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PATENTING PLANTS The Implications for Developing Countries

Global interest in biological diversity - 'biodiversity' - and its conservation has grown rapidly in recent years, exemplified by the signing of the Convention on Biological Diversity by over 150 countries as part of the UNCED package in 1992. Farmers have a role, particularly in less developed countries (ldcs), in maintaining biodiversity among the plant genetic resources used for food and agriculture. The growth of the biotechnology industry means that certain plant genetic resources are becoming commercially more valuable, so stimulating agriculture-related research by private companies and giving rise to demands from the developers of new plant varieties for more effective intellectual property protection over their inventions and the genetic resources they contain.

Agriculture in ldcs could suffer if free access to plant genetic resources ends, not least because the types of plant produced by the private commercial sector are unlikely to meet the diverse needs of peasant farmers. Furthermore, because of the important role that peasant farmers in developing countries play in conserving local plant genetic resources, there are also concerns that restrictions on free access will reduce global biological diversity.

This Briefing Paper examines the debate surrounding the extension of intellectual property protection to plant genetic resources, and the potential consequences of this extension for ldc farmers as producers and conservers of biodiversity.

Intellectual Property Rights: Plant Genetic Resources

The large investments being made in plant genetic research by biotechnology companies are part of a global trend towards the commercialisation and privatisation of research into genetic resources. In order to safeguard the returns to their investment, companies are pressing for intellectual property protection over their inventions, including those that consist of life forms.

Whilst inventors in most fields of industry have long been granted a degree of monopoly on their inventions, in return for making their knowledge available to society and as an incentive to further innovation, systems of intellectual property protection vary greatly around the world, being tailored to match cultural differences in attitudes to property rights as well as to meet the needs of nations at different stages of economic development. In many nations, and especially in the agricultural sector, informal innovation - ie without the protection of intellectual property rights (IPRs) - is still very important.

Biotechnology companies and some governments in industrialised countries are calling not merely for the introduction of some kind of IPR, but for 'harmonisation' - ie for all countries to adopt the types of IPR system currently operating in industrialised countries. For instance, the USA is exerting pressure in this direction as part of wider multilateral trade negotiations, particularly in the Uruguay Round and bilaterally, for example through the 'Super 301' trade legislation, which applies sanctions to trading partners who refuse to recognise patents on US intellectual property.

While IPRs are not new, their extension to biological products raises new economic, political and ethical questions which are the subject of this Briefing Paper. Two forms of intellectual property protection are relevant to plant genetic resources: patents and plant breeders' rights.

Patents

A patent protects a product or process which is the result of an inventive step and which is new, useful and non-obvious. In return for patent protection, the invention must be disclosed to the public. Patents usually permit the holder to forbid commercial use, sale or manufacture of the protected product or process by others for a period of 17–20 years. Patent systems are determined by national legislation and vary from one country to another in, for example, the length of the period of monopoly rights and in coverage. Many governments exclude pharmaceutical and food products, primarily so that their nationals can benefit existing technologies.

Countries with patent systems have developed safeguards to ensure that the system serves the public interest by balancing the rights and obligations of patent holders. In addition to more general antitrust laws, some countries have compulsory licensing measures to ensure that society can benefit from important innovations even if an inventor is reluctant to work a patent.

The number and proportion of inventions formally patented tends to be higher in industrialised than in developing countries. However, it is only relatively recently that plant and animal varieties, and the genetic resources that they contain, have fallen under the patent system. The most significant step in the extension of patent coverage to genetic resources took place in 1980 when the US Supreme Court ruled in the case of Diamond vs Chakrabarty that a genetically-altered bacterium could be granted a patent. Later, in 1985, the US Patent and Trademark Office ruled that a maize plant containing an increased level of a particular amino acid could also be patented.

Even industrial countries differ widely in the patent protection that they offer for living material. At one end of the spectrum, the US now grants patents on novel DNA sequences, genes, plant parts, plant or animal varieties, and biotechnology processes. European countries grant patents for plant and animal *genes* but they have only recently considered patent protection for plant *varieties*. The EC is considering a directive for the legal protection of biotechnology inventions which would provide a framework for patent law concerning genetic resources.

The extension of patent systems to include living things is coincident with the globalisation of patent systems. Though national, most patent systems operate under the framework of the 1883 Paris Convention which is administered by the UN World Intellectual Property Organization (WIPO). This flexible framework is likely to replaced soon: WIPO is preparing a draft treaty on patent harmonisation which stipulates that all inventions be patentable. More significantly, an agreement on Trade-Related Intellectual Property Rights (TRIPs) is being negotiated as part of the Uruguay Round of GATT. The draft agreement on TRIPs requires signatories to extend patents, or other IPRs, to all inventions, including plant and animal varieties; to limit compulsory licensing; and to provide a monopoly period of at least 20 years.

