These revisions mostly go back to pressures resulting from the growing importance of biotechnology.[43] A further indirect effect of PVP is that it probably reduces the flow of scientific information and germplasm from the private to the public sector (Butler 1996). This is due both to the private sector's interest in not having public competitors who develop varieties for public welfare as well as to the forced market orientation within public research institutes in times of scarce public funding.

Patents

Originally, patent law was not designed to apply to living matter, i.e. to material capable of self-reproduction or of being reproduced in a biological system. However, in the United States plant patents have been granted since the 1930s. Internationally, patent law is becoming more and more important with the growing relevance of biotechnological methods, in particular genetic engineering. The patenting of biological material is regulated in international patent law such as the WTO Agreement on Trade Related Intellectual Property Rights (TRIPs) and the European Patent Convention (EPC). The interpretation of these, however, led to a number of highly contentious questions. The TRIPs constitutes the international minimum standard for all WTO members and codifies that member states need to provide patents "for any inventions, whether products or processes, *in all fields of technology*" (Art. 27 (1) TRIPs, italics added). At the same time, "plants and animals other than microorganisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes" may be excluded from patentability in national legislation. However, states are bound to provide for the protection of plant varieties either by patents or by effective *sui generis* systems (e.g. plant variety protection)[44] or a combination of the two regimes (Art. 27.3 (b) TRIPs). In the industrialized world, there is usually a lot less leeway in terms of legal coverage. In the EPC, patents in the field of biological matter are excluded merely for "plants or animal *varieties* or *essentially biological processes* for the production of plants or animals" (Art. 53 (b) EPC, italics added). This implies that plant and animal compo-

36 UPOV, International Harmonization is Essential for Effective Plant Variety Protection and Transfer of Technology (Based on an intervention in the Council for TRIPS, September 19, 2002, Geneva.

37 Hans Neumeier, Sortenschutz und/oder Patentschutz für Pflanzenzüchtungen. Schriftenreihe zum gewerblichen Rechtsschutz des Max-Planck-Instituts für ausländisches und internationales Patent-, Urheber- und Wettbewerbsrecht 80, 1990, p. 231; L.J. Butler/ B.W. Marion, Impacts of Patent Protection in the U.S. Seed Industry and Public Plant Breeding, Univ. Wisconsin, 1983, p. 72; Ursula Prall, (1998): Saatgut und internationale Vorgaben des gewerblichen Rechtsschutzes, in: BUKO Agrar Koordination/Forum für Internationale Agrarpolitik. Saatgut. Stuttgart, 1998, S. 52-55.

38 Crucible Group, supra note 32.

39 Some argue that also the charge of royalties for replanting of PVP-protected seeds hampers agrobiodiversity which was made possible by the UPOV revision of 1991. However, though this cutback of the so-called farmers' privilege raises the fiscal pressure on farmers and their dependency on agribusiness under the given structures there is no immediate impact on agrobiodiversity: the replanting of high yielding crops is usually not linked to a substantial diversification in terms of adaptation or cultivating.

40 Varieties that are developed by adding through genetic engineering one or two genes to a variety that was developed in a longstanding plant breeding process.

41 As opposed to reproductive material only. This will impact on the farmers' possibility to replant harvested material.

42 In the development of an 'essentially derived variety' from an already existing protected variety the grant of the PBR now depends on the authorisation of the original breeder who will most likely link it to royalties.

43 Susan Bragdon/David Downes, Recent policy trends and developments related to the conservation, use and development of genetic resources. Issues in Genetic Resources No. 7, June 1998, p. 20.

44 Dan Leskien/Michael Flitner, Intellectual Property Rights and Plant Genetic Ressources: Options for a Sui Generis System. IPGRI (Hg.), Rom, 1997.

nents such as genes, gene sequences or cells, individual plants/animals as well as certain (non-microbiological) processes actually are patentable. The patent exemption on plant and animal varieties as well is being watered down by the European Patent Office judicature.[45] In the EC Biotechnology Patent Directive,[46] plant and animal varies *prima facie* are also excluded from patentability (Art. 4.1 (a)) However, this provision is qualified by the clause that "Inventions which concern plants and animals shall be patentable if the technical feasibility is not confined to a particular plant or animal variety" (Art. 4.2). US patent law is even more expansive.

