Benefiting from Biotechnology: Promoting small-farm competitiveness and intellectual property rights

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Abstract

The Green Revolution has contributed to alleviating poverty and hunger of hundred of millions of people, but remained technically and institutionally limited: it has largely bypassed small farms located in dry agro-ecological regions and its institutionally "top-down" approach was not equipped to address social, economic and environmental variations at the local level. However, with new developments in biotechnology, including genetic engineering, unprecedented possibilities to address the competitiveness of small farmers in Africa have risen. Yet, there are new challenges too. The new technology is driven by the private sector, which is not attracted to investing in research towards developing biotechnology specifically addressing the needs of small farms in Africa. Moreover, the accessibility of the existing technologies to small farmers is argued to be impeded by the intellectual property rights (IPR) leading to monopoly prices and hindering technology diffusion. Therefore, this paper analyses how intellectual property rights can be domestically tailored within the existing international commitments so as to incite the development of technologies that are favouring and accessible to small-scale farmers in Africa.

Introduction

The agricultural sector in developing countries is dominated by around 500 million small farms, with labour force working at low levels of productivity. Based on FAO's database, 85 per cent of these farms are small-scale, operating less than 2 hectares (Nagayets, 2005, p.356). Hence, there is an urgent need to boost the competitiveness of small-farm agriculture and its contribution to poverty alleviation through science and technology. In this context, new biotechnology, including genetic engineering, may play a historic role. Some advanced developing countries have already made significant progress in fostering technological innovation and knowledge transfer. For those lagging behind, designing an institutional framework to promote pro-small-scale agriculture is essential.

An effective intellectual property rights (IPR) regime can play an important role in such an institutional design - as the accessibility of any existing technology to farmers is equally important as its technical availability. However, there are concerns that small-scale farmers in poor countries by and large are being excluded from the benefits of new biotechnology. This is of particular importance because leading biotech companies in research and innovation have substantial market dominance in the field. Hence there is a situation whereby a highly sophisticated private industry investing heavily into research and innovation in agriculture does not seem to address the technological needs of the majority of developing country farmers. From legal and institutional perspectives, this paper addresses some of the question of why small farmers in developing countries, particularly in Africa, seem to have been left out of the process of technological development.

This takes the paper into the analysis of the WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights which obliges member countries to implement a patent system. The paper will assess the extent in which the protection requirement is flexible in its essence and content so as to leave some room for member countries to develop their own IPR regimes. We argue that the institutional challenge for African countries is to design an efficient framework that is compatible with multilateral (and in some cases regional and bilateral) IPR regimes, but more importantly capable of offering incentives for specifically pro-small scale biotechnology research and innovation in agriculture. Given the great heterogeneity of farming systems and variations in domestic institutional capacities, these countries should design their own IPR frameworks promoting both home-grown innovation and technology transfer.

This paper is organised as follows. It begins with an analysis of some of the new opportunities that new biotechnological applications offer to small-scale farmers in developing countries. Second, it provides an overview of physical, technical and institutional factors affecting the accessibility of biotechnology to small farmers. Then, the focus moves on to the flexibilities that the international patent law provides for developing countries to design their own

IPR regimes. Finally, the paper draws attention to some alternative institutional approaches and provides some policy recommendations to promote specially tailored intellectual property right regimes conducive to endogenous development through biotechnological innovations.

Making small farms more competitive

The Green Revolution has left large numbers of poor farmers located in dry agro-ecological regions untouched, especially in Africa (Hazell and C. Ramasamy, 1991). Since both the availability and the timing of water are vital for chemical fertilizers and semi-dwarf seeds to work effectively, the impact of the Green Revolution in dry ecologies without irrigation has been small. Mainly in sub-Saharan Africa and large pockets of areas in Asia, there are now an estimated number of 1 billion people living in rain-fed dry and cold ecological regions (Dixon, et al., 2001, p. 310), which has hardly been affected by the Green Revolution. Both poverty and malnutrition are prevalent in these regions where the ecological performance of staple food production needs to be improved. With innovative crop pattern diversification, these regions may become competitive in local, domestic and even international markets.

