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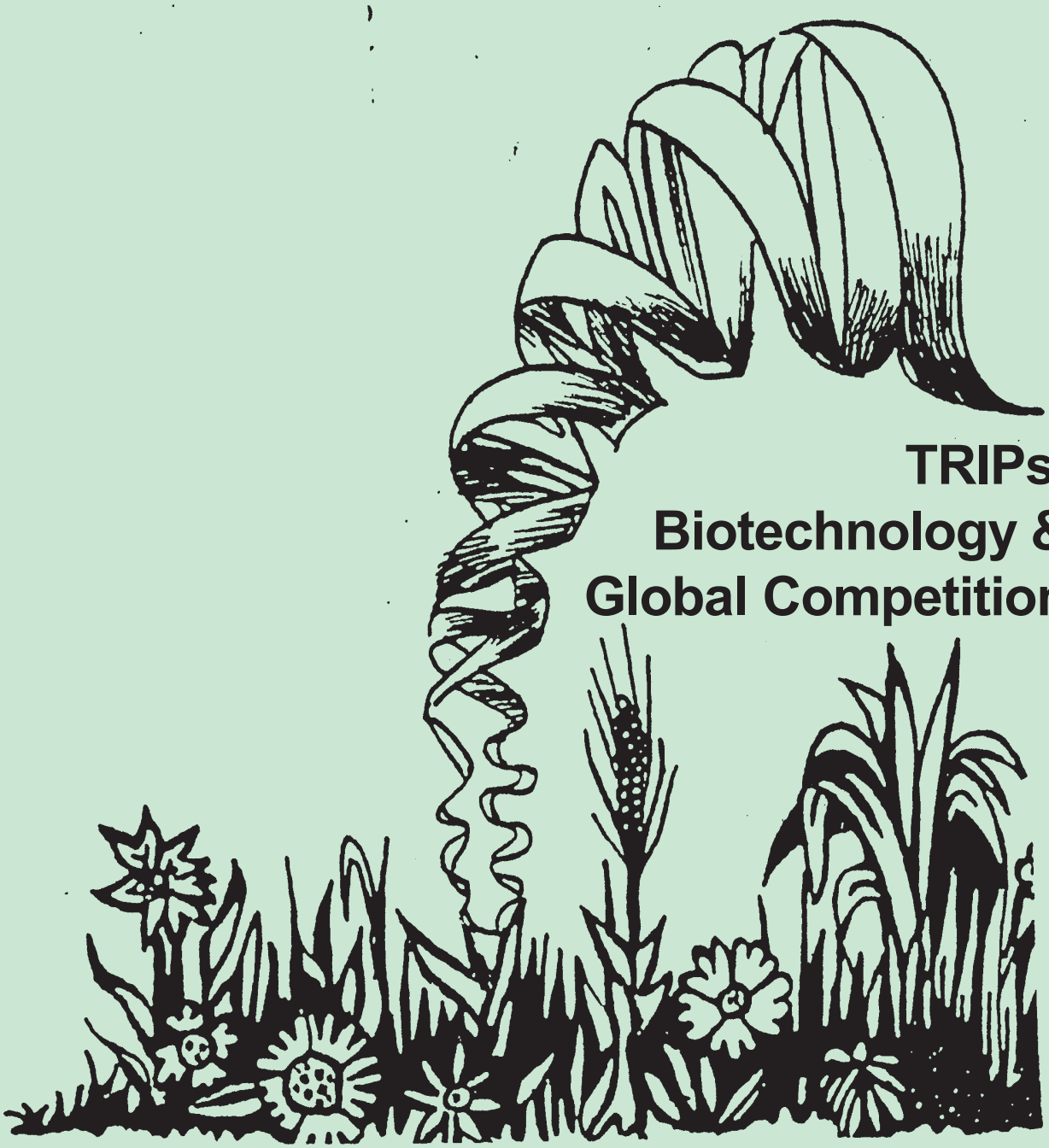

TRIPs, Biotechnology & Global Competition

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TRIPs, Biotechnology and Global Competition

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Prologue

The Agreement on Trade Related Intellectual Property Rights (TRIPs) entered into as one of the new areas under the package of the GATT, 1994 is the most controverisal. It is one set which goes against the whole spirit of trade liberalisation ushered in by the WTO/GATT. Under TRIPs, the provision on patents is the murkiest one.

A patent cannot be denied for an invention "merely because the exploitation is prohibited by law"

The agreement overlooks the existence of cultural differences in the field of intellectual property rights (IPRs). In just the second paragraph of the Article on patents the text states that a patent cannot be denied for an invention "merely because the exploitation is prohibited by law". Thus no member of the WTO can refuse a patent for an invention on any grounds, even if they have outlawed the use of such inventions.

IPRs are predominantly held in developed countries and are increasingly being held by TNCs. In developing countries the vast majority of IPRs are registered by TNCs. A 1975 joint WIPO/UNCTAD study found that 84% of patents registered in developing countries were held by TNCs. The protection of IPRs is a concern for them.

84% of patents registered in developing countries were held by TNCs

A number of developing countries see the passing of IPR laws as a means of attracting foreign investment. The combination of TNC pressure for IPR law extension and the desire of developing countries to attract foreign direct investment has helped lead to the inclusion of IPR protection in the Uruguay Round.

The relationship between the TRIPs Agreement and the already existing IPR treaties appears to be a complex one. Much of the backbone of the Agreement on TRIPs is provided by the already existing IPR treaties that are covered by the World Intellectual Property Organisation (WIPO). The TRIPs Agreement continually refers back to these and takes pains to point out that nothing in the TRIPs Agreement detracts from commitments already made under the existing Agreements.

Much of the backbone of the Agreement on TRIPs is provided by the already existing IPR treaties

Many developing countries argued that the TRIPs Agreement should be part of the WIPO system and not part of the GATT system. The USA, in particular, wanted IPRs to be included in the governance of the GATT. There were two main reasons for this:

- Firstly the USA was said to be unhappy with the working of the WIPO, particularly regarding enforcement of IPRs. It must be noted that the USA made little attempt to change the working of the WIPO system

The USA, in particular, wanted IPRs to be included in the governance of the GATT

- Secondly bringing IPRs into the GATT system would allow the USA to tie progress on IPRs to progress in other issues of concern to developing countries as well as allow it to use cross-retaliation against IPR infringers

Where is TRIPs on bio-technology?

Of great concern to the developing world has been the provisions in the TRIPs agreement concerning biotechnology. The issue is most clearly addressed in the discussion of what processes and products can be excluded from patentability.

The central issue regarding bio-technology patentability rests on the difference between the meaning of the phrases "essentially biological" and "non-biological and microbiological"

A signatory to the Agreement can deny a patent to the following:

- "diagnostic, therapeutic and surgical methods for the treatment of humans or animals" (e.g. heart bypass methods)
- "plants and animals other than micro-organisms.., and essentially biological processes for the production of plants or animals..." (e.g. naturally produced livestock)

A member cannot deny a patent to:

- "micro-organisms"...and..."non-biological and microbiological process" for the production of plants or animals.

Members must also:

- "provide for the protection of plant varieties either by patents or by an effective sui generis (self generated) system or by any combination thereof"

At its most basic bio-technology involves the manipulation of genetic material. This genetic material is then used, in some way, to affect the manner in which a living entity behaves. This behaviour can include reproduction and resistance to disease and chemicals.

The central issue regarding bio-technology patentability rests on the difference between the meaning of the phrases "essentially biological" and "non-biological and microbiological". The former need not be patented, the latter must be. Bio-technology logically involves the alteration of essentially biological processes by non-biological or microbiological processes. Therefore, according to the new GATT agreement, all bio-technology products may be patented.

Plant patents created

The TRIPs Agreement mandates member states to provide protection for plant varieties, either by patents or some home-grown system of regulation. If a home-grown system of protection is used it must be an effective one. The measure of effectiveness will be subject to review if a dispute about the issue arises. Such a dispute would go to a Panel of the WTO Dispute Settlement Body. This regulation of domestic systems is of concern to developing countries who rightly fear rich TNCs challenging their protection systems at the WTO.