What is the background of this discussion? Generally, in order to receive a patent, an innovation in the first place needs to qualify as an invention. The term "invention", though, is defined in none of the international agreements on patent law.[47] Nonetheless, there is a general agreement that innovations need to be practical and technical. In a second step, in order to be eligible for patent protection, the invention needs to be new, involve an inventive step (i.e. are 'non-obvious') and be capable of industrial application ('usefulness'). Finally, the granting of patent protection requires the disclosure of the invention. As for patents on biological matter ('biopatents'), a major dispute surrounds whether or not plant or animal genetic material may at all constitute the subject of an invention.[48] This raises doubts with respect to both practicality and technicality. In terms of practicality, it is still controversial whether products of biotechnology that are, or are based on, genes or cells taken from nature or isolated from pre-existing living matter constitute a product of nature and as such a unpatentable discovery, or whether they are patentable inventions. In the court practice of most industrialized countries, however, there is a clear, though not uniform, trend towards recognizing naturally occurring substances as patentable subject matter if they were isolated or purified and if their existence was previously unknown.[49] The patentability as such of living matter is no longer disputed by most courts. In terms of technicality, over the last years in many countries (as well as implicitly in the TRIPs Agreement) living beings have been ascribed a 'technical nature' that is a prerequisite for patenting. Reproducibility, as an additional requirement to prove technicality, leads to the necessity of disclosing inventions relating to or relying on biological material that is not publicly available and cannot be described in writing alone; this conundrum is partly resolved by the possibility of depositing biological material for the purpose of sufficiently describing a product patent. On top of the decision of whether plant and animal genetic innovations fulfil the legal criteria of an invention at all (practicality, technicality), the specific patent requirements of novelty, non-obviousness/inventive step, usefulness/ industrial applicability as well as sufficient disclosure need to be satisfied .[50] Then again, these requirements are insufficiently specified in international agreements (e.g. TRIPS) and interpreted in different ways in national legal systems. However, they have proved not to be insurmountable for the granting of biopatents.

Effects on agrobiodiversity

Patents impede the development of agrobiodiversity by restricting access to genetic resources used in breeding and research.[51] Similar to Plant Breeder's Rights in conventional plant breeding, the utilisation of germplasm, seeds of animals with a patented element (product patent), presupposes the right-holder's authorization. However, patents are more exclusive since licences to competitors can be refused. Only research without market-orientation is exempted. Also, licence fees are more costly than PBR royalties and may develop even prohibitive effects.[52] When processes for the genetic modification of plants and animals are patented (process patents) third parties depend on the patent holder's authorisation not only for the immediate application of the patented process, but also for the use, selling or import of products immediately derived from the process. Not only due to this generic protection, but also due to the lack of a breeder's exemption and a farmer's privilege, the exclusive right provided by a patent has stronger exclusive effects than Plant

45 Cf. *Ciba-Geigy* Case (EPOR Vol. C 758); *Lubrizol Case*, EPO Decision T320/87 Lubrizol/Hybrid plants (EPOR 173); *Plant Genetics System*, EPO Decision T356/93, Official Journal EPO 1995, 545.

46 cf. Directive 98/44/EC Of the European Parliament and of the Council of 6 July 1998 on the legal protection of biotechnological inventions.

47 Relevant in this context: the Paris Convention for the Protection of Industrial Property (1883), the Patent Co-operation Treaty (PCT) adopted 1970 under the auspices of the World Intellectual Property Organisation (WIPO), TRIPs (1994) or the European Patent Convention (EPC).

48 WTO, The relation between the TRIPs Agreement and the Convention on Biological Diversity. IP/C/W/368, 2002; WTO, Environment and TRIPS, WT/CTE/W/8, 1995; Patricia Lucia Cantuaria Marin, Providing Protection for Plant Genetic Resources. Patents, Sui Generis Systems and Biopartnerships. New York, 2002; Jayashree Watal, Intellectual Property Rights in the WTO and Developing Countries. The Hague, 2001.

49 Leskien/Flitner, supra note 44, p. 9.

50 Carlos M. Correa, Biological Resources and Intellectual Property Rights, in: EIPR Nr.5/1992, pp.154-157; Carlos M. Correo, Intellectual Property Rights, the WTO and Developing Countries. New York und Third World Network, Penang, 2000; Marin, supra note 48; Dutfiled, supra note 34; Leskien/Flitner, supra note 44.