New biotechnological developments promise to offer varieties with higher photosynthetic efficiency and enhanced resistance to abiotic-stress, such as draught, excessive cold and heat. It is now possible to identify the network of genes that is associated with tolerating abiotic stress which conventional breeding technology would only identify as a result of far larger number of target traits (Garg, et al, 2002, p. 15898). For instance modifying rice to overproduce trehalose – a compound that exists in certain organisms such as bacteria, yeast, and resurrection plants which stabilises biomolecules under stress condition – proved to improve its tolerance to salt, drought and cold stresses (Garg, et al, 2002, p. 15898). Similarly, research on frost tolerant potatoes in Bolivia, salt tolerant wheat in Egypt and cold tolerant tomatoes in China has been underway (FAO, 2002). Using genetic engineering to improve pest and disease resistance in East African bananas also offer higher productivity gains as compared to conventional breeding (Smale, et al. 2006). Similarly, biotechnological tools, such as marker-aided selection, has been used to improve the efficiency of conventional breeding techniques in order to identify drought tolerant maize traits to be bred with other varieties, such as African maize, which has improved the crop's biomass efficiency (i.e. higher proportion of seed development as compared to overall vegetation); (Nuffield Council on Bioethics, 2003, p. 21; Bruce, et al., p. 13).

Another major challenge facing small farmers in Africa is to diversify their production from staple foods to higher value cropping patterns with an increasing share of vegetables, fruits and livestock. Since these commodities have higher income elasticity for demand, they provide new opportunities for competitive farmers in the continent experiencing population growth, increasing urbanization with a widening middle-income class. However, the conventional applications of the Green Revolution in the 1970s and 1980s focused only on staple food products, mainly wheat and rice, paying almost no significant attention to horticultural crops and livestock products. Hence, African farmers now need scientific research and technological innovation in a wide range of high-value farm products.

Molecular biotechnology in horticultural crops has potential to offer improvements in both reducing costs and achieving high standards. However, the vast diversity of varieties in horticulture covering relatively small acreages makes it difficult to achieve adequate economies of scale, attractive enough for the private sector to undertake extensive biotechnology research (Alston, 2004, p. 86). Some genetic traits have been developed, such as herbicide tolerant tomato and lettuce, pest-resistant broccoli and potato, virus resistant raspberries and plums (Clark, et al., 2004, p. 89-94). Similarly, tomato with a silenced gene associated with fruit softening was developed with the effect of improved taste and longer shelf life (Clark, et al., 2004, p.90). [1] Although the marketing of genetically modified horticultural crops is not yet feasible given the unfavourable perception of consumers, biotechnological tools, such as marker-aided selection, could be used to improve the efficiency of conventional breeding techniques in horticultural crops. Nevertheless, the new technology remains underutilized and the vast majority of the new varieties remain uncommercialized (Clark, et al., 2004, p. 89).

In the field of livestock products, scientific research and innovation is also crucial for the competitiveness of farms in Africa. Livestock plays a vital role in rural livelihoods by providing farmers with a vital source of protein, asset base and income. Similar to horticultural crops, markets for livestock products have been growing in Africa. Biotechnological tools such as molecular markers and quantitative trait loci (QTL), identifying genes associated with desirable traits, and methods like artificial insemination, embryo transfer and in vitro fertilization that are used to disseminate superior germ plasm offer potential benefits for the poor. Productivity growth through these scientific innovations is expected to come from enhanced breeding scheme designs, improved quality and welfare of offspring, higher productivity and nutritional value in milk and meat production. Biotechnology is also used to improve the nutritious efficiency of livestock by modifying either the feed to improve its digestive productivity or the animals to improve their metobolismic productivity to make betters use of existing feeds (higher weight-gain and milk production per feed intake) (Madan, 2005, p. 133). Finding more effective ways of fighting animal diseases is also of crucial importance in the vast majority of African countries lacking good veterinary services.