If a home-grown system of protection is used it must be an effective one. The measure of effectiveness will be subject to review if a dispute about the issue arises

The issue of the patentability of life is not merely a trade issue. TNCs have pushed for intellectual property protection in GATT "to prevent extensive losses to worldwide industry due to inadequate and ineffective national protection of intellectual property."

The Third World has been repeatedly accused of "piracy" by the industrialised countries. In a 1986 survey, US companies stated that they lose US$23.8bn due to inadequate or ineffective protection of intellectual property. The U.S. agrochemical industry estimates that it loses over US$200mn in sales per year from inadequate and ineffective patent protection. The US pharmaceutical industry claims it has lost US$2.54bn.

A UNDP study shows the exact opposite: Developing countries would be owed as much as US$5.3bn if they were compensated only two per cent in royalties for global seed industry sales of US$15bn and 20 p.c. for pharmaceutical products derived from indigenous plants and knowledge. The 1994 report, *Conserving Indigenous Knowledge Integrating Two Systems of Innovation* done by the Rural Advancement Foundation International (RAFI) for UNDP, contends that an estimated 80 p.c. of the world's population depends on indigenous knowledge to meet their food and medicinal needs.

Developing countries would be owed as much as US$5.3bn if they were compensated only two per cent in royalties for global seed industry sales of US$15bn

Ironically, it is the companies that accuse the Third World of piracy and have created TRIPs to stop this piracy who are themselves engaged in large scale piracy of the biological wealth and intellectual heritage from the Third World. And not a single penny is paid for it.

Redefining human "invention"

Over the last decade and a half, the biotechnology industry has scored an impressive series of legal and policy victories, progressively expanding the scope of intellectual property laws. After gaining patents protection in the US for genetically engineered micro-organisms, plants and then animals, the industry turned its attention abroad, and began working with the US government to secure those market protections around the world. The success of the joint industry-US government effort has allowed a handful of corporations who dominate commercial biotechnologies to stake far-reaching claims of ownership over a vast array of living organisms and life processes (Shand, 1994).

Over the last decade and a half, the biotechnology industry has scored an impressive series of legal and policy victories, progressively expanding the scope of intellectual property laws

The patenting of life forms represents a radical departure from the traditional scope of industrial patent law. In addition to the basic criteria for patenting—novelty, usefulness and non-obviousness—there is a well-established doctrine in patent law that "products of nature" are not patentable. With the advent of genetic engineering, however, it did not take long to redefine what is considered a human "innovation" and legally patentable.

The patenting of life forms represents a radical departure from the traditional scope of industrial patent law

Over the course of a single decade, the U.S. government took giant steps to accommodate the corporate push to patent life. Following the U.S. Supreme Court ruling in *Diamond v. Chakrabarty* that genetically engineered micro-organisms are patentable; the U.S Patent & Trademark Office ruled in 1985 that plants (previously protected only by plant breeders' rights) could qualify under industrial patent laws; and the U.S. Patent & Trademark Office ruled in 1987 that genetically engineered animals are also patentable. As a result of these decisions, virtually all living organisms in the United States, including human genetic material, became patentable material, just like any other industrial invention.

A threat to global food security

Over the course of a single decade, the U.S. government took giant steps to accommodate the corporate push to patent life. As a result of these decisions, virtually all living organisms became patentable material, just like any other industrial invention

Escagenetics, a US based biotech major, has got a patent on all genetically engineered coffee plants. A biotech subsidiary of seed industry giant Coupe Limagrain of France holds a patent on virtually all transgenic melons, muskmelons and cantaloupes. DNA Plant Technology of the US has patented all transgenic pepper plants. Calgene Inc. of the US claims ownership of all genetically engineered plants in Brassica family which includes rapeseed, broccoli, cauliflower, cabbage and brussel sprouts.

Take the case of Ethiopia. This African country has invaluable coffee germplasm. But its option to use this germplasm to commercially develop and export high-tech coffee varieties can be severely restricted by Escagenetics' patent claim on *C.Arabica*. Ethiopia could also be prohibited from exporting transgenic coffee beans to the US or other countries where the patent is recognised under the TRIPs agreement.

Issues for analyses

Ethiopia has invaluable coffee germplasm. But its option to use this germplasm to commercially develop and export high-tech coffee varieties can be severely restricted by Escagenetics' patent claim on C.Arabica.

There are several issues for analyses. Firstly, genetically modified organisms produced by evolving biotechnologies are alien to the ecosystems in which they are released and can pose uncharted risks for the ecosystem. There is much debate and discussion aimed at ensuring that they do not harm human beings and the ecosystem with a demand for a Biosafety Protocol.

Several studies have shown all biotechnological innovations in the field of agriculture or medicine are based on the biodiversity and traditional knowledge resources in the South which are being stolen without any compensation or even acknowledgement.

Genetically modified organisms produced by evolving biotechnologies are alien to the ecosystems in which they are released and can pose uncharted risks for the ecosystem

The Convention on Biodiversity attempts to address this problem under Article 15(5): "Access to genetic resources shall be subject to prior informed consent of the Contracting Party providing such resources." Though not yet defined, prior informed consent should at the least, entail that the agency collecting the material be obliged to provide information on 1) the identity of the material, 2) the site and date of collection, and 3) the intended destination and use of the material (Kothari, 1995).

Further, Article 16 of the CBD provides that technology transfer must be accomplished on terms which recognise and are consistent with adequate and effective protection of IPRs. But then, it also says clearly that parties, recognising that patents and other IPRs may have an influence on the implementation of this Convention, shall cooperate in this regard subject to national and international law in order to ensure that such rights are supportive of and do not run counter to its objectives.

Since micro-organisms are living organisms, their patenting has been called the slippery slope that could ultimately lead to patenting of all life forms

The TRIPs allows countries to deny patenting of a] "diagnostic, therapeutic and surgical methods for treatment of humans and animals (e.g. heart bypass methods), and b] "plants and animals other than micro-organisms.., and essentially biological processes for the production of plants or animals.." (e.g. naturally produced livestock). However, it does not allow countries to deny patents for "micro-organisms" and "non-biological and microbiological processes".

Since micro-organisms are living organisms, their patenting has been called the slippery slope that could ultimately lead to patenting of all life forms. The object of this is to offer protection to bio-technology products, a position pushed by number of developed countries with advanced bio-technological industries.

Clearly there is a blurring division in the exclusions and inclusions in the realm of life forms

Clearly there is a blurring division in the abovementioned exclusions and inclusions in the realm of life forms. While the TRIPs agreement allows a biennial review of transitional arrangements (Art.71, so that it can be improved and not curtailed), it also allows a review of the

This research paper has barely touched on the complex legal issues involved which will certainly dog future debates.

exclusion of patentability of "plants and animals" and "biological processes..." at the end of four years (Art.27.3(b)).

While a heated debate rages in the arena of patenting of lifeforms, this review window is likely to be used by TNCs to push for being dropped altogether. On the other hand it also offers a platform for developing countries to question the definitions of bio-technology and their rights to deny patenting of any product made from genetical manipulation, and the linkages to biodiversity and gene piracy.

No international convention defines the word "micro-organism" or lays down criteria regarding the nature of and the extent of its protection

The second major issue that this research has brought out is the increasing concentration in the agricultural biotechnology industry in the hands of a few private firms and business groups. This has been boosted by:

- an increasing number of mergers and acquisitions;
- increasing number of collaborations between firms in the area of research and development; and
- closed loop cross-licencing among each other.

The increasing concentration in the agricultural biotechnology industry in the hands of a few private firms and business groups

Conclusion

This research paper has illustrated some very basic issues relating to patenting in the area of agriculture and the international fora which will deal with them. It has barely touched on the complex legal issues involved which will certainly dog future debates. The fundamental cause of the problem is that industrial patent law is not compatible with living things.