51 CIMMYT, Dimensions of diversity in: CIMMYT bread wheat from 1965 to 2000, 2000, p. 26.

52 India for example had to forgo the adoption of a specific technology for cotton pest control (b.t. technology) into their national breeding programmes since royalties at the rate of US-$ 7.7 Million demanded by agro-multinational Monsanto were considered too high (RAFI 1996: 36).

Breeder's Rights. It is unclear whether a system of compulsory cross-licensing between patents and plant breeders' rights will suffice to secure access to genetic material for breeding purposes.

Experience with patents on plant biotechnological innovations corroborates the feared restrictions on access and utilisation of the protected products and processes. Patent licences, if granted by the patent holder, reduce the incentives for third parties to engage in research and breeding within the scope of protection of the patent. This indicates that broad patents, which extend to second-generation uses, have stifling effects on the breeding efforts of competitors of the first patentee. An example was the US patent on all transgenic cotton plants.[53] With its extremely wide-ranging exclusive rights it had caused a standstill in cotton research so that in the end, the US Agriculture Department attained the patent's annulment.[54] The problem is aggravated by the cumulative application of IPRs. Developing a transgenic plant variety may lead to multiple rights, such as Breeder's Rights (on the variety) and patents (on selectable marker genes, traits, as well as transformation and gene expression technologies).[55] There are already over 9000 patents on staple crops;[56] in the case of animals, in Europe alone more than 50 animals have been patented with some 600 animal patents awaiting approval.[57] The multitude of IPRs and their accumulation will step up the costs of the breeding process as well as that of the end product. In the case of plants, this will increase the pressure to develop 'universal varieties' with a big market share that can be cultivated under very different natural conditions and feature only a minimum of uniform characteristics. It will also shift any added value from farmers to agribusiness and within agribusiness from small breeders to major companies that are equipped with the appropriate technology and with patents. Today, four multinationals hold 44 per cent of all patents on staple crops.[58] Concentration processes are likely, leading to the fusion of corporate genebanks and breeding populations, thus not only reducing diversity of breeding strategies but also increasing the risk of genetic erosion.[59]

Current developments

Against this backdrop, the current tendencies of strengthening international IPR regimes are questionable. While TRIPS is still being severely criticized (especially from a developing country perspective), a new trend has emerged especially with the US, but also in the EU, to conclude bilateral "TRIPS Plus" treaties with developing countries that go beyond TRIPs. For example, they define the UPOV 1991 provisions[60] as an effective sui generis system and demand "the highest international standards" in intellectual property rights protection, including patent protection of plant and animal varieties and of biotechnological inventions.[61] At the same time, the development of the Substantive Patent Law Treaty (SPLT) under the auspices of WIPO is being pushed.[62] The draft treaty not only strives for minimum standards (like TRIPS) but it defines both the top and the bottom line of IPR standards. The draft strongly expands the conditions of patentability (no concept of invention, no technicality), will probably restrict exclusions from patentability and aims at prohibiting member states from making any further demands[63] on patent applicants than those found in the treaty.[64] Some potential for a movement away from mere tightening of patent regimes might be provided by internal processes in the WTO. Firstly, in 1999 a review of TRIPs Art. 27.3 (b) was started. It was initiated largely because the United States, under pressure from private industry, wanted to negotiate stronger life patenting requirements without exclusions for plants and animals.[65] However, other members have perceived the review as an instrument to drive back bio-patenting. As the process has reached a deadlock, it is at present unforeseeable whether the US position will prevail. Secondly, the Doha Mandate in § 19 sets on the negotiation agenda the relationship between the TRIPS Agreement and the Con-

53 US patent No. 5159135.

54 Achim Seiler, Die Bestimmungen des WTO-TRIPS-Abkommens und die Optionen zur Umsetzung des Art.27.3(b): Patente, Sortenschutz, Sui Generis. Studie im Auftrag der GTZ, Frankfurt, 2000, p. 16. Patents with similar width have been granted by the European Patent Office, e.g. to soy (Patent specification 0301749 B1).