The development of animal biotechnology, however, has been slow as compared to crop biotechnology due to higher costs, inefficiencies in gene transfer techniques and the low rates of reproduction in animals (Madan, 2005, p. 130). Performance traits such as growth are associated with many genes, making research more complicated and potentially more expensive (Van Eenennaam, 2006, p. 136). Apart from transgenic research animals, there are only a few genetically modified animal product commercialized for the world agricultural markets. Moreover, the private sector's interest in investing in pro-poor livestock biotechnology has been absent. As a result, although reproductive techniques such as artificial insemination and embryo transfers are used in developed countries, African countries are lagging behind. For instance, more than 60 per cent of all embryo transfers (around 450,000), mainly in diary cows, in 2001 were undertaken in North America and Europe (Madan, 2005, p. 131). Since many animal species are unique to their local environment, each with different nutrient efficiency, disease resistance and development productivity (Madan, 2005, p. 133), there is an increasing need for specifically designed biotechnology applications addressing the needs of farmers in Africa. East Coast Fever Vaccine project coordinated by the International Livestock Research Institute (ILRI) in Kenya is a good but rare example of such applications.

International Intellectual Property Law and Agricultural Patents: Overview of Obligations and Flexibilities

The new biotechnology can be problematic when it comes to promoting competitiveness in developing countries. On the one hand, there is an increasing knowledge gap between developed and developing countries (Rausser, et al., 2000, p. 512). The fact that the new biotechnology has become increasingly more sophisticated, scientific research and trials requires heavy investment, excluding many African countries with limited resources to spend on R&D. The US, the UK, Sweden, Australia and Switzerland are leading countries in the field, while there are only a few developing countries making significant progress, such as South Africa, China and India. On the other hand, the knowledge gap between public and private research institutions is also widening. The research and development activities and subsequent technological adaptations have been dominated by the private sector which holds key methodological knowledge necessary for further innovation (Timmer, 1998). Some experts even argue that increasing scientific gap between developing and developed countries and the dominance of the private sector is creating a “scientific apartheid” (Serageldin, 2001).

Small-scale farmers are particularly disadvantaged – as leading biotech companies are inclined to design their products based on the needs of large-scale farms, especially in developed countries. First, given the limited purchasing power of small farms, it is only natural that a profit-propelled industry is interested in serving the interest of those high-income farms with a propensity to buy new technologies. Second, since large farms are the main target of the industry, the companies invest more on capital and labour saving technologies, such as pesticide and herbicide resistant varieties, rather than water efficient and extra-nutritious varieties which are more relevant for small-scale farms in Africa. Similarly, in developed countries, there has been a trend of shifting research priorities from productivity to quality attributes, reflecting affluent consumer preferences (organic products, functional foodstuff etc.); (Pardey, et al., 2006). Fourth, major biotech companies tend to protect the potential gains of their innovations through contract farming rather than investing in so called ‘terminator’ technologies which are not always technically possible and/or economically feasible. As a result, transaction costs associated with contract farming are extremely higher with small-scale farms as compared to large ones, making it more feasible for biotech companies to deal with the latter.

Intellectual property rights (IPR) also constitute a major factor affecting the level of accessibility of the new biotechnology to small farmers - as its various applications have been patented all over the globe. Traditionally the argument is made that IPRs only favour development in countries after achieving a certain stage of development. Below that level, they might rather hinder infant industries to develop (Spence, 2001, p. 270). For example, European industries at the beginning of the 20th century and Japanese industry until a few decades ago were able to develop their innovative hi-tech, car and pharmaceutical industries by using the lack of patent protection and copy technologies disclosed at foreign patent offices. Swiss chemical industry, Dutch audio fabrication and Swedish car production all saw daylight in period with no active patent law in their territory. These countries had already reached a certain stage of locally induced development, however. The argument above could hence nowadays be applied to countries like India, but in theory hardly to Africa and Least Developed Countries (LDCs).[2]

In biotechnology, however, this might be different. Indeed, not only is the field relatively more investment sensitive than any other, but IP laws and patent laws in general seem to offer greater flexibilities in relation to biotechnology than in any other field of technology. Indeed, small-scale farmers might have a stronger interest in (adjusted) IPRs that incentivize the home-grown local innovation of useful biotechnology products, than it has in the possibility to freely copy technologies as developed and disclosed at foreign patent offices. Hence, it comes down to implementing an IP system that securely protects investments, while using the flexibilities allowed under TRIPs and regional patent conventions to adjust the system to local needs.