The time has come to provide a clear and unambiguos definition of the term "micro-organism", so that what is patentable and what is not is clearly defined

The word "micro-organism" is not defined in the TRIPs agreement. Nor does the agreement specify any parameters concerning the scope of its protection (Mashelkar, 1995). And no international convention defines the word "micro-organism" or lays down criteria regarding the nature of and the extent of its protection. The TRIPs agreement does not specify any guidelines regarding the scope of its protection.

More importantly, patents are given for "inventions" and not for "discoveries". In the area of biotechnology, the complexity arises from the fact that it is increasingly becoming difficult to determine where "discovery" ends and "invention" begins, because the starting point of any biotechnological invention is pre-existing biological matter provided by nature.

An extremely important process of review is contained in the TRIPs provisions on plant/animal patentability

The time has come to provide a clear and unambiguos definition of the term "micro-organism", so that what is patentable and what is not is clearly defined. Greater clarity in many such and other issues connected with biotechnology is the need of the hour.

There is a legitimate fear in the developing world that this process of review will be used to remove the operation of home-grown regulation of plant patenting

An extremely important process of review is contained in the TRIPs provisions on plant/animal patentability. The text of the subparagraph on the issue is to be "reviewed four years after the date of entry into force of the WTO Agreement" (mid 1999 at the latest). There is a legitimate fear in the developing world that this process of review will be used to remove the operation of home-grown regulation of plant patenting.

The four-year review on the patenting of bio-technology provides a good opportunity for lobbying in the following areas:

- Self-generated patent protection for plants (the so-called sui generis system) needs to be more clearly protected from challenge
- Countries must be allowed to opt out of the patenting of bio-technology products and plants
- Countries must be allowed to refuse patents to goods banned in their territories
- Provisions need to be inserted into the TRIPs agreement to compensate developing countries for the development of products based on biodiversity located in their territory
- The agreement must be made subservient to the need to protect biodiversity

The second set of problem which needs to be resolved is under the provision of competition issues in the TRIPs agreement

The second set of problem which needs to be resolved is under the provision of competition issues in the TRIPs agreement. Article 8.2 of the TRIPs allows members to take "appropriate measures....to prevent the abuse of intellectual property rights by right holders or the resort to practices which unreasonably restrain trade or adversely affect the international transfer of technology".

The Agreement (Article 8.2) applies only to 'trade' and to 'international' technology transfer, thus leaving purely domestic practices to the sovereign control of Members

Importantly, notes an UNCTAD report, 'The TRIPS Agreement and developing countries' (1996): "In this context, two points are noteworthy. First, the Agreement (Article 8.2) applies only to 'trade' and to 'international' technology transfer, thus leaving purely domestic practices to the sovereign control of Members.

"Secondly, it applies only to anti-competitive conduct related to IPRs, not to anti-competitive conduct in general. Consequently, control of the excercise or the exploitation of IPRs that forms a broader and distinct restrictive practice or agreement (such as joint ventures, bid-rigging or distribution agreements) is not covered by the TRIPS Agreement.

"In this context it may be noted that under the laws of countries with a long-standing antitrust law tradition, agreements among competitors (so-called horizontal agreement), including price-fixing and market divisions, are subject to general principles of antitrust policy even if they imply the use, acquisition or licencing of intellectual property. Examples include cross-licencing and patent policy.

"Similarly, the abuse of market power is not normally excused by the existence of intellectual property protection where the conduct is due to the factual market power and independent from intellectual property protection".

Article 40 of the TRIPs Agreement deals more specifically with potential of market abuses in contractual licensing

Article 40 of the TRIPs Agreement deals more specifically with potential of market abuses in contractual licensing. In this regard the UNCTAD report observes: "Restrictive practices or practices affecting technology transfer that occur outside a licensing context, such as delimitation agreements, assignments, intellectual property clauses in research and development agreements or in cooperation agreements, as well as unilateral conduct by enterprises enjoying some sort of market power, are not subject to Article 40."

From the interpretation of the limited references to competition issues under TRIPs, it appears that specification of unlawful conduct has been left to being regulated by Members. At another level the WTO Working Group on the Interaction between Trade and Competition Policy has listed "the relationship between trade-related aspects of intellectual property rights and competition policy" as one of the issues to be discussed. Thus the agenda of the Working Group on Trade and Competition Policy offers a crucial window for Members to raise the issues either here or elsewhere of:

- the appropriate interpretation of Articles 8.2 and 40 of the TRIPs Agreement and its possible elaboration at the 1999 review;

- the increasing concentration of biotechnology businesses in controlling such technology through closed-loop arrangements; and

- exploring the possibility of members approaching the antitrust bodies of other members to challenge the increasing concentration of the biotechnology businesses having cross-border impacts.

Jaipur
December 1997

Pradeep S Mehta
Secretary General

(Adapted from "Unpacking the GATT" by Phillip Evans, 1994 and "No Patents on Life Forms", CUTS Briefing Paper #8/November 1995 by Pradeep S Mehta and N Suresh)

Executive Summary

As signatories to GATT, developing countries are committed to strengthening their IPR laws. One of the important changes to be introduced is the extension of the role of IPR to agricultural technologies and products. They are expected to adopt a *sui generis* system for the protection of new plant varieties and extend the patent system to cover microorganisms.

The proposed changes to the IPR policies of developing countries have raised a number of important issues. One of the most important of these is the likely impact of these changes on a developing country's ability to undertake agricultural research.

Provisions of TRIPs can have serious impact on agricultural research by developing countries. Furthermore, the impact will be felt on both conventional breeding research and biotechnology based research.

The impact on breeding activities will be serious if the PBRs based on the 1991 Convention of UPOV are adopted. However, it must be pointed out that the presence of a strong public sector in conventional breeding is likely to lessen some of the negative impact of PBR. Therefore, the governments of developing countries, must do two things:

Firstly, they must reverse the current tendency to neglect national agricultural research systems.

Secondly, they must ensure that the use of IPR by public sector institutions does not lead to a restricted availability of breeding material and seeds to small breeders and farmers.

Furthermore, if the public sector continues to provide improved germplasm and technical support to small breeders at nominal prices, the impact of PBR on the availability of improved varieties will be marginal. Unfortunately, there is strong pressure on these institutions to raise additional resources. There is a serious danger that they might follow the private sector and use PBR to increase their earning. In fact, this is already happening in some of the Latin American countries that have introduced PBR laws. This could be very harmful in the long term. It is important that the use of PBR by public sector institutions does not restrict the availability of breeding material to breeders.

In short, developing countries can take a number of steps to reduce the negative impact of a PBR system. They have some choice with regards to the type of *sui generis* they adopt. They can reduce the impact of PBRs held by foreign interests by strengthening national research systems. They can ensure that public sector institutions use IPR intelligently so as to encourage research without restricting the diffusion of new breeding material and seeds. Considering the current environment against public support to economic activities, these measures will require strong political will.

The situation is more grim in the case of agricultural biotechnology research. The research in this area is completely dominated by firms in developed countries, while public sector research institutions (both international and national) are very weak. The adoption of an IPR system which includes patents for biotechnology based techniques and products will be extremely detrimental to local research.

As our study of the cotton and rice research in India has shown, most of the important techniques and genes used in the development of genetically engineered plants are already owned by firms in developed countries. As these patents rights are not applicable in developing countries, local researchers are able to undertake research on local problems. Once these rights become applicable in developing countries, research and its commercialization will face problems.

The effect of the TRIPs Agreement on transfer of technology is also likely to be negative. The Agreement limits the ability of developing countries to force the working of a patent. In the circumstances, a foreign firm may prefer to import a product rather than produce it locally. This could impede the diffusion of technology to developing countries.

What can developing countries do to reduce the impact of IPR on biotechnology research?

- They must ensure that they adopt an IPR system which is the least restrictive to local research activities. They must, in particular, avoid granting broad patents, which are especially restrictive in nature.

- They must strengthen biotechnology research capabilities. Even if strong IPR will prevent the commercialization of local research, strong capabilities will help in bringing down the price of technology imports.

