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3

***Intellectual Property Rights and
Agricultural Technology***

Linking the Micro and the Macro-Scales

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I

INTRODUCTION

Intellectual property rights (IPRs) refer to the assurance given by the government to reward the innovators by granting monopoly over production and marketing (Subbaram and Thyagrajan, 1998). IPRs are claimed to have been an important driving force behind the rapid industrial growth in the developed world. IPRs primarily evolved to protect mechanical and chemical innovations for which identification of novelty, the inventive step and the innovator is relatively straightforward. A major deficiency of the current IPR regimes is their failure to provide any rewards

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to the public domain foundations on which the innovations may be based. This becomes a particularly important concern when the IPR regime is extended to the biological domain (Utkarsh *et al*, in press). For in this domain activities outside the purview of formal science as well as publicly funded research have created extensive material and knowledge resources, which may often serve as the basis of protected innovations. Many high-yielding varieties (HYVs) of crops have also been developed through large public investments in agricultural research institutions. Other applications such as use of Neem oil as an insecticide are part of public domain knowledge that may be built upon through small steps such as a process for increasing the shelf life of Azadirachtin, the molecule responsible for pesticidal properties of Neem oil. Today IPR regimes as enshrined in Trade Related Intellectual Property Rights (TRIPS) provide for protecting these additional inventive steps without any sharing of benefits with this public domain foundation, a process often criticised as 'biopiracy' (Shiva, 1999).

The debate on IPRs has become sharper of late as exemplified by several recent controversies in the field of agriculture such as patenting of the so-called terminator technology (RAFI, 1998). At the root of these debates is the issue of monopolisation of markets. Such monopolisation may result not only from operation of market forces, but also from political-bureaucratic manipulation. The recent suicides of cotton farmers of Andhra Pradesh due to unprecedented crop failure have been attributed to supply of poor quality pesticides (Kumar, 1998). The alternative technology being promoted to avert such crisis, viz, the BT-cotton (cotton, implanted with genetic material from *Bacillus thuringensis*, a pest resistant microbe) technology has also been criticised on ground of lack of public appraisal of its field trials (Reddy, 1998). These controversies call for redefining the relationship between development of technology, its protection through IPRs and safeguarding the public interest. This article attempts to address this relationship, drawing primarily on our field level experience in many parts of the country.

II

TRADE RELATED INTELLECTUAL PROPERTY RIGHTS (TRIPS)

India along with 129 other countries is now a signatory to General Agreement on Tariffs and Trade (GATT) that came into force since 1994. One of its constituent agreements, Trade Related Intellectual Property Rights (TRIPS) requires all member countries to provide for strong and 20-year long patent protection to processes as well as products of both domestic and foreign innovations. It also compels member countries to protect innovations in all fields, including agriculture (Dhar and Chaturvedi, 1999). It also erodes the authority of the governments to demand compulsory licensing of essential goods in public interest and to regulate the prices. Member countries are permitted to exclude from patenting natural plants, animals and essentially biological processes for reproduction. However, new plant varieties are required to be protected through patents or *sui generis*, i.e., independent systems or combination thereof that must be effective. The requirement of efficacy would preclude farmers saving, replanting or selling their produce from the protected varieties for reproductive purpose. Within these limits it is not mandatory for member nations to adopt the International Union for the Protection of New Varieties of Plants (UPOV) system, which has neither provisions to protect farmers' interests nor to reward them for development or maintenance of cultivars. UPOV only provides for strong breeders' rights suited to the developed countries where the functions of grain and seed production are divided between farmer and breeder respectively (Dutfield, 1999). Developing countries like India where more than half the seed supply is ensured by saving and exchanging of seeds, therefore require an innovative piece of legislation looking beyond UPOV.