Plant Breeders' Rights

Many countries have judged patent systems to be an unsuitable form of IPR for living things such as plant varieties because of restrictions on access that they impose. Therefore, in order to provide less exclusive intellectual property protection for plant

varieties, national systems of plant breeder's rights (PBRs) have developed. Most of the industrialised countries which have PBRs are members of the International Union for the Protection of New Varieties of Plants (UPOV), an inter-governmental association outside the UN system. The UPOV Convention, agreed in 1961, provides a framework for national PBR legislation. Although others cannot commercialise a protected variety without permission from the PBR holder and payment of a royalty, the genetic material contained within that variety is freely available for the purpose of breeding other varieties, under the 'breeders' exemption'. Similarly a 'farmers' privilege' allows farmers to re-sow seed harvested from protected varieties for their own use. These are two important differences from the patent system.

The UPOV Convention was revised in 1991 and now member states do not have to guarantee the breeders' exemption or the farmers' privilege. Also, the protection provided by PBRs has been extended from the propagating part of the variety (the seed) to the whole plant, including grain for food in the case of cereal crops. Together, these changes make the PBR system more similar to the patent system.

The Current Situation

While the extension of IPRs to genetic resources and the harmonisation of IPR regimes are highly likely, the exact pattern of change is difficult to predict. It will depend on:

- whether the revisions of the UPOV Convention agreed in 1991 are translated into national PBR laws;
- whether agreements are made on patent system harmonisation in WIPO; whether an agreement in WIPO allows for compulsory licensing and the extension of patents to genetic resources; and whether the principle of farmers' privilege is applied to patents for plant varieties;
- whether ldcs implement intellectual property protection; and, if they do, which system they choose (patents, PBR, revised PBR);
- whether agreements are made on TRIPs in GATT; whether the resulting agreement is linked to the General Agreement on Trade in Goods, through cross-retaliatory trade mechanisms; and whether the TRIPs agreement allows compulsory licensing. The draft agreement on TRIPs, which is likely to form the basis for an agreement under GATT, stipulates that signatories must provide for the protection of plant varieties 'either by patents or by an effective *sui generis* system'. This could be plant breeders' rights;
- the extent to which any new legislation is enforced.

It is unlikely that any new IPR regimes would be enforced rapidly and widely, particularly amongst farmers in developing countries, but the existence of more extensive intellectual property protection for plant genetic resources could, in the long run, have a substantial impact on global biological diversity, on developing country agriculture and on plant genetic research in the long run.

Biodiversity, Plant Genetic Resources and Peasant Farmers

At the 1992 UN Conference on Environment and Development (UNCED) a comprehensive Convention on Biological Diversity was agreed to promote both the conservation and the utilisation of biological diversity at three levels: ecosystems, species and genes. The implicit intention is that sharing the benefits of biodiversity use will promote conservation: that conservation will be encouraged by providing incentives, and enabled by providing the technological and financial means. The convention comes into force on 29 December 1993.

The convention addresses IPRs on genetic resources in its Article 16, but only in a general way: on the one hand it recognises IPRs, on the other, calls for mechanisms, which it does not specify, to be developed to ensure that IPRs do not prove a barrier to technology transfer. Further, it calls for cooperation to ensure that IPRs are supportive of and do not run counter to the wider objectives of the Convention.

Plant genetic resources for food and agriculture (PGRFA) comprise the range of plants which have long been managed by humans in farms and forests as well as the wild relatives of these plants. PGRs provide resistance to pests and disease in plants, tolerance to environmental extremes, and specific culinary and nutritional qualities. Their value to agriculture is already well-known, and their potential as a 'raw material' for the biotechnology industry is increasingly being recognised. Since 1983, international cooperation in the field of PGRFA has been governed by the non-binding International Undertaking of the UN Food and Agriculture Organisation.

About 120 plant species are important as food crops world-wide, but 90 per cent of human energy intake is met by 20 crops, and just three crops – maize, rice and wheat – provide 60 per cent. The main diversity in food crops has always existed at the intra-species level, manifested by the vast array of varieties of the principal crops. For example, in the Philippines 123 rice varieties have been found on just 5 sites; in the Andes 50 potato cultivars on one farm are typical in many areas; and in Malawi 12 bean cultivars are used on an average farm.