55 Suri Seghal/Jan van Rompaey, IPR Complexities in the Global Seed Industry: "Seed World", May 1992.

56 Action Aid/Berne Declaration/IATP/Misereor: Trips on Trial - The Impact of WTO's Patent Regime On the World's Farmers, the Poor and Developing Countries, 2001, p. 8

57 Greenpeace, Zootiere, Rennpferde und Menschen. Patente auf Leben: Dokumentation über Anmeldungen am Europäischen Patentamt 1999-2000. Hamburg 2001, p. 8.

58 Action Aid et al. supra note 56, p. 8

59 For animal breeding, Wetterich (2001: 46) points out that with each merger independent breeding populations are merged in order to increase the selection intensity in the subsequently enlarged population. Since a higher selection intensity implies an increasing exclusion of individuals from reproduction it enhances the risk of genetic erosion.

60 See some remarks on sui generis options below.

61 GRAIN, TRIPS-plus: where are we now? August 2003.

62 Cf. WIPO, Draft Substantive Patent Law Treaty. Standing Committee on the Law of Patents, Eighth Session, Geneva, November 25 to 29, 2002.

63 Such additional demands could include requirements for the disclosure of the origin of genetic resources and traditional knowledge or evidence of prior informed consent and benefit-sharing (see below).

64 GRAIN, WIPO moves toward "world" patent system, July 2002.

65 Bragdon/Downes, supra note 43, p. 11; CIEL (Center for International Environmental Law), The 1999 WTO Review of Life Patenting Under TRIPs, 1998.

vention on Biological Diversity (CBD). This raised the question whether TRIPS should be amended to incorporate certain requirements of the CBD.[66] Particularly, patent applicants might be required to disclose the origin of any genetic material or traditional knowledge used in inventions and to demonstrate that they have obtained prior informed consent from the competent authority in the country of origin and entered into appropriate benefit-sharing arrangements. Though it is unclear whether the development of an IPR regime for traditional knowledge[67] might not lead to a further tightening up of the IPR system, which can be considered detrimental to agrobiodiversity, disclosure of origin and prior informed consent address "bio piracy" of biological resources and traditional knowledge, thus adding to a more equitable system (Correa 2003: 1). However, determining the "origin" of genetic resources for food and agriculture will prove difficult, since international exchange in breeding has led to a strong interdependency among countries. A last strand of discussion to mention is the debate on the design of "effective sui generis systems" under Art. 17.3 (b) TRIPs. This provision is only relevant for developing countries, which have yet to dispose of a regime for plant variety protection. A number of suggestions have been made. They range from the adoption of a UPOV 1991 or UPOV 1978[68] to developing alternative PVP systems with different criteria as well as to an opening of the protection system for benefit sharing agreements, Farmers' Rights[69] or the protection of communities' intellectual rights.[70]

5.1.2 Sovereignty

At the international level the questions of access relates to the public vs. national sovereignty over resources. As with private right restrictions (IPRs), access to, and exchange of genetic resources can be hampered by way of sovereignty regimes.

In 1992 when the Convention on Biological Diversity was passed, a major shift in the property regime concerning genetic resources took place: Up to then, biological resources were considered a "common heritage" or public good, and access to them was unrestricted. Compared with this, the new regime was one of national sovereignty over genetic resources, including those for food and agriculture. Thus, biodiversity was attributed the same status as other natural resources like oil and ores. The background for this change was that during the 1980s the utility value of biodiversity (for pharmaceutical and industrial purposes) became more apparent, especially combined with the emergence of new methods of biotechnological use and bioprospecting. The utilisation perspective began to dominate the international debate on biodiversity loss that led to the CBD negotiations.[71] As it is the South where the major part of global biodiversity is concentrated, developing countries played an important role in raising equity concerns about the open access system. They argued that if Northern companies were to continue to exploit the species and genetic resources of the South, while the South had to pay when making use of the breeding results, an equitable sharing of benefits was necessary to compensate for the unequal exchange. The concept of common heritage favoured by the industrialised countries and nature protectionists was successfully rejected.[72] The CBD instead recognizes the sovereignty of nations over their genetic resources, thus defining property rights. It also requires the establishment of conditions of access to genetic resources and the fair and equitable sharing of the benefits arising out of their utilization (Art. 15 CBD). The core of the access regime is a bilateral system that is subject to mutually agreed terms and prior informed consent. On a case by case basis, nation states and companies that want to use genetic resources from the country sign public-private contracts on the exchange of genetic resources as well as monetary and non-monetary benefits such as technologies and knowledge. A number of such biopartnerships have been agreed with varying degrees of success.[73] The crucial point is the negotiation of fair and clear contractual terms in a situa-