Till recently developing countries like India largely kept the agricultural sector outside the purview of IPR regimes so as to make technology affordable to poor peasants. Developing countries are thus provided a period of ten years by TRIPS to reform their national IPR legislations. However, they must soon provide a mailbox facility to file applications for product patents, which

can be scrutinised after 2005 A D. Till then, the developing countries must provide for Exclusive Marketing Rights (EMRs) to innovations that have obtained patent protection and marketing approval in any WTO member nation. Developing countries, committed to these provisions, are finding it difficult to formulate legal and policy measures to mitigate the serious implications of this requirement of providing monopolies in the health and agricultural sectors.

III

IMPLICATIONS OF MONOPOLISATION

Social, economic and ecological impacts of monopolisation of agriculture are serious. The domination of few HYVs and a handful of crop species has spurred the so-called green revolution, fuelled by heavy inputs of irrigation, chemical fertilisers and pesticides (Kothari, 1997). Its gains are likely to be only short-term while its deleterious impacts on agrobiodiversity, soil fertility and hydrological cycle would persist much longer. For instance, in Dhikonia village in Baran district of Rajasthan the local farmers complain that the wheat hybrid today yields only one-third of what they used to get from traditional variety called 'Katya' which they replaced at the instance of local agricultural officials (Rabindar Biswas, *pers. comm.*). The traditional varieties are neither easily available today nor perform well given the drastically impoverished soil and water regimes over the last two decades. The farmers in northern Andhra Pradesh similarly found themselves doomed due to the poor quality pesticides dumped on them by the private companies in collusion with bureaucrats (Kumar, 1998). The monoculture of cotton spread all over the landscape made it more susceptible to pest attack. The resultant crop failure was unprecedented causing losses beyond recovery and forcing farmers to commit suicide.

Monopolisation may also affect the economy owing to exorbitant prices of the IPR protected items. Besides, some Multi-National Corporations (MNCs) have gone to the extent of forcing their customers not just to buy seeds but also chemicals for further

crop treatment (RAFI, 1998). The farmers, having lost traditional diversity and having no right to replant the protected seeds, have no option but to purchase the costly seed from the company. IPRs may also restrict exports. The rose growers from Bangalore have been exporting flowers raised from stocks without paying the license fee to the plant breeders in the Netherlands. The Dutch breeders therefore forced their government to ban the import of rose flowers from India. Once the plant breeders' rights are enforced in India, it will greatly restrain the floriculturists who are today simply trying to evade the issue by finding alternative markets. Meanwhile, the breeders are employing newer means to curtail farmers from replanting through a technological innovation, dubbed by some as 'terminator technology' (RAFI, 1998). The seeds of the varieties developed using this technology do not germinate and hence can only be consumed but not replanted, forcing the farmer to buy the seeds from the company every year. The hybrid seeds in vogue today also oblige the farmers to purchase seeds annually for a high level of production though its replanting for lower yield is not ruled out as in the case of terminator technology (R. S. Rana, *pers. comm.*)

Ecological repercussions of monopolies in the form of monocultures are also quite serious. The long-term sustainability of intensive cultivation of cash crops like sugarcane is questioned given the depletion of water table and soil fertility. However, cascading effects of such monocultures in the surrounding landscapes are often ignored. Sarus cranes, an ecologically sensitive species, used to commonly feed in the fields surrounding Bharatpur National Park in Rajasthan. Recent replacement of traditional wheat and mustard farming with floriculture has made the fields unattractive to birds, probably due to loss of soils invertebrates owing to heavy chemical inputs (Kamal Sinha, *pers. comm.*)

Indian agriculture lost its base of diversity even in the absence of IPR protection, largely due to public sector research institutions responsible for the green revolution, besides the market forces and policy measures such as pricing structure, subsidies, credit policies, irrigation and power facilities, etc. All these incentives nurtured monocultures of HYVs and monopolies of related technology at the cost of traditional farming practices and local

cultivars. Thus grudging only IPRs or private sector cannot adequately address the problems of sustainability of Indian agriculture. The challenge before us is therefore to promote appropriate technology, both within and outside the IPR framework, through a variety of institutions, public as well as private.