Diversity is deemed important for food security at global and local levels: agriculture in practically all countries is heavily dependent on a supply of plant genetic resources from other parts of the world. North America, for instance, is dependent on other regions for genetic resources for its major food crops. Africa South of the Sahara is dependent on other parts of the world for 87% of the plant genetic resources needed. The agricultural systems of the industrialised world are particularly dependent on PGRFA from tropical and subtropical regions of developing countries where most of the centres of diversity from which PGRFA originated are located.

Genetic Erosion and Agricultural Development

There has been an increase in genetic diversity from the birth of agriculture until recent times as a result of the human management of plant genetic resources on farms, such as crossing different cultivars, and saving seed from spontaneous mutations and wild relatives of food crops. In recent years this genetic diversity has declined rapidly. The loss of PGRFA is closely bound up with agricultural development itself, particularly with the introduction of modern varieties. Biotechnology is likely to accelerate genetic erosion by facilitating the breeding of modern varieties.

The 'Green Revolution' from the 1960s onwards provided new short-straw, fertiliser-responsive varieties of rice, wheat and maize which greatly increased yields where water supply was reliable and contributed to an increase in world food production. But as farmers replaced their many traditional varieties with a few introduced ones, valuable genetic resources were lost. A handful of rice varieties now cover the majority of rice lands in Asia where once thousands of varieties were grown. In Zimbabwe, two hybrid varieties account for 90% of all maize seed planted, and have displaced many traditional varieties of millet and sorghum.

The genetic base of the new varieties is narrow. This is an inherent outcome of conventional scientific plant breeding, where repeated cycles of selection reduce the level of variation within a plant population. It is also a legal requirement for any variety for which IPR protection is sought; the variety must be sufficiently uniform and genetically distinct to make it clearly identifiable.

The initial response of the international community to the threat of genetic erosion was to build a network of 'gene banks' where seeds of the abandoned varieties could be stored and conserved *ex situ*. However, *ex situ* conservation of plant genetic resources has resulted in some loss of viability and of characteristics, and farmers are being encouraged to conserve traditional varieties on-farm. For instance, Agenda 21 — the

Could Farmers Patent their Own Varieties?

Developing countries confront a system which maintains open access over their genetic resources while establishing private property rights for improved products based on those resources. Could the patent system be used to protect their own genetic resources? Is it possible to use existing or modified IPR regimes also to protect 'unimproved' genetic resources, and to use them as a tool in biodiversity conservation?

Conventionally the answer would be 'No'. But if genes, gene-constructs and genetic characteristics can be patented in industrialised countries, why cannot developing countries patent their own genetic resources?

Theoretically, a form of plant breeders rights' could be applied to plant varieties whether they are 'invented' or 'discovered'. However, wild plant varieties as well as 'landraces' and other farmers' varieties would not meet the criteria that varieties must be *distinct, uniform* and *stable* for PBR protection under the UPOV Convention. Because these varieties are often variable - and therefore important sources of genetic diversity - they cannot be protected under existing PBR schemes. Perhaps an adapted PBR system could be developed which dispenses with the requirements for uniformity and stability, but this would make it difficult to meet the 'distinct' requirement.

Similar problems would exist if the patent system were to be used. For a patent to be granted for an invention, normally the invention has to be fully described as part of the application. With living materials, clearly this cannot be done, and most patent offices accept a deposit of the material instead. Whilst this requirement could be met for the highly diverse genetic material under discussion (as it is in a genebank sample), there is no guarantee that the sample would be representative of the wider genepool. Another approach would be to claim patent rights over genes or genetic characteristics which occur in the wild or in farmers' varieties. However, problems of ownership would certainly arise if the same characteristic is found elsewhere. If ownership were vested in the sovereign state, then competing claims might be made by other states. The legal costs of these sorts of approaches might soon escalate.

Despite these potential limitations, the State of Queensland, Australia, has passed legislation giving it IPRs over genetic information embodied in the plants and animals found in the state. Similar initiatives have not been taken so far by developing countries.

programme of action for sustainable development agreed at the UNCED — emphasises the conservation and utilisation of plant genetic resources *in situ* as a component of programmes to promote sustainable agriculture.

Genetic Resources and Peasant Farmers

Small-scale farmers outside the limited high-potential agricultural areas constitute about 80 per cent of the total in developing countries. The areas which they farm are characterised by complex interactions among a wide range of plant and animal species in agro-ecological conditions which are diverse and risk-prone. Modern varieties are generally less resilient than local varieties ('landraces') under these conditions, and perform poorly unless inputs designed to enhance their performance can be supplied (fertiliser; pesticide; irrigation). In the majority of peasant farming areas such inputs are difficult and expensive to obtain, and they represent a high risk strategy since their use increases the financial loss that crop failure would incur.