66 WTO, The relation between the TRIPs Agreement and the Convention on Biological Diversity. IP/C/W/368, 2002, pp. 3.

67 cf. WIPO, Consolidated survey of Intellectual Property Protection of Traditional Knowledge. Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore, WIPO/GRTKF/IC/5/7, 2003; IISD (International Institute for Sustainable Development), Traditional Knowledge and Patentability, IISD Trade and Development Brief, No. 7, IISD, Winnipeg, Summer 2003, pp. 4; Graham Dutfield, Protecting Traditional Knowledge and Folklore: A review of progress in diplomacy and formulation policy. International Centre for Trade and Sustainable Development (ICTSD), 2002.

68 which prohibits double protection and still grants both the full farmers' privilege and breeder's exemption.

69 Farmers' Rights cannot be examined further in the context of this article. They were defined in the non-binding International Undertaking on Plant Genetic Resources for Food and Agriculture (IU), in FAO Conference Resolutions 5/89 and 3/91 Cf. Martin Girsberger, Biodiversity and the Concept of Farmer's Rights in International Law, Berne 1999.

70 Biothai/Grain, Signposts To Sui Generis Rights. Resource materials from the international seminar on sui generis rights, 1998; Leskien/Flitner 1997, supra note 44.

71 Lorraine Elliott, The Global Politics of the Environment. New York 1998, p. 74.

72 Gudrun Henne, Das Regime über biologische Vielfalt von 1992. In: Sebastian Oberthür/Thomas Gehring (Hg): Internationale Umweltschutzregime. Opladen 1997, p. 190.

73 Marin, supra note 48 pp. 120, Harvey Bialy, Latin America. A new look in North-South biopartnerships. Nature Biotechnology, vol. 16 (11) 1998, p. 986.

tion that might be asymmetric in terms of information and power shares.

As the exchange of genetic material in the field of agriculture is much more common, breeding having long since been an internationalised activity, it was obvious that the CBD bilateral system would not be optimal for agro-genetic resources, for the transaction costs of negotiating bilateral agreements would simply be too high. Also, it was feared that developing countries would stop to contributing genetic material into international gene banks since access to ex situ collections was not addressed by the Convention – a loophole threatening to undermine the CBD. Therefore, in order not to thwart the CBD adoption, it was agreed to regulate this issue under the auspices of the FAO, traditionally responsible for agriculture.[74] This change of forum lead to the revision of the International Undertaking on Plant Genetic Resources for Food and Agriculture (IU), a non-binding instrument that had to date governed access to plant genetic resources for food and agriculture (PGRFA). Still based on the concept of "heritage of mankind", the IU needed to be brought into harmony with the CBD. After eight years of tough negotiating, an internationally binding Seed Treaty (International Treaty on Plant Genetic Resources for Food and Agriculture/ITPGR) was signed in 2001, which regulates facilitated access to PGRFA.

Different access regimes

The crucial difference in the access regimes of CBD and Seed Treaty is that the latter is based on a Multilateral System (Art. 10 ITPGR). This Multilateral System consists of a list of 35 food and feed crops for which the member states will provide facilitated access.[75] The respective genetic material belonging to public institutions[76] will be kept in the public domain. "Facilitated access" means that an exchange free of charge or at minimum fees may exclusively take place for breeding, research and – expressly not for industrial purposes (Art. 12.3 (a) (b)). Unlike in the CBD there is no need to apply prior informed consent procedures on a case-by-case basis. Although a number of countries (among others the EU) aimed at maintaining open access to PGRFA, a restriction in the form of a list was inevitable; especially the Group of Megadiverse Countries under the leadership of Brazil had fought hard for it and wanted to keep it as short as possible. A standardised Material Transfer Agreement (MTA) will specify the details of access and will also be the basis for private contracts between the providers (mostly gene banks) and the demanders of PGRFA. Many questions are still open and will need to be clarified once the Treaty comes into force.[77] One of those questions is the status of intellectual property rights, since the interpretation of the Treaty's wording on the protection of material received via the multilateral system is still very contentious.[78] Some discern it as a loophole since the holder of an IPR, specifically of a patent, could restrict use of the protected sequence or compound by others, and even access if the patent covered the method of isolation, so that the Seed Treaty's intention of facilitating access would be undermined.[79] Despite some weak spots the ITPGR is certainly an essential instrument for ensuring the sustainable use of PGRFA. It might serve as a blueprint for dealing with farm animal genetic resources that have not yet been the object of much specific consideration within international politics.