The minimum obligations that African national patent laws have to fulfil operate basically at two levels: the international and the regional level. At the international level, the WTO Agreement on Trade Related Aspects of Intellectual Property (the 'TRIPs' Agreement [3]) constitutes the major international treaty on IP law, harmonising to a large extent basic rules of patent law. [4] At the regional level, IPR treaties such as AIPO's Bangui Agreement or ARIPO's Harare Protocol are to be taken into account.

The TRIPs Agreement makes patents -enshrining the right to prevent third persons to use the patented invention without the consent of the patent holder [5] - available for any type of new, inventive and industrially applicable inventions [6]; whether products or processes; in all fields of technology; for a minimum term of 20 years [7]; and without discrimination as to the field of technology, the place of invention, or whether products are imported or locally produced. As the Agreement is imbedded in the WTO dispute settlement system, it enjoys a strong enforcement mechanism. In fact, for the first time in history, disputes over intellectual property rights can be brought before an international court. However, based on this foundation, the agreement allows for high levels of flexibilities and exclusions, particularly in the field of biotechnology.

First, there is flexibility in the date of final implementation of the TRIPs agreement depending on a member country's level of development. While developed countries had to implement the Agreement by the 1st of January 1995 already; developing countries [8] enjoyed a maximum period of implementation up to the 1st January 2005. [9] For LDCs [10], the period of transition lasted until the 1st of January 2006 [11]; except for pharmaceutical patents which are excludable from patent protection until 2016 [12]. The Council for TRIPS can, however, upon duly motivated request, extend this period. In 2005, the Council decided to extend the general transition period until the 1st of July 2013. [13] However, it is important to note that laws, regulations and practice made during the additional transitional period may not result in a lesser degree of consistency with the provisions of the TRIPS Agreement. This means that the rules which had already been established before the extension of the period may not be changed in the direction of a lower level of protection.

Secondly, within the patentability criteria of novelty, inventiveness and industrial application, member states are free to design to concrete content of these concepts. Limited exceptions of the rights [14] are possible to the extent that they do not unreasonably conflict with the normal exploitation of the patent and that they do not unreasonably prejudice the legitimate interests of a patent owner. [15] Also, the possibility to implement limitations aiming at allowing the use of patented inventions without the patent holder's consent, e.g. compulsory licenses, is fully accepted. [16] Moreover, as for the possibility of patentability exclusions for inventions whose commercial exploitation would be going against the ordre public [17] and/or morality [18], member states are free to fill in themselves. [19]

Third, as for flexibilities specifically addressing biotechnology and living matter, the TRIPs Agreement allows for excluding plants and animals from patentability, provided that an effective sui generis system [20] is established for the protection of plant varieties.[21] As regards living matter, in fact, the Agreement requires only micro-organisms, non-biological processes for the production of plant and animals, and microbiological processes to be set patentable.[22] It seems hence that plant and animal related inventions, other than non-biological processes and micro-organisms, can be excluded from patentability without infringing the basic TRIPs principle that all inventions in any field should be patentable.

Furthermore, the TRIPs Agreement offers several portals for flexible interpretations of its provisions. Although it aims at securing effective IPR protection mechanisms provided that "measures and procedures to enforce intellectual property rights do not themselves become barriers to legitimate trade", the agreement indeed also recognizes in its preamble "the underlying public policy objectives of national systems for the protection of intellectual property, including developmental and technological objectives". This is further strengthened by Article 7, ruling the TRIPs Agreement is to contribute to the promotion of technological innovation and the transfer of technology in a manner that is "conducive to social and economic welfare, and to a balance of rights and obligations". Furthermore, Article 8 provides in a portal to adopt measures necessary to protect public health and nutrition, as well as to "promote the public interest in sectors of vital importance to their socio-economic and technological development" – however, only to the extent that such measures are consistent with the provisions of this Agreement. This latter limitation would mean such concerns can only be taken into account within the borders of the TRIPs obligations and scope of rights; rendering the Article 8 possibility quite marginal. However, in literature, Article 8 has been interpreted fairly largely to eventually even serve as a legitimate portal to exclude certain inventions in the pharmaceutical or agricultural sector from patentability, if this would otherwise make the cost of access prohibitive or cause economic harm (Llewelyn, 2003, p. 330). Furthermore, still under Article 8, it is also allowed to take actions aimed at preventing the abuse of IP-rights (by the right holders) that would adversely affect the international technology transfer.