- Developing countries must modernize their patent offices.

- They must use all available opportunities to negotiate an IPR regime which is more favourable to their interests.

To conclude, the TRIPs related changes in IPR are likely to have a negative impact on agricultural research in developing countries. They will particularly restrict the freedom of biotechnology researchers to use commercially important techniques and genetic material.

Furthermore, commercialization of locally developed products will become extremely difficult. It is, therefore, vitally important that the new IPR laws exclude (or dilute) those provisions of a TRIPs Agreement which are excessively restrictive in nature. An important objective of these laws should be to minimize curbs on research (and its commercialization) by persons other than the patent holders. Developing countries should also try to have the TRIPs agreement modified so as to limit its detrimental effect on local technological development.

Introduction

Intellectual property rights (IPRs) and their implications for developing countries have become a subject of intense debate in recent years. The inclusion of IPR in the GATT negotiations and Trade Related Intellectual Property Rights (TRIPs) in the Dunkel Draft have placed IPR at the centre of international economic relations.

Until recently, most developing countries (and some developed countries) had comparatively weak IPR regimes

Intellectual property rights are monopoly rights given by the state to an inventor, giving control of an invention for a limited time.[1] Until recently, most developing countries (and some developed countries) had comparatively weak IPR regimes. This meant that in these countries the protection of intellectual properties was limited, both in terms of coverage and duration of the protection. For example, in the case of pharmaceuticals and agro-chemicals, only processes could be patented in these countries. As products could not be patented, local researchers and firms were free to produce products which were patented in other countries through alternative processes. Similarly, IPRs for life forms (plants, animals and cells) were not recognized by a number of countries.

With the coming in force of the TRIPs provisions of the Dunkel Draft, the situation is changing rapidly. The signatory countries are obliged to change their IPR laws to meet the requirements of TRIPs. Developing countries, in particular, are expected to make important changes in their IPR laws.

With the coming in force of the TRIPs provisions of the Dunkel Draft, the situation is changing rapidly. The impact will be serious on the pharmaceutical and biotechnology industries

These changes are likely to affect the developing countries' ability to develop and commercialize new technologies and products in a number of industries. The impact will be serious on the pharmaceutical and biotechnology industries.

This paper examines the impact of TRIPs related changes on the development and commercial use of agricultural biotechnology by developing countries.

The paper is divided into four sections. Section I describes the role of IPR in agricultural biotechnology. Section II describes the nature of agricultural biotechnology. Section III examines the impact of IPR in agriculture on R&D and technology acquisition by developing countries. Section IV contains conclusions.

Section I

IPR in Agriculture

Plant varieties could only be protected by a system called the Plant Breeders' Rights (PBR), which was designed to protect the work of plant breeders

Traditionally, patents were not granted for living organisms. Plant varieties could only be protected by a system called the Plant Breeders' Rights (PBR), which was designed to protect the work of plant breeders. Most countries which recognize these rights are members of an international convention called UPOV (International Union For the Protection of New Varieties of Plants).

UPOV is an intergovernmental Organization established by the International Convention for the Protection of New Varieties of Plants. The objective of the convention is to ensure that member states grant exclusive property rights to breeders of new plant varieties. The convention, first signed in 1961, came into force in 1968. Since then it has been revised in 1972, 1978 and 1991.[2]

Compared to patents, the protection provided by the PBR is weak

Compared to patents, the protection provided by the PBR is weak. For example, the 1971 UPOV provides two important exemptions to the breeders' rights. These are breeders' exemption and farmers' privilege. The former allows breeders to use protected varieties for breeding purposes and for developing new varieties. The breeders are free to exploit these varieties commercially. The farmer's privilege allows farmers to save protected seeds for sowing in following years.

In order to make the convention more attractive to the newly emerging plant biotechnology industry, the convention was modified in 1991. It strengthened the position of the PBR holders *vis a vis* other breeders and farmers. In the 1991 version of the UPOV, the scope of breeders exemption has been considerably reduced.[3] The 1991 version still allows researchers free access to protected material. However, a new variety cannot be used for commercial purposes if it is essentially derived from a protected variety, or its production requires the repeated use of a protected variety.

The scope of the farmers' privilege has been restricted in the 1991 version of the UPOV, it is required that these privileges are "within reasonable limits and subject to the safeguarding of the legitimate interests of the breeders"

Similarly, the scope of the farmers' privilege has been restricted in the 1991 version. The privilege, which was automatic in the 1978 Convention, has been made optional in the 1991 Convention. According to the 1978 convention, the farmers' privilege came into existence when a state adopted the 1978 convention. On the other hand, in the case of the 1991 convention the member states are required to make special provision in their national legislation to include farmers' privilege. Furthermore, it is required that these privileges are "within reasonable limits and subject to the safeguarding of the legitimate interests of the breeders".[4]

Although some developing countries have joined the UPOV Convention, most of its members are developed countries. Out of the 32 members in May 1997, only five were developing countries. These

were Argentina, Chile, Colombia, Paraguay and Uruguay. Furthermore, almost all the members belong to the 1978 version of the Convention. (Belgium and Spain are two exceptions. They are still members on the basis of the 1961 Act, amended by the 1972 Additional Act.) In fact, the 1991 Act is not yet in force. Its entry into force requires the deposit of five instruments of ratification, acceptance, approval or accession. Only three countries (Denmark, Israel and Netherlands) have done so.

Following the TRIPs agreement, many developing countries are also in the process of enacting plant breeders' rights

However, a number of member countries have already introduced national laws on the lines of the 1991 Act. For example, members of the European Union follow a supranational protection system which is based on the UPOV 1991. Other members of the Convention are in the process of revising their laws to bring them in line with the UPOV 1991. According to the latest published information, by March 1997 26 states were granting plant variety protection on the basis of the 1991 Convention. This trend is expected to continue and, according to the UPOV, the 1991 Act must now be regarded by all countries as the new international plant variety protection standard.[5]

Although, many countries have strengthened the PBR legislation, the agricultural biotechnology industry still considers them to be too weak

Following the TRIPs agreement, many developing countries are also in the process of enacting plant breeders' rights. The Indian government, for example, has prepared a *Draft Legislation on Plant Varieties,* which has been under consideration for some time. Following the 1991 versions of the UPOV convention, the Act has restricted the breeders' privilege. It, however, has provisions for farmers' privilege and farmers' right.[6] The bill also provide for compulsory license by the government.

Although, following the 1991 version of UPOV, many countries have strengthened the PBR legislation, the agricultural biotechnology industry still considers them to be too weak. The industry prefers to rely on industrial patents for the protection of its intellectual property. This trend, which began in the late 1980s has seen a sharp increase in the 1990s.

This, however, changed in 1977 when it was decided that a natural product could be considered for patenting in any "new" form or composition. Following this, patents on living matter began to be granted as a matter of routine in the US in the 1980s

Prior to 1977 the US Patent and Trade Mark Office did not grant patents for living organisms. This was because they were considered to be "products of nature" and not covered by the American patent laws. This, however, changed in 1977 when it was decided that a natural product could be considered for patenting in any "new" form or composition. Following this, patents on living matter began to be granted as a matter of routine in the US in the 1980s. The first of these was a patent issued in 1980 for a genetically engineered bacteria capable of cleaning oil spill. (in the Diamond v. Chakrabarty case).[7] In 1985 a maize variety containing an increased level of tryptophan, an amino acid, was awarded. Since than more than 100 patents for agricultural technologies/products based on biotechnology have been granted in the USA..

With the emergence of a biotechnology industry as a major source of technical change in agriculture

In short, recent years have seen a strong trend towards an increased use of IPR in agriculture. The UPOV Convention, on which most countries' PBR legislation is based, has been strengthened. Also, with the emergence of a biotechnology industry as a major source of technical change in agriculture, the use of patents in agriculture has increased sharply. However, most developing countries still do not recognize any form of IPR in agriculture. They do not have PBR legislation and their laws do not recognize patenting of living forms.