6 Seed and breeding regulations

Seed and breeding law is national law, although some aspects in EC countries underlie European harmonisation. As an example, aspects of German seed law and animal breeding law will be described in order to outline what other legal factors apart from IPRs and international access regulation may turn out to restrict the development of agrobiodiversity. They are problematic in terms of agrobiodiversity to the extent that they promote the streamlining of selection criteria. Also, by implicitly furthering high performance varieties and races they contribute not only the displacement of traditional varieties/races but also to the spread of high input agriculture.

Seed law

In plant breeding, independent of private law on variety protection, EU member states, most transition countries and some developing countries feature a compulsory variety registration under public law.[80] This means that in order to market seeds commercially, the variety needs to fulfil specific

74 Resolution 3 of the Nairobi Final Act.

75 This implies that as long as the list is not extended all other crops will fall under the Bilateral System of the CBD.

76 This refers mostly to national and international (CGIAR) genebanks.

77 In order to take effect, 40 ratifications are needed. At present, 33 countries have ratified.

78 Art. 12.3 d ITPGR reads that "Recipients shall not claim any intellectual property or other rights that limit the facilitated access to plant genetic resources for food and agriculture or their genetic parts or components, *in the form received* from the Multilateral System" (italics added). The construction of this phrase opens the door for multiple interpretations.

79 Graham Dutfield, Trade, Intellectual Property and Biogenetic Resources: A Guide to the International Regulatory Landscape. Geneva, 2002: p. 17; Commission on Intellectual Property Rights, Integration Intellectual Property Rights and Development Policy. Report of the Commission on Intellectual Property Rights. London 2002, p. 69.

80 David Gisselquist, Regulatory Issues. In: D. Wood/J. M. Lenné (ed.): Agrobiodiversity: characterisation, utilisation and management. Oxon 1999, p. 413.

criteria. The basic principle of the German Seed Law (SaatG)[81] concerning agricultural varieties goes: Seeds and seedlings can only be marketed when they are approved of; they will only be approved of when they belong to a variety that is registered.[82] For variety registration, Germany, like many other countries, has established a double set of requirements. Firstly, the "DUS" criteria, that are also crucial for variety protection, demand that plants grown from a specific lot of seeds are *d*istinct and *u*niform, and that their characteristics are *s*table over a minimum of 2 years. For the reasons outlined above (chapter 5.1.1), it is the uniformity criterion (§§ 30.1, 32 SaatG) that some experts are very sceptical about. In addition to the DUS, set seed registration in Germany presupposes that the variety demonstrates *v*alue in *c*ultivation and *u*se (VCU) (§ 30 (1), § 34 SaatG). A government agency, the Bundessortenamt (Federal Agency for Varieties), conducts the DUS and VCU tests, which are paid for by the breeding companies, who also pay an annual fee for the listing of registered cultivars. The VCU, or performance criteria, are a bundle of value designating qualities such as qualities of cultivation, resistance, yield and quality. The VCU is, under German Seed Law, the toughest standard that a breeder has to comply with in order to get a new crop registered; some 90% of applications fail, mostly due to lacking VCU.[83] Varieties are considered to have value in cultivation and use when the entirety of their 'value designating qualities' represents a distinct improvement vis-à-vis existing varieties (at least within a regional area) in terms of the exploitation of either the harvested material or any products thereof. Individual, unfavourable characteristics may be compensated for by other favourable qualities (cf. § 34 SaatG). The specification of VCU, which is crop-specific, is being defined by the Bundessortenamt, i.e. by the executive powers. Although there have been some change in the weighting of the qualities,[84] high yield still constitutes the predominant orientation. In terms of agrobiodiversity, this adds to a relatively monostructured alignment of plant breeding. Per se, a standardisation of selection criteria is promoted. Thus, variety registration as a means that was, and is, intended for consumer (i.e. farmer) protection as a side effect streamlines plant breeding according to state preferences. And those preferences are not shared by every farmer; organic farmers, for example, require varieties with different qualities since chemical inputs in cultivation are prohibited in organic farming.[85] Another bottleneck of diversity is that seed sale of old cultivars – traditional varieties as well as out-of-date commercial cultivars – is illegal. This issue, however, is being tackled by way of an EU initiative on conservation varieties.[87] Registration of land races and varieties endangered by genetic erosion shall do without the DUS criteria and with liberalised VCU requirements. At the moment, the implementation provisions are still being drawn up by the European Commission.