Plants and animals can be excluded from patentability under the TRIPs Agreement, provided an effective sui generis system is established for plant varieties.[23] The most largely established system of sui generis protection, the UPOV system [24], provides IP protection for plant varieties that are found -after a two year period of testing-new, distinct, uniform and stable.[25] Hereby, major differences exist as compared to the patent system which requires the disclosure of the invention that is applied for patent protection and also works with a requirement of non-obviousness; both lacking under the UPOV system. Hence it is argued that while the patent system is meant to protect <u>innovation</u>, the UPOV system protects <u>investment</u> (Llewelyn, 2003, p.316). Furthermore, as for the scope of the rights conferred, the UPOV system provides in a so called farmer's privilege, enabling farmers to save and re-use harvested seeds, and embodies a breeder's exemption, allowing the development of new plant varieties based upon an existing, protected variety.

The possibility to establish a sui generis system for the protection of new plant varieties, however, does not necessarily mean countries must join the traditional UPOV-system of plant variety protection. They may choose to design a system specifically tailored to their local needs and interests.[26] Here, the major uncertainty is to know whether or not such systems would comply with TRIPs by providing effective protection mechanisms. Before WTO judicial bodies, their effectiveness is likely to be judged upon sufficient strength of the rights conferred (Llewelyn, 2003, p. 310). This 'sui generis'-possibility is limited to plant varieties and does not cover the full range of biotechnological inventions. In particular, it does not address the protection of nucleic ('gene') sequences, nor any processes. In this context, it must be mentioned that it remains unclear to what extent countries can refuse the patenting of plant and/or animal gene sequences under the TRIPs Agreement, which only allows its member parties to exclude 'plants' and 'animals'.[27] However, it is obvious that the flexibilities and exceptions discussed above provide room for various interpretations.

The second multi-national level of intellectual property regulation affecting domestic African patent laws is composed of two regional intellectual property organisations and their conventions. On the one hand the African Intellectual Property Organisation ('AIPO') [28] brings together English speaking African countries, mainly playing a role of simplifying the administrative procedure for patent applications to its member states.[29] On the other, French speaking African countries are grouped by the African Regional Intellectual Property Organisation (ARIPO) [30] which incorporates a similar simplified application procedure but also rules substantial patent law provisions. As for biotechnology and the patentability of plants and animals, AIPO's Bangui Agreement establishes an exclusion form patentability for plant varieties, animal species and essentially biological processes for the breeding of plants or animals other than microbiological processes and the products of such processes.[31]

African countries are not making use of existing flexibilities in their patent laws. In fact, they tend to implement patent laws more or less copied from developed countries' patent acts and their patent offices tend to simply follow patentability decisions of major patent offices (United States Trademark and Patent Office; European Patent Office; Japanese Patent Office). They seem to be reluctant to implement sui generis systems for plant variety protection too. Although, many developing countries are pressured to join the UPOV system in bilateral free trade agreement-negotiations, a majority of African countries has not adhered to UPOV, let alone benefiting from the possibility to implement sui generis systems tailored to their local needs. UPOV adherence is limited to only a few African countries which have mostly joined the weaker 1978 version of the UPOV convention.[32]

IPR and Competitiveness - Public-Private Partnership

Following the era of the 'welfare state' in the 1979s and early 1980s and that of 'neo-liberalism' over the 1990s, there has been a significant shift in political/policy approach to institutional development over the recent years. The state-led centralist approach of the Green Revolution to scientific research and technological innovation is no longer considered to be feasible. In many developing countries, public research institutions, which were never designed to be competitive, find it increasingly difficult to obtain adequate resources and expertise to innovate in a rapidly developing technology field. They do not have the market knowledge and entrepreneurial drive to respond to today's world of extremely diversified and sophisticated agricultural markets. Furthermore, the design of these institutions had been based on the conventional neo-classical assumption that there is a linear path from investment and research to innovation and the subsequent adoption by farmers (Hall, et al., 2001, p. 785). This has been called into question as being simplistic and infective. Instead, the 'process' approach proposes that the technological innovation is affected by many dynamic factors leading to setbacks and irregularities requiring micro management and extensive farmer participation (Hall, et al., 2001, pp 785). Hence, there is an increasing need for developing countries to move away from the conventional institutional approaches considering scientific research and technological innovation as explicit 'public goods' achievable through linear pathways which only the welfare state has the responsibility to provide.