IV

TO PATENT OR NOT?

The adverse consequences associated with monopolisation have prompted many to advocate that India must not allow patents on life forms and their derivatives on the grounds that these are immoral and socially unacceptable (Shiva, 1999). This is completely unrealistic; it is not moral arguments but economic, technological clout that count when IPR regimes are negotiated. India unfortunately ranks pretty low on both these counts. On the global scale, India's economy is small, and is plagued by a negative balance of payments, and we have failed to develop new technologies. At the same time we want access to global markets, we are courting foreign investment, looking for foreign aid, and importing foreign technologies. We are therefore in no position to dictate terms during international negotiations. These unpleasant facts cannot be wished away. The only way ahead for us is then to accept this reality and work out a practical strategy of how to gradually turn the situation in our favour.

While our intellectual and political leadership continues to call for rejecting the IPR regimes, in actuality the Government merely surrenders (Mehra, 1999). Thus to meet our obligations under TRIPS and to avoid possible sanctions, the Indian Parliament has amended the Indian Patent Act 1970, so as to grant EMRs in the field of agro-chemicals and pharmaceuticals. When the amendments were tabled in Rajya Sabha during December 1998 session of the Parliament, the pressure from opposition forced the government to agree to further modify them so as to exclude from EMRs any inventions based on formulations in Indian medicinal systems. It is likely that such inventions may be

excluded from product patents also, when the patent act gets amended further. Unfortunately, it is likely that excluding the innovations based on Indian system of medicine from EMR regime may do more harm than good. Firstly, it would deprive Indian entrepreneurs and public sector research institutions like Council for Scientific and Industrial Research (CSIR) of an opportunity of protecting its innovations. For instance, CSIR already owns four US patents on Neem applications (Dutfield, 1999). Secondly, the developed countries may object to this restriction and continue to encourage IPR protection to such innovations in their own countries, putting Indian entrepreneurs at a disadvantage. Further, they may refuse to share with us any benefits generated from such protected markets unless we extend similar protection, as required by the 'national treatment' clause of the TRIPS (Utkarsh *et al.*, in press).

It is true that Indian research establishment is lagging behind in innovating useful technologies and protecting those. Our floriculturists have done little to domesticate and market natural wealth of flowers, such as herbs belonging to genus *Impatiens* having several dozens of beautiful flowering species in the Western Ghats. Orchids, with more than 250 species in the Western Ghats and 750 in north-eastern India, are also ignored in cultivation though some species are being over-harvested from the wild. More than two-thirds of the patents in India are sought by foreign corporations and this proportion may only grow after the patent act is brought in conformity with TRIPS (TIFAC, 1998 b). This is clear from the thousands of EMR applications, mostly by foreign agencies and the rise in the shares of pharmaceutical companies, following the recent amendments to patent law in that direction (Anonymous, 1998). However, it is not impossible for Indian scientists to add value to this local diversity, as is clear from the magenta-white Bougainvillea variety developed by the National Botanical Research Institute (NBRI), Lucknow (Mago, 1999). This variety was developed some 20 years ago but not protected in India in the absence of Plant Variety Protection and Farmer's Rights (PVP) Act. Some Japanese visitors acquired this variety few years ago and further developed it commercially. The Japanese scientists had the courtesy to write back to NBRI declaring their intentions to protect

global marketing and sell it worldwide, offered to share 5 per cent of the benefits with NBRI. The NBRI can perhaps seek access to technology and local marketing rights but are handicapped by the absence of legislation that would enable them to get into such an agreement

Indeed today, there is little reason why we should shy away from a system of product patents with appropriate safeguards so as to create space for approval of applications on the merit of each case instead of agreeing to grant EMRs. After all, the Indian government has demonstrated its commitment to TRIPS by drafting a PVP Act, ready for tabling in the Parliament (Vishwanathan, 1999). The earlier drafts of the PVP Act proposed a 'Community gene fund' to recognise and reward farmer's contribution (Swaminathan, 1995). We are given to understand that the recent drafts have done away with such an arrangement in view of the proposed National Biodiversity Fund, proposed under the draft Biological Diversity Act, which is discussed later. Thus the term farmer's rights included in the title appears to be cosmetic and in reality, the Act would merely provide for strong plant breeders' rights (PBRs) at the cost of the farmer.