Beyond seed trade law, marketing standards and grades of goods play an important role in terms of agrobiodiversity, which shall not be elaborated here in detail.[88]

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81 Saatgutverkehrsgesetz (Seed Trade Law) of 20 August 1985, BGBl. I, pp. 1633, last amended by means of the Zweite Gesetz zur Änderung des Saatgutverkehrsgesetzes (Second Law for the Amendment of the Seed Trade Law) of 21 March 2002, BGBl. I, pp. 1146.

82 Hans Walter Rutz, Rechtliche Rahmenbedingungen für die Sortenprüfung. In: Tagungsreader Workshop Züchtung für den Ökolandbau, 10./11. Juni 2002 in Hannover, p. 8.

83 Josef Steinberger, Der landeskulturelle Wert im Wandel der Zeit. In: Bundessortenamt 1949-1999, Festschrift 50 Jahre. Hannover 1999, p. 34.

84 Cf. Steinberger, supra note 83.

85 FiBL/Öko-Institut, Studie zur Abschätzung der Marktabdeckung mit ökologisch vermehrtem Saat- und Pflanzgut und Untersuchung zur Beseitigung bestehender Hemmnisse in der Sortenzulassungspraxis für Sorten, die für den Ökologischen Landbau besonders geeignet sind. Berlin 2003, pp. 55
These varieties might for example not feature certain resistances required in VDU testing because they are necessary in conventional (but not organic) cultivation, so that the respective applications are turned down (cf. Peter Kunz, Photopathologie/Resistenzzüchtung In: Joseph Steinberger, Workshop Züchtung für den Ökolandbau am 10. und 11. Juni 2002 in Hannover – Kurzfassung der Vorträge und Stellungnahmen sowie Zusammenfassung der Ergebnisse. Herausgeber Bundessortenamt 2002, pp. 29-30.). The fact that the BSA conducts performance testing under conventional cultivation conditions might have discriminating effects vis-à-vis organic farming varieties, too, since the different needs of this way of farming are not taken into account.

86 Cf. Art. 20a, Council Directive 98/95/EC of 14 December 1998 amending, in respect of the consolidation of the internal market, genetically modified plant varieties and plant genetic resources, Directives 66/400/EEC, 66/401/EEC, 66/402/EEC, 66/403/EEC, 69/208/EEC, 70/457/EEC and 70/458/EEC on the marketing of beet seed, folder plant seed, cereal seed, seed potatoes, seed oil and fibre plants and vegetable seed and on the common catalogue of varieties of agricultural plant species. Official Journal of the European Communities L25: 1-26.

87 Cf. Art. 20a, Council Directive 98/95/EC of 14 December 1998 amending, in respect of the consolidation of the internal market, genetically modified plant varieties and plant genetic resources, Directives 66/400/EEC, 66/401/EEC, 66/402/EEC, 66/403/EEC, 69/208/EEC, 70/457/EEC and 70/458/EEC on the marketing of beet seed, folder plant seed, cereal seed, seed potatoes, seed oil and fibre plants and vegetable seed and on the common catalogue of varieties of agricultural plant species. Official Journal of the European Communities L25: 1-26.