However, as developing countries begin to implement the provisions of TRIPs, this situation will change. The acceptance of TRIPs implies that member states will have to:

- recognize plants breeders' rights in new varieties of plants;
- recognize patents for microorganisms;
- recognize patents for microbiological processes for the production of plants and animals.

This is likely to have serious implications for the acquisition of agricultural technology by these countries. The impact will be crucial in the case of biotechnology based agricultural technologies.

Section II

Agricultural Biotechnology

There have been major developments in agricultural biotechnology in the 1990s, particularly in the development of improved varieties of crops. With the emergence of biotechnology, the ability of researchers to introduce new traits to commercially important crops has dramatically increased. As a result, many crops have been genetically altered. The number of genetically altered plants (often referred to as transgenic plants) is already large. For example, in the US alone, more than 2700 field trials involving transgenic plants took place between 1987 and 1996.[8] While fifteen transgenic plants had received approval for sale in the USA by November 1996, another 13 transgenic plants were waiting to receive marketing permission in the US at that time.[9]

Biotechnology has contributed significantly to other areas of agricultural technology. The emergence of biotechnology is expected to have important implications for agriculture in developing countries.

Biotechnology has contributed significantly to other areas of agricultural technology. For example, the use of a number of new techniques (such as the use of RFLP markers) has been augmented to improve the effectiveness of conventional breeding methods. Also, a number of biopesticides and biofertilizers based on genetically modified microorganisms are ready for commercialization.

The emergence of biotechnology is expected to have important implications for agriculture in developing countries. In theory the new technology offers these countries technical solutions which can contribute to increased agricultural production with reduced reliance on chemical inputs. However, in practice, the ability of developing countries to benefit from the new technology will be limited by two emerging trends. These trends are:

Countries to benefit from the new technology will be limited by two emerging trends.

- A decline in the importance of public sector agricultural research centres;
- The escalating importance of IPR in agricultural biotechnology.

These trends and their implications for developing countries' capability to develop and use new agricultural technologies are discussed in the following paragraphs.

The Role of the public and private sector as sources of agricultural technologies.

Public sector research centres (both national and international) have played a vital role in the improvement of agriculture in developing countries, particularly since the 1960s, when international agricultural research centres (IARCs) provided them with major technological inputs and breeding material. This was possible because a) these centres had a mandate to support the growth of agricultural development in

developing countries and b) these centres were at the forefront of technological advance. In other words, they had both the technology and desire to transfer it to developing countries.

The increase in wheat production in India (and many other countries) illustrates the vital contribution made by the IARCs and other public sector research institutions in the past

The increase in wheat production in India (and many other countries) illustrates the vital contribution made by the IARCs and other public sector research institutions in the past.

A large increase in wheat production in India became possible when semi dwarf wheat varieties, which could benefit from higher doses of fertilizer application without lodging, were introduced from Mexico in the 1960s. These varieties were based on research work carried out at Universities in the US and CIMMYT (an IARC) in Mexico. Breeding based on Mexican advanced lines was carried out by researchers at Indian universities and national research centres, leading to the development of a number of new varieties in the late 1960s. Two of these, *Kalyansona* and *Sonalika* were so successful that they became the most widely grown varieties not only in India but in the developing world as a whole.

A sample survey of 24 private seed companies engaged in the production and marketing of pearl millet seeds in India found that 16 had obtained germplasm from ICRISAT (an IARC)

The contribution of public sector institutions has not been restricted to open pollinated crops. They have made equally important contribution to the development and introduction of hybrids in developing countries. For example, more than half of the maize released in developing countries during 1966-90 contained CIMMYT material (germplasm).[10]

In the more advanced developing countries, such as India, Pakistan and the Latin American countries, the national research systems have played an equally important role in the development of hybrids. For example, a sample survey of 24 private seed companies engaged in the production and marketing of pearl millet seeds in India found that 16 had obtained germplasm from ICRISAT (an IARC) and 6 from public sector universities.[11]

This situation has changed. With the emergence of biotechnology, private sector firms have emerged as technological leaders in a number of important areas. On the other hand, international agricultural research centres

It is, therefore, clear that the public sector (both national and international) institutions have played a central role in the improvement of agricultural technology and increasing production in developing countries. Even in crops where private sector seed firms are major players (such as hybrids), these institutions have acted as major sources of technology and breeding material.

This situation has changed. With the emergence of biotechnology, private sector firms have emerged as technological leaders in a number of important areas. On the other hand, international agricultural research centres, which provided the bulk of the technical inputs to developing countries in the past, are comparatively minor players in biotechnology. This has affected their ability to provide technological support to developing countries.

Are comparatively minor players in biotechnology

Today, research in biotechnology and the development of biotechnology based products (such as transgenic plants and their seeds) is largely concentrated in private firms in developed countries. A handful of these firms, such as Monsanto, Calgene, AgrEvo and Mycogen account for much of the R&D. These firms also account for most transgenic plants and other biotechnology based agricultural products. For example, of the 28 transgenic plants approved for sale or in the pipeline in the US by November 1996, only one was developed by a public sector institution (a virus resistant Papaya developed jointly by Cornell University and the University of Hawaii) Of the rest, eight were

developed by Monsanto. The other firms with transgenic plants included Calgene (3), Asgrow (2), DeKalb (2), Mycogen (1).

The degree of concentration in the agricultural biotechnology industry has been boosted by a number of mergers and acquisitions

Thus, research and product development activities in agricultural biotechnology are dominated by a handful of private firms in developed countries. The degree of concentration in the agricultural biotechnology industry has been boosted by a number of mergers and acquisitions. Some important mergers and acquisitions include:

- the acquisition of majority shares in Calgene by Monsanto. This gives Monsanto an extremely strong position in the field of transgenic canola, tomato and cotton;

- the acquisition of Plant Genetics Systems (PGS) by AgroEvo. PGS is a world leader in the field of insect resistant plants and in canola transgenics. It has also developed transgenic crops with tolerance to broad spectrum herbicide Basta, which is produced by Hoescht. AgrEvo, which is largely owned by Hoescht, has developed herbicide resistant corn and soybean;

- the merger between Agridyne and Biosys. Both are leaders in the field of biopesticides. AgriDyne has three *azadirachtin* based biopesticides in the market. It is also working on the use of recombinant DNA technology for synthetically producing pyrethrum, an important plant based insecticide. Biosys has developed and commercialized biopesticides based on nematodes, pheromones and baculoviruses.[12]

There is also an increasing tendency among biotechnology firms to collaborate with large seed and agro-chemical firms

There is also an increasing tendency among biotechnology firms to collaborate with large seed and agro-chemical firms. Some of the important collaborations include:

- collaboration between Mogen International and Asgrow Co. to develop nematode-resistant varieties of horticultural crops. Asgrow will finance part of the research. Mogen will receive royalty on the sale of the resistant plants;[13]

- collaboration between Mogen International and Sandoz Seeds to develop fungi-resistant varieties of specific horticulture and agricultural crops. Sandoz will finance part of Mogen's research for 4 years and will also market the seed developed as a result of this research. Mogen will receive royalty on the sale of these seeds; [14]

- collaboration between Mycogen and Pioneer for the development of insect resistant plants and seeds. Mycogen is among the leaders in this field. Pioneer will provide $ 21 million to support Mycogen's research and will receive non-exclusive license to all insect resistant (Bt) crop technology developed by Mycogen for a period of ten years;[15]

These mergers and collaborations have concentrated much of agricultural biotechnology in the hands of a few private firms and business groups

- collaboration between Monsanto and Pioneer for the development and marketing of maize with insect resistance. The collaboration involves the use of Monsanto's technology to genetically modify Pioneer's varieties.[16]

These mergers and collaborations have concentrated much of agricultural biotechnology in the hands of a few private firms and business groups.