V

PREVENTING BIO-PIRACY

The emerging IPR regimes, as enshrined in the TRIPS, protect innovations primarily developed within the system of formal science. In consequence, scientists and enterprises especially from the developed world are provided strong protection while there is no mechanism at all to acknowledge and share benefits with the foundation of resources or knowledge in the public domain. For instance, Neem oil is a well-known pesticide in many parts of rural India. However, its active principle Azadirachtin suffers from quick breakdown. W.R. Grace and Co., a transnational corporation invented a chemical treatment for stabilising the Azadirachtin thereby increasing its shelf life, and making it possible to be transported worldwide. This innovation was protected through US patent No 5124349 (Subbaram and Thyagarajan, 1998). Although

the use of Neem oil by the Indian farmers was mentioned in the patent application, there can be no provision under the present regime for sharing the huge commercial benefits resulting from the sales of the insecticide with the Indian government or farmers. The patent would not prevent the Indian farmers from using Neem oil as a pesticide as long as it was produced on the farm or purchased in crude form from neighbours or local market. However, any Indian entrepreneur would be prohibited from developing and marketing a commercial invention similar to the protected one. The Indian entrepreneurs would thus be compelled to pay royalty to the Grace Company and market their product at the prices fixed by the company. As neither the Indian farmers nor industry knew the process of stabilising Azadirachtin, it is difficult to successfully contest the claims of novelty and inventiveness of the patent.

Rice Tec, an U.S. based company, has obtained a U.S. patent No 5663484 on a rice grown in the U.S. similar to Basmati rice traditionally grown in India and Pakistan (TIFAC, 1998 a). The patent claims made under the name of Basmati specify that the inventive steps lies in obtaining equivalent or superior quality of grain from crop grown in an entirely different country. Poor documentation on the part of Indian scientists and traders has prevented the government from contesting the Rice Tec claims regarding grain qualities (Rangnekar, 1999). As a matter of fact, the Basmati cess levied on the exports should have sponsored such research, but the funds seem to have been wasted. The government also seems to have abandoned its initial plans to prevent the Rice Tec from selling the new variety in the name of Basmati under the provisions for geographical indication under TRIPS. These geographical appellation provisions offer protection to names of products whose special qualities are intricately associated with their place of origin. However, to invoke the TRIPS provisions, the product needs to be domestically protected. Unfortunately, India is yet to enact legislation on geographical appellation, making our case untenable. Further, Basmati does not exclusively grow in India and is a premier export commodity in Pakistan also, thus raising trans-boundary issues and weakening our case further. This exemplifies the need for a regional cartel like that of the Andean countries, so as to collectively fight on

such issues (Glowka, 1997)

The only reprieve to India and Pakistan comes from the fact that its traditional market in European Union (EU) has allowed only the long grain aromatic rice grown in India and Pakistan to be packaged and sold as Basmati. This trademark like protection is offered by the natural choice of the consumers but has no legal locus stand even domestically. Going by the recent WTO dispute over Banana case, the US might eventually force EU to allow the sale of U.S. products, at the cost of Indian exporters. Unfortunately, given the complexity of the case the Indian government is still engaged for more than a year in collecting relevant evidence to challenge the patent. Similarly, Darjeeling tea, a premium product lacks protection under geographical appellation provisions. Meanwhile, the tea exporters association noticed several trademark violations, worldwide, during a survey sponsored through a cess on exports. Further, United Kingdom has come forward to afford trademark like protection to Darjeeling tea, through certification, but the Indian government is yet to take up the matter (Anonymous, 1998).