There is a need for new policy approaches designed to provide more institutional incentives that would enhance the role of the private sector, both local and international, to invest in biotechnology. However, without a sound legal framework stably protecting the investments/innovations, biotechnological industries cannot flourish. A specially tailored IPR regime reflecting country specific realities and priorities would be a vital tool within a comprehensive institutional framework promoting agricultural competitiveness. Hence, rather than simply imitating European intellectual property laws, African countries should benefit from the flexibilities provided under TRIPs, UPOV and Regional African Intellectual Rights Conventions to tailor special IPR frameworks. These frameworks should not only be sophisticated enough to promote home-grown biotechnological innovation and technological transfer but also conducive for public-private partnerships which are becoming increasingly common in advanced developing countries.

Public-private partnerships (PPPs) offer new institutional opportunities for enhancing biotechnological research. There are various types of institutional design for PPPs, but in general public institutions and the private sector pool their resources for research which would then benefit both the private sector and the overall public. It is usually the case that the private sector provides its methodological knowledge, financial resources and marketing expertise while the public sector is providing institutional and infrastructural support, such as introducing supportive legislation, allowing the use testing facilities and germplasm varieties. In this way, private biotech companies can gain access to large domestic agricultural markets. For big multinational biotech companies, it is also considered to be a tool of building a pro-developmental public image (Kameri-Mbote, et al., 2001, p 12). PPPs can also help public institutions convert their research outputs into end-user oriented products. They can also promote private sector development in countries with agricultural sectors dominated by state-owned monopolies (Spielman, et al, 2007, p34). More importantly, innovation-driven PPPs can play a major role in making technology both available and accessible to poor farmers.

Conclusion

The new biotechnology offers new opportunities to provide pro-small farm growth and development in rural areas in Africa. It can address the needs of small farms in unfavourable ecologies where ecological frontiers have been reached and the marginal benefits that the conventional technology has to offer has already been exhausted. Through more robust staple varieties which are tolerant to abiotic stresses, it offers farmers in ecologically unfavourable areas opportunities to improve their productivity. Research in high-value agricultural commodities such as horticultural crops and livestock which are becoming increasingly more important sources of income for African farmers is also promising. The advances in technological applications addressing malnutrition and diseases would also be major breakthrough in the fight against poverty. Hence, new biotechnology is rapidly improving its technical capacity to provide breakthrough innovation with the potential to benefit African farmers.

The technical availability, however, is no guarantee for availability and accessibility which can only be dealt with establishing right economic incentives and institutional frameworks. There is a widening knowledge gap between developed and developing countries on the first hand, between public and private sector on the other. Furthermore, multinational companies governing the market at this moment are inclined to design their products based on the needs of large-scale farms, ignoring small farms with limited purchasing power. There is a need for designing new institutional frameworks tailored ensure high accessibility for small farms while providing adequate incentive to the private sector to invest in innovation and technology transfer.

Establishing an adequate IPR regime seems essential in this context. Traditionally the argument is made that IPRs only favour economic development of countries who have reached a certain stage of development; and developing as well as least developed countries are characterized by a persistent reluctance to IP rights. Yet, small scale farming might have a stronger interest in (adjusted) IPRs that incentivize the innovation of locally useful biotechnology products, than it has in the possibility to freely copy technologies as developed and disclosed at foreign patent offices and hence in the lack of IPRs. In fact, absence of IPR regimes providing incentive and reward for innovation is seen as a major institutional constraint hindering local innovation

IPRs, in particular patents and sui generis rights for plant or animal variety protection, need however to be implemented in a well thought manner balancing rights and obligations of the right holders to the local circumstances. In this, it seems that African countries have not used flexibilities to do so as they are provided in both International and Regional patent law treaties. Hence, we argue that least developed countries need to design new institutional frameworks for intellectual property protection exclusively in the field of biotechnology. A specially designed IPR regime should be a patent protection system (rather that UPOV- system) sophisticated enough to cover nucleic ('gene') sequences and methodological processes while also being conducive to public-private partnerships.