Importance of IPR in Agricultural Biotechnology

As mentioned earlier, in the past the use of IPR in agriculture was comparatively limited. With greater awareness of the economic importance of biotechnologies and genetic resources, and the expanded role of private firms in agricultural research, the use of IPR to protect new developments has become common practice. The techniques used in genetic engineering and new products (such as genes with desirable traits and genetically engineered plants) are now patented as a matter of routine.

Since the early 1980s the PTO office of the US has awarded more than a hundred patents for techniques used in genetic engineering, and genetically engineered plants, most of these patents are owned by the leading private firms

Since the early 1980s the PTO office of the US has awarded more than a hundred patents for techniques used in genetic engineering, and genetically engineered plants.[17] These patents cover most of the techniques and commercially important genes used in genetic engineering. For example, almost all the techniques used in the development of transgenic pest resistant crops, and a number of genes responsible for this (Bt genes) have been patented.

Furthermore, most of these patents are owned by the leading private firms. Mycogen, for example, has a near complete control of the technology used for the development of pest resistant plants using Bt genes. It claims to have patents covering more than 30 Bt gene sequences effective against a variety of insect pests.[18]

Referring to one of these patents, the Mycogen President Jerry Caulder claims: “All insect resistant transgenic plants now under commercial development have used the synthetic Bt gene technology that this patent now covers”.[19]

Similarly, another firm, Calgene, has an unchallangeble position in the field of canola transgenics due to its patent holdings.[20] It has patents for all aspects of this technology and products. These include the target gene and proteins, the technology required to introduced these genes into canola and the technology required to express these genes specifically in the seed.[21] Helped by these patents, the company hopes to achieve a monopoly in the field of genetically engineered canola for the production of industrial oils.

According to Andrew Baum, President of Calgene’s Oil Division: “Our objective is to become the world’s leading supplier of proprietary, high value, genetically engineered plant oils to the food, oleochemical and lubricant markets, and we are on track to achieve this objective”. The firm is already producing several thousand acres of genetically engineered canola in the USA.[22]

While the patent holders are prepared to license some of their patented technologies they are keen to maintain monopoly positions in what they consider to be strategically crucial areas.

Another large seed company, DeKalb, which was the first to transform Maize, has a number of patents giving it a very strong position in the production of transgenic maize plants.[23]

While the patent holders are prepared to license some of their patented technologies (usually through cross-licensing agreements), they are keen to maintain monopoly positions in what they consider to be strategically crucial areas. For example, Calgene has licensing arrangements with a number of firms such as Plant Genetics Sciences, Monsanto and AgrEvo under its canola patents. However, all the licenses are outside the area in which Calgene is primarily interested, namely rapeseed oil modification. It intends to keep this technology to itself.[24]

Inserting foreign genes into plants is among the most commonly used techniques in the development of genetically engineered plants

Following the trend set by the industry, the public sector institutions in developed countries, such as universities, are also increasingly relying on patents. In many instances, the commercial rights to these patents have been sold to private firms through exclusive licenses. For example, Leiden University has a US patent for a system called binary vector system (BVS), which is used in inserting foreign genes into plants. This is among the most commonly used techniques in the development of genetically engineered plants. The University has given an exclusive right to Mogen (a leading biotechnology firm) to use or license this technology. This license has made Mogen's position in this field very strong, as all users of this technology now need a license from Mogen.[25]

Some biotechnology patents have a very broad scope. Their coverage is not restricted to a specific crop or a technique. In many cases they cover any method for the development of a product (such as a genetically modified plant) in any crop.

Some of the important broad patents in agricultural biotechnology include:

- Calgene has a patent which covers genetically engineered brassica cells. The patent covers the most efficient and commonly used method of producing transgenic brassica. It also has a patent which covers all seed specific promoters in all crops except bean phaeolin promoters.

- Mycogen has a patent which covers any method of modifying Bt gene sequences.

- Mogen has an exclusive license for binary vector system (BVS), a widely used method of plant transformation.[26]

- Agracetus has a patent covering all forms of genetically engineered soybeans.[27] Earlier it was awarded a patent which gave it rights to all genetically engineered cotton plants and seeds, regardless of the method used to engineer the plant. Although this patent was later rejected by the patent office, this was done on the criterion of obviousness and not for the breadth of the patent.

- Escagenetics Corpn. has a species wide patent on all genetically modified plants and seeds of C. arabica, the most important coffee species.

Furthermore, broad patents have encouraged the leading companies to cross license patented technologies to each other, further consolidating the position of the large players

- Biosem has a species wide patent on all genetically transformed Cucumis melo (melon, muskmelon) plants using agrobacterium in transformation.

- DNA Plant Technology has a species wide patent on all transgenic pepper plants.

Clearly, patent protection with such a broad scope provides the patent holders with extreme control of a technology. The impact of such patents on the ability of competitors to carry out research is particularly restrictive. Furthermore, broad patents have encouraged the leading companies to cross license patented technologies to each other, further consolidating the position of the large players. This has disadvantaged both small companies and developing countries. Their ability to

undertake research and development is impaired as the broad patents close most routes to independent technology development. Moreover, they will find it difficult to get licenses as they do not have the patents necessary for swapping arrangements in cross licensing deals.

The monopoly provided by the patents is being used by the patent holders, to exclude competitors from both business and research activities

In short, the use of IPR is becoming increasingly common in agriculture. This is particularly true in the case of techniques and products based on biotechnology, a number of which have been protected through patents. As can be expected, the monopoly provided by the patents is being used by the patent holders (most of whom are leading biotechnology, agrochemical and seed companies), to exclude competitors from both business and research activities.

In fact, patent holdings have emerged as one of the most critical business assets. This was clearly illustrated by one of the most important recent takeovers in the industry. This involved the takeover of PGS, a leading biotechnology firm (which has a large patent portfolio in the fields of transgenic pest resistant and herbicide resistant plants) by AgrEvo.

Of the US $ 730 million paid by AgrEvo for the acquisition, only US$ 30 million were for PGS's physical assets. The remaining US$ 700 million were paid for the acquisition of patented technologies owned by PGS. These included patents for the technology used in the development of crops resistant to herbicide Basta, which is produced by AgrEvo.[28]

It must also be emphasized that as proprietary technologies grow in importance, firms are becoming more determined to protect their monopoly positions. According to a senior executive of Pioneer Seed Co., "Security for proprietary genetics is at the heart of any good seed company's ability to offer cutting edge products to the world's farmers and to maintain a research budget. We intend to aggressively protect our intellectual property rights and we have the tools to do it." [29]

As proprietary technologies grow in importance, firms are becoming more determined to protect their monopoly positions

To summarize, agricultural biotechnology research is almost exclusively carried out by firms in developed countries. A handful of these firms have a stranglehold on new agricultural technologies. Much of this control is maintained by patents. Consequently, a number of commercially important technologies are already closed to newcomers.

Section III

Impact of IPR on Technology Acquisition By Developing Countries

Impact of Plant Breeders Rights (PBRs) on local breeding activities

As mentioned earlier, PBRs are used mainly for the protection of new plant varieties. Broadly speaking, they are primarily relevant to the varieties developed through the use of conventional breeding methods. There is widespread feeling that the formulation of national PBR laws based on the 1991 UPOV (an increasingly common practice) will impinge upon the breeding activities in and for developing countries. As mentioned earlier, the 1991 version of the UPOV convention seriously limits the breeders' privileges. In theory, this can restrict the breeding work needed to increase agricultural production in developing countries.[30]

However, in practice, the impact of PBR on food crops in developing countries will be moderated by the fact that most of the breeding work relevant to developing countries is carried out at international agricultural research centres (IARCs) and national agricultural research institutes and universities in developing countries.

These institutions are still the major sources of new varieties and breeding material used in developing countries. Therefore, the impact of the PBR on developing countries will depend on a) the ability of these institutions to continue as major centres of breeding activities and b) their IPR policy.

Unfortunately, there has been a recent tendency, in many developing countries, to neglect public sector agricultural research in general and breeding activities in particular. This trend needs to be reversed. However, considering the current anti-public sector sentiment, this will require strong political will.