In contrast, victory came much more easily in one of the controversial cases relating to turmeric. The US patent office granted a patent (No 5401504), after initial reluctance, on the use of turmeric in the powder form for wound healing, on the grounds that such usage was not known in the US (Subbaram and Thyagarajan, 1998). However, CSIR could present published evidence in an appeal in the US court that such usage was known in India, and hence not novel. Consequently, the patent was revoked. This was an exceptionally easy case to argue though it cost CSIR dearly. CSIR has also clarified that this war was only illustrative and future infringements are to be fought by the concerned entrepreneurs not by the government (R. Mashelkar, *pers. comm.*). As exemplified by the Neem and Basmati cases, proofs of public domain origin of knowledge or resources can be of little use in contesting and rejecting some of the patents. However, it is possible to use such evidence to claim a share of the subsequent commercial benefits to reward and promote public domain knowledge and conservation of biodiversity, taking advantage of the international Convention on Biological Diversity (CBD).

VI

CONVENTION ON BIOLOGICAL DIVERSITY

The CBD came into effect in 1993 and was signed by 171 countries till date (CBD, 1999). The convention reflects the worldwide concern to prevent unfair exploitation of the rich genetic wealth and traditional knowledge of the developing countries by the developed world. CBD reaffirms sovereign rights of the member nations over their genetic resources. It requires all the nations to facilitate global access to their genetic resources; but stipulates that such access must be on the basis of prior informed consent (PIC) of the country of origin. The terms of the agreement could include sharing of benefits, technology transfer and preferential location of research and development (R & D) units in the country of origin. It also requires member countries to obtain traditional knowledge of sustainable uses only with the approval of its holders, their involvement in its wider application and sharing the resulting benefits with them. It requires nations to protect the traditional knowledge and customary practices relating to uses of biological resources. Further, it stipulates that IPR regimes should be supportive of and not run counter to the CBD objectives of conservation, sustainable use and equitable sharing of benefits.

Unfortunately, CBD does not provide any explicit rights to nations or people regarding the vast store of genetic material or knowledge transferred abroad prior to 1993. Much of the public domain germplasm and pertinent information is today more readily available through repositories housed in the developed countries than in the developing countries of origin. For instance, the most extensive and efficient source of information on traditional uses of Indian plants like Neem is a database called NAPRALERT, housed at Chicago in the US. (Gadgil and Rao, 1998). This information is compiled through exhaustive search of literature including Indian sources, often not available to most Indians. Similarly, Rice Tec developed its Basmati lines from the strains obtained before the CBD (TIFAC, 1998 a). Hence, the question of prior informed consent of India or Pakistan does not arise within the existing CBD framework. Despite such limitations,

many of the provisions in CBD may be of great help in safeguarding the interests of the developing countries provided that they enact supportive national legislation

VII

DISCLOSURE IN IPR APPLICATIONS

To give effect to the provisions of CBD, the Indian government has drafted a Biological Diversity legislation to be tabled soon in the Parliament for enactment (Government of India, 1998). This draft Act provides for protection of people's knowledge through registration at local, state and national levels, sought to be protected through a *sui generis*, i.e., independent system of IPRs to be specified in the rules. It proposes a national authority, which would be responsible for regulating access to Indian biological resources and knowledge and for laying down benefit-sharing conditions in respect of their utilisation. The authority must also challenge worldwide IPR applications anywhere in the world, including, of course in India that do not acknowledge and make appropriate benefit-sharing provisions for use of Indian biological resources and knowledge. It creates a national fund into which royalties obtained through such benefit-sharing arrangements are to be deposited to reward people for their conservation efforts and knowledge on the basis of claims by village level management councils. Though this is a positive beginning, it is necessary to ensure a proper harmonisation of the provisions of the new Patent Act, Protected Plant Varieties Act and the Biological Diversity Act. This would be facilitated by inclusion of the following provisions (Utkarsh *et al.*, in press):