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Endnotes

1. Development of new technologies extending the shelf life of horticultural crops that has short post-harvest lives such as banana, mango, papaya is very important. Biotechnology has been used in several flower varieties, such as carnation, rose and gerbera for the purpose of modifying a greater variety of flower colour (currently produced in South America for markets in north America) (Clark, et al., 2004, p. 93).

2. In fact, of a list of 50, 32 LDCs are WTO member states. As regards Africa, this includes Angola; Benin; Burkina Faso; Burundi; Central African Republic; Chad; Congo; Democratic Republic of the Djibouti; Gambia; Guinea; Guinea Bissau; Lesotho; Madagascar; Malawi; Maldives; Mali; Mauritania; Mozambique; Niger; Rwanda; Senegal; Sierra Leone; Tanzania; Togo; Uganda; and Zambia. Furthermore, Cape Verde; Ethiopia; Sao Tome & Principe; and Sudan are in the process

of accession (http://www.wto.org/English/thewto_e/whatis_e/tif_e/org7_e.htm (last visited 7 October 2007)).

3. Agreement on Trade Related Aspect of Intellectual Property Protection, Annex IC to the Agreement Establishing the World Trade Organization, Marrakech, 15 April 1994, 33 International Legal Material 1197 (1994).

4. For a list of (African) member states to the WTO: http://www.wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm (last visited 10 October 2007).

5. Article 28 § 1 (a) TRIPs Agreement (as regards product patents) & Article 28 § 1 (b) TRIPs Agreement (as regards process patents).

6. Article 27 § 1 TRIPs Agreement.

7. Article 33 TRIPs Agreement.

8. The decision to classify as a developed or rather as a developing country does not depend upon strict WTO criteria, but on (challengeable) self designation.

9. Article 65 TRIPs Agreement.

10. As regards LDCs, WTO follows the UN categorisation of LCDs which sets three cumulative criteria for the identification of the LDCs. According to Article 11 § 2 of the WTO Agreement (Agreement Establishing the WTO, Marrakech, 15 April 1994, 33 International Legal Material 15 (1994), available at: http://www.wto.org/english/docs_e/legal_e/04-wto.pdf (last visited 7 October 2007).

11. [Article 66 TRIPs Agreement.

12. WTO, Doha Ministerial Declaration on the TRIPs Agreement and Public Health, 14 November 2001, WT/MIN(01)/DEC/2, at § 7, available at: http://www.wto.org/english/tratop_e/dda_e/dda_e.htm (last visited 7 October 2007).

13. TRIPs Council, Decision of the extension of the transition period under Article 66 § 1 for least developed countries, 29 November 2005, available at: http://www.wto.org/English/news_e/pres05_e/pr424_e.htm (last visited 7 October 2007).

14. As guaranteed under Article 28 of the Agreement.

15. [Article 30 TRIPs Agreement. See on the concrete content of these criteria: WTO Dispute Settlement Body, Panel Report Canada – Patent Protection of Pharmaceutical Products, WT/DS114/R, 17 March 2000.

16. Under Article 31 of the TRIPs Agreement.

17. This concept is generally linked to safety issues. In fact, the Technical Board of Appeal of the European Patent Office established the principle that claimed subject matter that is likely to seriously prejudice the environment should be excluded from patentability for being contrary to the ordre public (Technical Board of Appeal of the European Patent Office, Plant cells/PLANT GENETIC SYSTEMS, 21 February 1995, T 356/93, Official Journal of the European Patent Office (1995) 545, § 18). Obviously, issues of biosafety and biodiversity immediately come to mind (See for instance: G. VAN OVERWALLE, Influence of Intellectual Property Law on Safety in Biotechnology, in World Congress on Safety of Modern Technical Systems, Saarbrücken 2001, TÜV-Verlag, pp. 664–670). Yet it remains to know to what extent patent examiners can assess safety.

18. Under EPO case law, the concept of morality is a belief about whether a certain behaviour is right or wrong, based on the totality of norms that are deeply rooted within European society and civilization (see Technical Board of Appeal of the European Patent Office, Plant cells/PLANT GENETIC SYSTEMS, 21 February 1995, T 356/93, Official Journal of the European Patent Office (1995) 545, § 6).