The pressure on public sector institutions to generate financial resources is pushing them to protect their technologies, breeding material and new varieties. This could lead to a situation where most new varieties in developing countries are controlled by these institutions through PBRs. As long as they continue to provide breeding material and varieties to breeders and farmers at a nominal fee, the impact (for example, on availability, prices and diffusion of new seeds) will not be significant. Considering its importance, the policy adopted by the public sector research institutions must be decided at national level. Furthermore, the chief concern of the policy should be the availability of breeding material and seeds at a reasonable price, and not the short term earnings of an individual public sector research institute.

Impact of IPR on the development of Biotechnology Based Agricultural Technology

Will a strong patent regime encourage the development of agricultural biotechnology in developing countries? A number of them are undertaking the development of biotechnology based agricultural technologies locally. These include the development of genetically engineered plants with pest resistance and other desirable characteristics.

The impact of IPR on local development of agricultural biotechnology is likely to be strongly negative

Our research suggests that the impact of IPR on local development of agricultural biotechnology is likely to be strongly negative. This is mainly because firms in developed countries maintain tight control, through patents, of a large number of useful technologies. Once the IPR laws in developing countries are tightened, these firms will be able to extend their patent rights. This will restrict the freedom of researchers in developing countries to develop/use these technologies locally. The impact will be particularly strong in countries such as India, which have a strong agricultural technology base.

The example of Bt cotton and rice research in India shows how the new IPR regime can damage these activities. Cotton is among India's most important commercial crops. However, as in other parts of the world, its production in India suffers from frequent attacks of cotton bollworm, which is its most serious pest. As wild varieties with resistance to bollworm are not available, conventional breeding techniques have not met with much success in developing pest resistant cotton varieties. In fact, as the bollworm has developed resistance to most pesticides, its incidence has increased to epidemic level. Consequently, in spite of intensive use of pesticides, large quantities of cotton continue to be lost annually to the bollworm. [31]

Using genetic engineering techniques, it is now possible to develop crops which have strong in-built pest resistance. This is done by the introduction of certain genes (genes taken from a bacteria *Bacillus thuringiensis* (Bt) are the most commonly used) which can impart pest resistance to the host plants.

To develop pest resistant cotton with Bt gene is of the Indian government has been interested in acquiring this technology for a number of years. It first tried to get the technology from Monsanto in the early 1990s. However, the negotiations broke down as the price (US$16 mn) asked by Monsanto was thought to be too high

Considering the size of the pest problem, the technology to develop pest resistant cotton with Bt gene is of immense importance for India. In fact, the Indian government has been interested in acquiring this technology for a number of years. It first tried to get the technology from Monsanto (a world leader in producing plants with Bt genes) in the early 1990s. However, the negotiations broke down as the price (US$16 mn) asked by Monsanto was thought to be too high.[32]

Also, Indian researchers and the biotechnology establishment felt that India had the capability to develop plants with Bt genes without help from outside. It was also felt that the Bt cotton produced by Monsanto did not fully meet Indian requirements. The Monsanto Bt cotton was resistant to Heliothis (one of the pests) but not to Spodeptera (which is an equally important pest in India). So, it was felt that in order to develop pest resistant plants for local conditions, India needed to develop its own Bt cotton.

India's Department of Biotechnology is now funding a research project to develop Bt cotton plants. The objective of the project, which involves a number of India's leading research centres, is to produce a pest

resistant cotton suitable for Indian agro-climatic conditions. Indian researchers have designed a Bt gene which has been found to be effective against both Heliothis and Spodeptera pests. This will be synthesized and used for the development of Bt cotton with resistance to both the pests. It is reported that locally developed Bt cotton plants will be available for breeding purposes within the next two years.[33]

The situation will change dramatically after the year 2005, if India modifies its patent laws to recognize the patenting of genes and biotechniques

As we have mentioned earlier, the technology involved in the development and production of Bt crops is heavily protected by patents. Some of the leading firms such as Mycogen, Monsanto and PGS control most aspects of the technology. For example, the methods of synthesizing Bt genes, most of the Bt gene and the techniques for the transfer of these genes to cotton plants are all protected by patents.

The Indian researchers have been able to undertake this research as currently India does not permit the patenting of living organisms (including genetic material and genetically engineered plants). As the patents taken by the foreign firms in these areas are not valid in India, Indian researchers are free to use techniques and genes which are under patent protection in other countries. The situation will change dramatically after the year 2005, if India modifies its patent laws to recognize the patenting of genes and biotechniques. Once foreign firms are able to extend their patents to India, local researchers will find it difficult to develop (and use) Bt cotton.

The problem is not confined to Bt cotton. A similar situation exists in the case of rice.[34] Researchers in India are working on the development of pest resistant rice with Bt genes. Our research shows that almost all the components of this technology (such as various novel genes, promoter genes, selectable marker genes and the methods of transformation) are directly or indirectly patented.

For example, the Bt gene being currently used by Indian rice researchers is patented and has been purchased from Plant Genetics Research Institute (Japan) on the understanding that the gene can be used only for research purposes. Commercial use of the products using this gene will require a new and commercial arrangement. Similarly, the method used by Indian researchers for the transfer of Bt gene into rice plants (binary vector method) is patented by Japan Tobacco. Again, Indian researchers' access to the method is limited to research purposes and they are not permitted to use the method for commercial purposes.

The strengthening of the patent laws of developing countries will restrict the ability to develop and commercialize biotechnology based agricultural technologies

In short, the technology and genes involved in the transformation of a number of important crops are controlled through patents by firms in developed countries. The strengthening of the patent laws of developing countries (in accordance with the provisions of TRIPs) will allow the patent holders to extend their rights to developing countries. This will restrict the ability of these countries to develop and commercialize biotechnology based agricultural technologies.

IPR and International Diffusion of Agricultural Technology

Will a strong IPR regime benefit developing countries by encouraging transfer of planting material and agricultural technology?

As far as the impact of PBR on the availability of planting material and local breeding activities is concerned, the impact is likely to be

mixed. For example, a study of the impact of PBR in five Latin American countries (Argentina, Chile, Uruguay, Columbia and Mexico) suggests that PBR has a mixed effect on the access to germplasm.

In the case of breeding lines of grain hybrids and high quality propagating material for ornamentals and fruit varieties (whose germplasm is almost wholly owned by private firms in developed countries), effective PBR appeared to have improved access. However, the use of imported germplasm by farmers in these countries was often restricted by the supplier's business interests. This was especially true if the use of germplasm by an importing firm conflicted with the interests of the supplier in the domestic or international market. For example, in 1994 Argentinean strawberry producers were denied permission to export strawberry plants to Europe by the American breeders and European licensees, because the Argentinean exports competed with European production directly.

What is the likely impact of strong patents on the diffusion of biotechnologies?

It is possible to argue that strong protection to their intellectual properties will encourage foreign firms to transfer technologies to developing countries. In general, there is no empirical evidence to suggest that the IPR regime has any direct bearing on the level of foreign investment and transfer of technology to a country.[35] However, certain provisions of the TRIPs have the potential to restrict transfer of technology to developing countries. The TRIPs Agreement equates the working of a patent with imports. In other words, a country can not revoke a patent even if a patent holder refuses to produce it locally.

Thus, TRIPs will have two important effects on the transfer of technology to developing countries.

- Firstly, the patent holders will be tempted to export products rather than manufacture them in developing countries.

- Secondly, TRIPs will increase the bargaining power of the technology owners and they will be able to demand (and get) higher prices for technology.[36]

Section IV

Conclusions

As signatories to GATT, developing countries are committed to strengthening their IPR laws. One of the important changes to be introduced is the extension of the role of IPR to agricultural technologies and products. They are expected to adopt a *sui generis* system for the protection of new plant varieties and extend the patent system to cover microorganisms.

The proposed changes to the IPR policies of developing countries have raised a number of important issues. One of the most important of these is the likely impact of these changes on a developing country's ability to undertake research and development in agriculture. We are particularly concerned about the impact of a strong IPR system on research aimed at the development of new plant varieties and genetically engineered plants.