- (a) Disclosure of source of biological material and related information, along with proof of prior informed consent as appropriate, in all the three legislations.
- (b) Acceptance of village level registers as evidence of rights relating to public domain knowledge and resources in all the three legislations
- (c) A system of registration of claims of knowledge and resources and of information/material transfer agreements

- (ITA/MIA) in favour of individuals or groups of individuals, under the Biological Diversity Act.
- (d) Grant of petty patents under the Patent Act
- (e) A system of registering local cultivars and land races not covered by the national plant varieties register under the Protected Plant Varieties Act.
- (f) Establishment of a National Biodiversity Tribunal under the Biological Diversity Act, to encompass the Plant Varieties Appellate Tribunal and to serve to operationalise the benefit-sharing arrangements in relation to the Patent Act as well.

Registering Claims of Knowledge

It is possible that some of the applications provide inadequate or misleading disclosures and agreements. For instance, an entrepreneur may obtain information about medicinal usage of a plant from a villager without an agreement and apply for IPRs on subsequent innovations. In such a case, when the patent claims are laid open for public scrutiny, any concerned agency or individual may submit evidence pertaining to the prior existence of the knowledge in the literature or databases, including in the village documents and the registration proposed under the draft Biological Diversity legislation. In case such claims are sustained, the IPR applicant should not only share benefits but also pay a penalty. For providing an effective opposition, it would be necessary for the people to register their knowledge fully or at least as claims, under the Biological Diversity Act. It is equally necessary to collate this information in the form of computerised databases. The Biological Diversity, Patent and PVP Acts must require the respective authorities to conduct a thorough search of such databases to verify the claims of novelty made in IPR applications.

Instituting Petty Patents

The computerised databases may also facilitate entrepreneurs to scrutinise the registered claims and approach suitable claimants to access the relevant information with appropriate approval of the government as per the proposed Biological Diversity Act. If

such information adds to the publicly available literature and databases, the claimants should be specially rewarded. Further, if such information triggers some commercial application, the reward may be proportionally higher. The rewards could take the shape of up-front payments received at the time of contract, milestone payments received during various research stages and finally, a share in the royalty subsequent to marketing (Glowka, 1997). However, in any case the contractual arrangement is likely to enable the claimant to tap very limited benefits as compared to the entrepreneur wielding more information and power. One must therefore explore the possibility of stronger protection to such information.

Some of the folk knowledge or grassroots innovations or cultivars may indeed be worthy of special recognition other than mere claims protected through contracts. However, such innovations are difficult to protect under current IPR regimes which demand high levels of inventiveness, investment and elaboration. Hence, to protect grassroots innovations, a system of petty patents should be initiated (Utkarsh *et al.*, in press). Such petty patents may be granted to individuals or groups of persons. These must be relatively easy to apply for and quick to obtain. The cost of filing and maintenance must be low. The government may also consider subsidising the costs of some of the more promising applications. The criteria for patenting may be retained but the degree of specification should be kept minimal. Thus it might suffice to demonstrate that a herbal mixture is clinically effective to acquire a petty patent. Today, a patent cannot be granted on such knowledge. The petty patents must also be subject to prior public scrutiny, like the patents. The petty patents may provide correspondingly lesser degree of monopoly and fetch lesser rewards than a patent. To operationalise this system, the petty patent offices must be located at the level of each district or a cluster of districts. Besides, these offices must have efficient computerised information network to undertake adequate and efficient scrutiny of the applications. The National Foundation for Innovations proposed in the Union Budget 1999-2000 can take a lead in this direction (Mashelkar, 1999), working in collaboration with National Development Research Council (NDRC), Technology Information and Forecasting Assessment Cell (TIFAC) and Technology Development Board (TDB).