88 Based on UN/ECE norms, the EC (and for some additional crops Germany) have specified standards for a vast number of fruit and vegetables, potatoes etc. that are relevant in trade. The standards regulate quality grades, sizes (diameter, weight), tolerances vis-à-vis sorting errors, packaging and labelling for agricultural products that are sold freshly (aid 2001). While the standards aim at protecting processors, traders and consumers against cheating and aim at furthering simplification and differentiated sales, they also impact on the variety of marketed crops. Those varieties of apples, tomatoes and potatoes that are bigger or smaller than required, that are not as regular as required cannot be offered for sale to the end user except in direct marketing on farms. This has led to a comprehensive drop out of cultivation and sale of many crop varieties and to the dominance of 'standard cops'.

Livestock breeding law

The regulatory regime on livestock breeding reflects to a large extent the economic conditions. Over a long period of time, animal breeding and husbandry law have supported one-sided selection strategies focused on economic performance. They have thus contributed to the depletion of farm animal diversity. Although in the meantime the objective of "genetic diversity" is codified in the German Livestock Breeding Act[89] (§ 1.2 (4), § 4.1 TierZG), the longstanding specification of selection criteria through state agencies, which used to build the basis of performance tests and of obligatory assessments of breeding quality,[90] has fostered a narrowing of animal genetic diversity. This trend has been resumed by including into the Breeding Act the promotion of "breeding progress" as an undefined legal term (§ 5 TierZG). As a consequence of this orientation, the administrative bodies give permission for the insemination of cattle, pigs, sheep, goats and horses only if the breeding value of the sperm donating animal is higher than the average breeding value of comparable animals (§ 10.2 (1) TierZG). For chickens, there is no legal control of breeding. Nor is there access to the breeding process for chicken farmers since the existing breeding lines of laying hens and broiler are private property of a small number of trans-national breeding companies; farmers only raise hybrid chickens and they, themselves, cannot breed, correspondingly influencing genetic diversity.

7 Conclusions

This article has shown that access restrictions in the form of IPRs and sovereign rights as well as high performance oriented regulations of crop and livestock breeding might impact negatively on agrobiodiversity. The respective regimes have only developed in the past 80 years, gaining rigidity parallel to the increasing relevance of biotechnology.[91] From the 1920s onwards, these various regimes started to replace an open access regime and a largely unregulated seed and livestock sector. It needs to be stressed that the former regimes actually contained a number of deficiencies. The introduction of variety protection (plants) and performance testing (livestock) certainly increased productivity in times when food security in Europe was still endangered. Also, before the introduction of seed testing there was the danger of cheating farmers by not procuring information on the quality of the seed. The solution of restricting and privatising access and of prescribing selection objectives, however, might turn out to have caused new problems: the loss of agrobiodiversity.

A substantial part of the problem, therefore, can be described as being caused by unintended feedback of a previous strategy. In other words, it was the post-war policy of food security that promoted the industrialization of agriculture, first in the developed nations (e.g. through the EC Common Agricultural Policy) and later in developing countries. The "Green Revolution" – the political push for the introduction of new crops, irrigation, fertilizers, pesticides and mechanization from the 1960s on – aimed at closing the so-called 'development-gap' between the South and North. The model of food security not only led to major increases in production output, but also contributed – among other factors – to the global homogenising of production structures and market conditions. Agrobiodiversity loss can be considered a "second-order problem" (Jahn/Wehling 1998), to the extent that it is at least partly caused by efforts to solve (other) problems. The efforts have led, as a result, to the reduction of the fundamentals of agricultural production: agrobiodiversity. The development, therefore, is paradoxical: the result of breeding for a high yield and homogeneity for "food security" destroys the race, species and genetic diversity and, therefore, the resources on which the breeding itself is established.

The imminent challenge is thus not only about reducing given obstacles and introducing new instruments. It is also about using *reflexive* strategies to avoid causing new problems in the future. Elements of a reflexive strategy could be integrated knowledge production, the anticipation of systemic consequences, adaptivity of problem-solving, as well as participatory evaluation and goal formulation.[92] Some of these elements have already become reality, such as participatory breeding approaches as promoted by the FAO; others need to be developed.

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89 Tierzuchtgesetz (BGBl. 1998 I, 145).

90 "Zuchtwertschätzungen".

91 Kal Raustiala/David Victor, The Regime Complex for Plant Genetic Resources. To be published in: International Organisation, No. 1/2004.

92 Jan-Peter Voss, Shaping sustainable Transformation. Introducing reflexivity to processes of socio-ecological change. Forthcoming.