19. [Article 27 § 2 TRIPs Agreement.

20. This basically refers to IP systems of a different nature from those categorized under the TRIPs Agreement (Patents; Trademarks; etc.)

21. No such obligation has been incorporated as regards animal varieties, however.

22. Article 27 § 3 (b) TRIPs Agreement.

23. [The distinction between plants as a generic term and plant varieties as a taxonomical rank has been largely discussed in case law of the European Patent Office; see: Enlarged Board of Appeal of the European Patent Office, Transgenic Plant/NOVARTIS II, 20 December 1999, G1/98, Official Journal of the European Patent Office (2000) 125.

24. [UNION INTERNATIONALE POUR LA PROTECTION DES OBTENTIONS VEGETALES, International Convention for the Protection of New Varieties of Plants, 2 December 1961, as Revised at Geneva on 10 November 1972, on 23 October 1978, and on 19 March 1991, 1861 United Nations Treaty Series 281, available online at: http://www.upov.int/en/publications/conventions/1991/act1991.htm (last visited 2 October 2007), 'UPOV Convention 1991'.

25. Article 5 of the UPOV 1991 Convention.

26. [See in relation hereto: P. CULLET, Intellectual Property Rights and Food Security in the South, 7 The Journal of World Intellectual Property 3 (2004). Also, as regards protection of 'traditional knowledge': T. COTTIER and M. PANIZZON, A New Generation of IPR for the Protection of Traditional Knowledge in PGR for Food, Agricultural and Pharmaceutical Uses, in T. COTTIER & S. BIBER-KLEMM, Rights to Plant Genetic Resources and Traditional Knowledge: Basic Issues

and Perspectives, Swiss Agency for Development and Cooperation and World Trade Institute, Cabi Publishing, 2006, pp. 203-238; and also: G. DUTFIELD and J. POSEY, Indigenous Peoples and Sustainability: Cases and Actions, Utrecht, IUCN International Books, 1997.

27. In law, see the Costa Rican 'Ley de Biodiversidad' (1998) and the Andean Community's Common System on Access to Genetic Resources (1996).

28. In Europe for instance, plant, animal or even human genetic sequences are not considered to fall under the definition of 'plants', 'animals' or 'humans' but are instead equalled to chemical substances. However, the scope of a patent on a gene sequence might be larger than covering merely the gene sequence in its isolated laboratory form and might instead extend to the (plant-) organism in which the gene sequence has been entered and is performing its function, regardless of whether the organism itself is patentable. In this context, moreover, the possibility to exclude plants and animals is strongly limited by the fact that non-essentially biological processes (e.g. processes of genetic engineering) must be patentable and that the 'product obtained directly by that process (Regardless of whether this itself is patentable or not) (which can very well be a plant or an animal) has to fall under the scope of protection of such process patents under Article § 1 (b) of the TRIPs Agreement.

29. Member states to AIPO Bangui Agreement are: Benin; Burkina Faso; Cameroon; Central Africa; Congo; Cote d'Ivoire; Equatorial Guinea; Gabon; Guinea; Guinea Bissau; Mali; Mauritania; Niger; Senegal; Chad; Togo.

30. Cf. AFRICAN REGIONAL INTELLECTUAL PROPERTY ORGANIZATION (ARIPO), Protocol on Patents and Industrial designs within the Framework of the African Regional Intellectual Property Organisation, Harare, 11 December 1987, as last amended at 13 August 2004, available at: http://www.oapi.wipo.net/doc/en/bangui_agreement.pdf (last visited 7 October 2007).

31. Members to ARIPO are: Botswana; Gambia; Ghana; Kenya; Lesotho; Malawi; Mozambique; Namibia; Sierra Leone; Somalia; Sudan; Swaziland; Tanzania; Uganda; Zambia; and Zimbabwe.

32. Article 6 (c) of the Bangui Agreement on the Creation of an African Intellectual Property Organization, Bangui (Central African Republic), 24 February 1999, available at: available at: http://www.oapi.wipo.net/doc/en/bangui_agreement.pdf (last visited 7 October 2007).

33. Two versions of the UPOV convention can be adhered to: UPOV 1978 and UPOV 1991.

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