Registering Farmers' Varieties

Besides modifying the patent system to protect special folk knowledge or innovations, it is necessary to explore the possibilities of tailoring Plant Breeders' Rights regime to protect folk varieties. It is very difficult to distinguish and protect farmer varieties, as these are genetically very diverse, manifesting considerable morphological and cultural variation from place to place, one generation to another. Hence, it is often difficult to distinguish one variety from another. Further, their denominations could become confusing as a given variety may bear different vernacular names in different places. 'Kagga' is a vernacular generic term describing various salt resistant varieties traditionally grown along the coast of northern Karnataka, with lot of variation, from village to village assigned to names such as 'Bilikagga'. Alternatively, a single base name may refer to two different varieties. The modern plant breeders develop varieties that have a very narrow genetic base, so that these satisfy the distinctiveness (D), stability (S) and uniformity (U) criteria prescribed for protection under the UPOV framework, also adopted by our draft PVP Act. The folk varieties are unlikely to satisfy these norms and are deprived of protection. However, petty patents or a less rigorous plant breeder's rights system might serve to protect at least some of the folk varieties. Indeed, there have been proposals both locally and globally to modify the UPOV criteria and restrict them to distinctiveness (Dutfield, 1999). Nevertheless, questions pertaining to novelty and ownership raise further difficulties in protecting folk varieties.

Most of the folk varieties are not novel. However, these are also not registered under the Seed Act 1966, which primarily recognises varieties developed by public sector breeding programmes such as through the agricultural universities. The PVP Act precludes protection of varieties registered under the Seed Act. Hence, many folk varieties can be potentially considered eligible for protection, provided that suitable criteria are evolved under the PVP Act or under the registration system proposed under the Biological Diversity Act. As many of the distinct folk varieties have a localised distribution, extending over a few talukas or districts, their custodianship may be entrusted to farmer communities or to appropriate institutions of self-governance such

as Panchayats, i.e., village councils. Identifying all the beneficiaries would of course be an immense challenge, requiring innovative mechanisms. In case a folk variety does not seem to be distinct in terms of identity or ownership, the cultivators could be rewarded from the National Biodiversity Fund, as a broad-based incentive for continued conservation of genetically diverse germplasm, not linked to any specific cultivar (Swaminathan, 1995).

Collaborative Research

Implementing any kind of benefit-sharing would necessitate a decentralised programme of documenting agro-biodiversity at the village level as proposed in the Biological Diversity Act. The local level characterisation will have to be validated by scientists from agricultural universities, Indian Council of Agricultural Research (ICAR) network, etc., even employing advance techniques such as DNA fingerprinting. This information must also be linked to the databases of accessions held by the National Bureau of Plant Genetic Resources (NBPGR). As a matter of fact, NBPGR has recently initiated a countrywide drive to collect germplasm of folk varieties (P. L. Gautam, *pers. comm.*). This programme must include provisions to distinguish folk varieties, their geographical distribution and the custodian farming communities. Such information would help in identifying and protecting some speciality products through geographical indications and also facilitate technology transfer.

Translating any kind of IPRs into economic benefits requires market opportunities and good information about them. But today the traditional farmers know nothing of the premium markets of Europe or even of Mumbai. The meagre income the villagers earn from the biodiversity today only promotes unsustainable harvests of medicinal plants or replacement of land races with HYVs, which is accelerated by subsidies for modern seeds, chemical fertilisers and pesticides. For encouraging biodiversity friendly practices, information on local and global markets must be collated and fed back to the villagers so that they can make an informed choice and assert themselves on the issue of procurement price. This is a task in which the public sector research institutions in the field of agriculture, science and technology can play an

important role by suitably employing information technology to empower the farmers. This is indicated by databases created by Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI) ([url:http://www.csf.cdorad.edu/sristi/institut.htm](http://www.csf.cdorad.edu/sristi/institut.htm)) or M.S. Swaminathan Research Foundation (MSSRF) ([url:http://www.mssrf.org.sg/webfris/index.htm](http://www.mssrf.org.sg/webfris/index.htm)). Such information systems would suit well the mandate of the National Bioresources Board (NBB), proposed under the Department of Science and Technology, as per the Union Budget 1999-2000 (Utkarsh *etal*, in press).