In general, it appears that the introduction of a strong IPR system in developing countries will curtail the freedom of researchers. Once the laws are changed, the firms in developed countries, which control an increasingly large number of techniques and genetic material used in agricultural research, will extend these rights to developing countries. This will clearly reduce the technological options available to researchers there to undertake independent research.

The introduction of a strong IPR system in developing countries will curtail the freedom of researchers

In order to examine the issue clearly, it is important to make a distinction between two types of research: namely conventional breeding research, which is the main source of new plant varieties, and biotechnology based research (primarily genetic engineering research), which is used for the development of transgenic plants.

The most important difference, from the point of view of this paper, is the relative importance of public and private sectors in the two forms of research. In the case of conventional breeding aimed at developing improved plant varieties for developing countries, public sector research institutions have a strong presence. On the other hand, biotechnology based agricultural research is highly dominated by private sector firms based in developed countries.

The presence of a strong public sector in conventional breeding is likely to lessen some of the negative impact of PBR. The governments in developing countries, however, must do two things. Firstly, they must reverse the current tendency to neglect national agricultural research systems. Secondly, they must ensure that the use of IPR by public sector institutions does not lead to a restricted availability of breeding material and seeds to small breeders and farmers.

We would like to emphasize that if the public sector continues to provide improved germplasm and technical support to small breeders at nominal prices, the impact of PBR on the availability of improved varieties will be marginal. Unfortunately, there is strong pressure on these institutions to raise additional resources. There is a serious danger that they might follow the private sector and use PBR to increase their earning. In fact, this is already happening in some of the Latin American countries that have introduced PBR laws. This could be very harmful in the long term. It is important that the use of PBR by public sector institutions does not restrict the availability of breeding material to breeders.

It is clear that developing countries can take a number of steps to reduce the negative impact of a PBR system. They have some choice with regards to the type of *sui generis* they adopt. They can reduce the impact of PBRs held by foreign interests by strengthening national research systems. They can ensure that public sector institutions use IPR intelligently so as to encourage research without restricting the diffusion of new breeding material and seeds. Considering the current environment against public support to economic activities, these measures will require strong political will.

The situation is more grim in the case of agricultural biotechnology research. The research in this area is completely dominated by firms in developed countries, while public sector research institutions (both international and national) are very weak. The adoption of an IPR system which includes patents for biotechnology based techniques and products will be extremely detrimental to local research. As our study of cotton and rice research in India has shown, most of the important techniques and genes used in the development of genetically engineered plants are already owned by firms in developed countries. As these patents rights are not applicable in developing countries, local researchers are able to undertake research on local problems. However, once these rights become applicable in developing countries, research and its commercialization will face serious problems.

The effect of the TRIPs Agreement on transfer of technology is also likely to be negative. As mentioned earlier, the Agreement limits the ability of developing countries to force the working of a patent. In the circumstances, a foreign firm may prefer to import a product rather than produce it locally. This could seriously impede the diffusion of technology to developing countries.

What can developing countries do to reduce the impact of IPR on biotechnology research?

- They must ensure that they adopt an IPR system which is the least restrictive to local research activities. They must, in particular, avoid granting broad patents, which are especially restrictive in nature.

- They must strengthen biotechnology research capabilities. Even if strong IPR will prevent the commercialization of local research, strong capabilities will help in bringing down the price of technology imports.

- Developing countries must modernize their patent offices. In most developing countries the patent offices are extremely poorly organized and provide little help to local researchers.

Some of the negative impact of a strong IPR on local biotechnology research can be reduced if the patent offices

- could become competent to scrutinize patents for their breadth and technological control and

- provide researchers with access to information contained in patents.

Furthermore, it must be stressed that developing countries must use every opportunity to negotiate an IPR regime which is more favourable to their interests. They should, in particular, concentrate on the following aspects of IPR.

1. **Freedom to refuse the granting of broad patents.** As these patents unduly restrict the freedom of local researchers to develop important technologies, developing countries must not grant these.

2. **Insistence on local production.** According to TRIPs, the import of a patented product is sufficient to meet the condition of the working of a patent. In view of the liberal import policies being followed by most developing countries there is a great danger of this provision being exploited by foreign firms. Developing countries should insist that local manufacture of the patented product be made the condition of the working of a patent.

3. **Modernization of patent offices.** Developing countries require technical support in the modernization of their patent offices. Bilateral and multilateral arrangements for getting this support from developed countries should be strengthened.

4. **Support for IARCs.** IARCs will continue to be vital for the growth of agriculture in developing countries. As alternative sources of agricultural technology, they can partly counteract the effects of IPR. Developing countries should strive to make these institutions stronger.

To conclude, the TRIPs related changes in IPR are likely to have a negative impact on agricultural research in developing countries. They will particularly restrict the freedom of biotechnology researchers to use commercially important techniques and genetic material.

Furthermore, commercialization of locally developed products will become extremely difficult. It is, therefore, vitally important that the new IPR laws exclude (or dilute) those provisions of a TRIPs Agreement which are excessively restrictive in nature. An important objective of these laws should be to minimize curbs on research (and its commercialization) by persons other than the patent holders. Furthermore, developing countries should try to get the TRIPs agreement modified so as to limit its detrimental effect on local technological development.

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17. Stone Richard, "Sweeping Patents Put Biotech Companies on the Warpath", *Science,* Vol. 268, No. 5211, 5 May 1995, pp 657-658.

18. *Agbiotech News and Information*, Vol 8, No 1, January 1996, p.5N.

19. *Biotech News*, January 20, 1995 Vol 15, No 2, p.2.

20. *Agbiotech News and Information*, Vol 8, No 1, January 1996, 6N-7N.

21. *Agbiotech News and Information*, January 1995, *Agbiotech News and Information*, February 1995 and *Agbiotech News and Information*, January 1996, 6N-7N.

22. *Agbiotech News and Information*, February 1995.

23. *Agbiotech News and Information*, December 1995, 225-226N and *Agbiotech News and Information*, November 1995, 211N-212N.

24. *Agbiotech News and Information,* July 1995.

25. *Agbiotech News and Information,* February 1996, 27N.

26. Ibid.

27. Stone Richard, op. cit. 17.

28. *Nature Biotechnology*, Vol 14, October 1996, pp. 1209-1210.

29. "Pioneer Strengthens Protection of Intellectual Property Rights", *Seed World*, July 1995, p. 12. These tools include molecular markers technology or DNA finger printing. It is used by Pioneer and other seed companies regularly to determine if their proprietary seed lines have been used by competitors in product development.

30. It must be pointed out that the importance of PBRs for agriculture is often exaggerated. Most PBRs are taken for horticulture. For example, rose and chrysanthemum are the most commonly protected plant species. The number of PBR applications for food crops are comparatively small. *"People, Plants and Patents"*, Prepared by the Crucible Group, International Development Research Centre (IDRC), Ottawa, 1994.

31. Cotton, which is grown on 4% of crop area in India, accounts for 45% of pesticide used. On average, cotton farmers are reported to apply an average of 17 rounds of pesticides. Alam Ghayur, "Biotechnology and Sustainable Agriculture: Lessons from India", *OECD Development Centre*, Technical Paper No. 103, December 1994.

32. Monsanto is reported to have asked for US $ 16 million for transferring the Bt cotton technology to India. *Down to Earth*, New Delhi, March 31, 1994.

33. Based on discussions with Dr. Manju Sharma, Secretary, Department of Biotechnology, Government of India, Dr. Raj Bhatnagar, ICGEB, Dr. (?) Pental, University of Delhi and Dr. Rakesh Tuli, National Botanical Research Institute.

34. Based on discussions with Dr. S K Raina, Indian Agricultural Research Institute.

35. UNCTAD, "The TRIPs Agreement and Developing Countries", United Nations, New York and Geneva, 1996, p. 17.

36. UNCTAD, op.cit, p. 18