An alternative strategy has been for peasant farmers, as informal plant breeders, to adapt crops to the specific requirements of their agro-ecological environment and socio-economic situation. The wide range of traditional landraces maintained on farms is the result of this work, and more than 85 per cent of seed in most developing countries is produced by farmers themselves. Farmers therefore both depend on genetic diversity as the 'pool' from which their landraces are drawn, but also contribute to the maintenance of diversity by their very strategies of growing a wide range of cultivars which interbreed among themselves and, in some cases, with wild relatives. The role of farmers in developing plant varieties was recognised at the FAO Conference resolution in 1989, endorsing the concept of Farmers' Rights - *'rights arising from the past, present and future contributions of farmers in conserving, improving, and making available plant genetic resources'*. Subsequently, recognition has been given in other international agreements, notably the Convention on Biological Diversity and UNCED's Agenda 21. According to the FAO resolution, Farmers' Rights are *'to allow farmers, their communities, and countries in all regions, to participate fully in the benefits derived, at present and in the future, from the improved use of plant genetic resources, through plant breeding and other scientific methods.'* However, substantial political and practical difficulties are likely to be met by attempts to implement Farmers' Rights (see Box).

It is sometimes argued that most peasant farmers are beyond the scope of the 'Green Revolution' approach to agricultural development since the varied needs of farmers in these diverse environments cannot be easily met by a small number of highly uniform new varieties which are heavily dependent on external inputs. It is claimed that the new technologies should build upon farmers' existing knowledge and technology systems employing a decentralised and participatory approach to technology development which draws upon innovation in both the 'formal system' of research laboratories, plant breeders and private companies and in the 'informal system' of farmers and their communities. Besides being more likely to meet small farmers' immediate needs, such an approach might also contribute to maintaining genetic diversity. New systems of plant breeding have therefore been envisaged, in which formal scientific breeding is integrated with farmers' traditional practices. Whether IPRs are compatible with such systems is discussed below.

Consequences of IPRs for Agriculture and Genetic Diversity in ldcs

Access to Plant Genetic Resources and Effects on Domestic Plant Breeding

Historically, agricultural development in industrial countries has been dependent on public sector plant genetic research rather than on private companies. The same was true of the Green Revolution in ldcs in the 1960s and 1970s, and private plant breeding companies, focusing on the small areas of highly commercial agriculture, are only recently beginning to emerge. Nowadays, whether a developing country will benefit from the introduction of PBR or patent legislation depends on the extent to which a private plant breeding sector is present in the country. PBRs promote local private sector plant breeding oriented to the needs of local commercial agriculture.

In the few developing countries where there is a high level of research and development in biotechnology, patent legislation may promote the availability of patented biotechnology innovation, and increase cooperation between foreign and local companies. Set against this, the granting of patents on plants involves the risk that access to a common pool of plant genetic resources, essential to plant breeding, is likely to become restricted.

Experience shows that most foreign countries registering their patents in ldcs do so in order to protect the import of their products, rather than to initiate local production. Furthermore, the international seed market now, unlike the seed market at the time when industrialised countries adopted their PBR laws, is dominated by a few seed companies poised to achieve market dominance in individual developing countries. Under these conditions, patents or PBR will mainly facilitate the introduction into developing countries of foreign varieties with a narrow genetic base.

The adoption of PBR may encourage seed companies in UPOV member states to make larger investments in varietal development and to distribute their new varieties rapidly. On the other hand, costs to farmers using these varieties will increase as royalties will have to be paid and farmers may be obliged to purchase new seed for each crop. Many farmers in developing countries will no longer be able to afford new varieties. However, if a developing country does not adopt IPR legislation, foreign IPR holders may be reluctant to export new varieties to it. If an ldc grants patent protection for foreign plant material, access to this material could be enhanced.

Attempts to limit patent protection, through compulsory licensing for example, would influence these results. However, WIPO and GATT proposals allow for compulsory licensing only in extreme circumstances.

The 1991 revisions to the UPOV Convention extend PBR protection from the propagating part of the plant to all material derived from the protected variety. This means that countries which do not recognise PBRs and therefore do not require royalties to be paid on seed (ie virtually all ldcs), would not be able to sell grain produced from protected varieties to UPOV member states. Similar effects would result from the extension of patents to cover genetic material.

Implications for the Conservation of Plant Genetic Resources by Peasant Farmers

The commercialisation of plant breeding promoted by IPRs has led to intensive breeding of new varieties with a limited genetic base. As discussed earlier, these varieties do not always meet the needs of small farmers. The adoption of intellectual property protection for plant material may therefore speed up the marginalisation of low-input farmers. They are less likely to benefit from the seeds produced commercially, while the extension of private seed companies may lead to erosion of the role of public sector breeders and undermine informal seed exchange mechanisms.

Increased intellectual property protection will also affect the biodiversity conservation activities of peasant farmers. This is perhaps the biggest threat of IPRs to biodiversity. In the long run the maintenance of global plant genetic diversity depends less on the relatively small number of formal plant breeders producing improved varieties for the marketplace, than on the vast number peasant farmers who develop and maintain varieties to meet the needs of agriculture in highly variable environments.

Local varieties need to be enhanced using modern plant breeding techniques, and farmers themselves need to be able to develop locally-adapted varieties using enhanced germplasm produced by plant breeders. Progress in agricultural development consistent with conservation of PGRFA will require the formal and informal sectors to work together, but intellectual property protection may drive a wedge between them. Under patent law, farmers or local public sector plant breeders cannot develop or maintain varieties for local distribution by resowing and crossing seed saved from the harvest of a protected variety, without permission and without the payment of royalties. In patenting applications, protection can be claimed even for individual genetic characteristics. A situation could arise where, if a protected gene finds its way into another variety (whether by deliberate or accidental crossing, or natural introgression), the patent holder could exercise their claims over the resulting variety. Thus a seed company could have a legal right to claim as its own all plants, with, for example, a high level of commercially-valuable compound. Such restrictions would be likely to limit both the flow of acceptable varieties to farmers and their contribution to biodiversity. So domestic patent and IPR legislation, particularly in developing countries, should include provisions to maintain the 'farmers' privilege' of permitting farmers to plant saved seed in successive seasons.

There are also wider political and economic issues surrounding the extension of intellectual property rights to plants and their genetic components. Developing countries are being asked to introduce systems which will ensure that their farmers pay for improved germplasm while their own valuable contributions of genetic resources to the world community remain unrewarded. Many developing countries now emphasise that they have sovereign rights over PGRFA in their territories. Increasing attention is being placed on possible mechanisms to ensure that ldcs receive a share of the benefits derived from biodiversity (see Box). This is more than simply a matter of equity between ldcs and industrialised countries. If ldcs – or their farmers – are not receiving due compensation for their role in the development and conservation of PGRFA, then the incentives for conservation are likely to be sub-optimal. Solutions to this problem are now being sought in FAO and under the umbrella of the Convention on Biological Diversity. Such solutions may also require re-examination of the Paris Convention on patents, the UPOV Convention and the draft WIPO treaty on patent harmonisation. If the GATT Uruguay Round is finally agreed, these matters will need to be addressed as part of the implementation of the agreement on TRIPs.

Conclusions

Recent pressures towards the wider granting of intellectual property rights over genetic material originate within industrialised countries; their impacts will be felt predominantly by the agriculture of those countries, and their benefits will accrue primarily to companies located there[1]. However, some impacts will also be felt in ldcs: particularly in consequence of the restrictions that IPRs will impose on access to and exchange of genetic material by farmers and public sector plant breeders. The net effect of these restrictions may be slightly positive in the high potential areas where a high proportion of planting material is purchased each year. Elsewhere, they are likely to be negative – how strongly negative will depend partly on the extent to which ways to protect farmers' informal exchange mechanisms and re-use of saved seed can be implemented and the extent to which IPR systems can be modified to provide incentives for biodiversity conservation. The overall impact on ldcs is likely to be slight until legal and administrative infrastructures are strong enough to permit wide implementation of the measures proposed, but the erosion of biodiversity in developing countries will continue as commercial agriculture expands into these areas. In the longer term, agricultural biodiversity will be protected if farmers are encouraged to continue to conserve, utilise and develop a wide range of crop varieties. IPRs, in their current form, will be a hindrance to this if they place in jeopardy the required cooperation between the formal and informal sectors.

[1] See, for instance the report of the House of Lords Select Committee on Science and Technology: 'Regulation of the UK Biotechnology Industry and Global Competitiveness' (HL Paper 80; October 1993). The report's discussion of intellectual property rights is couched in terms of UK competitiveness; there is no mention of potential impacts on ldcs.

For further information please contact Elizabeth Cromwell. ODI also gratefully acknowledges the contribution of David Cooper to this Briefing Paper.