Encouraging such public sector research would however require a review of the existing institutions and their limitations. In particular, we must identify the disincentives that must be removed and positive incentives that need to be offered. For instance, release of varieties developed by agricultural scientists working in the public sector is preceded by trials often lasting a decade, by which time the original inventor might have been transferred and hence unable to claim credit (K. N. Ganeshiah, *pers. comm.*). In contrast, the recent trials of Bt cotton were commissioned for just three years. Further, these trials are conducted by the private entrepreneur, without any involvement of local agricultural university network. Such discrimination by the government further discourages the public sector breeders, who do enjoy the fat salary or any other benefits available in the private sector. The public sector must devise mechanisms to promote useful innovations including involvement in technology transfer.

VIII

TECHNOLOGY TRANSFER AND APPRAISAL

CBD insists on transfer of technology, preferential location of R & D in the country of origin and involvement of local scientists as a part of access and benefit-sharing mechanism (Glowka, 1997). While technology transfer could be ensured through ITA/MTA in case the genetic material is acquired in accordance with the national law, there remain several hurdles in extending similar provisions to accessions maintained abroad prior to CBD. The

International Undertaking on Plant Genetic Resources (IUPGR) of the Food and Agriculture Organization of the United Nations (FAO) has lent credence to the concept of farmers' rights arising out of their past, present and future contributions (FAO, 1996). The undertaking has accepted in principle the rights of the countries of origin over the germplasm preserved in the foreign repositories housed by the Consultative Group on International Agricultural Research (CGIAR) institutions. About 6,00,000 of these accessions are now proposed to be placed under the auspices of the FAO, which may make them available to the members of the undertaking, free of charge, on the basis of mutual exchange or mutually agreed terms. It is quite likely that a protocol to CBD may soon be developed to operationalise these provisions. However, prior, to any such arrangement member countries are required to provide information on their accessions along with relevant details such as the country of origin. Unavailability of such information is a major obstacle in further progress and to avoid such delays in future, good documentation is essential. After having properly organised our own information, we must demand at the global fora that the Clearing House Mechanism (CHM) under CBD undertakes the responsibility of furnishing information of IPR applications worldwide and of the relevant biological source, prior knowledge and country/ies of origin. This would facilitate international agreements on technology transfer and benefit-sharing.

Public Appraisal of Technology

Any technology, whether imported or locally developed, must be subjected to prior assessment in terms of its social, economic and environmental impacts. CBD for instance, has specific biosafety provisions for prior evaluation of likely hazards from Living Modified Organisms (LMOs) which may soon be developed into a protocol. However, as the controversy over Bt-cotton trials illustrates, prior public appraisal of technology is non-existent in India (Reddy, 1998). In fact, the scientific establishment strongly advocates educating the masses to accept technologies, rather than involve them in a process of appraisal. What is needed instead, is an open, transparent and participatory evaluation of new technologies. Such public participation is actively sought in most

other countries that have instituted biosafety regulations (Balkrishna, 1997). Similarly, the evaluation of IPR claims must be made a more broad-based process. For instance, specialists such as Ayurvedic and folk healers, private and public plant breeders, farmers, etc., must be effectively involved in evaluating IPR applications even prior to inviting opposition.

Appropriate Technology

Debate over transfer of technology is based on the assumption that the most useful technology would be produced in the developed countries and the developing nations must somehow access it. While this may be true to an extent, the take-home lesson of green revolution is that technological failures could largely result from the wide scale and centralised nature of its application. More fundamentally, the misplaced faith in modern science that drives the technological change is responsible for the neglect of traditional farming practices and local cultivars. Such diverse practices still reside in rural India, and deserve wider application. For instance, the farmers from Kolar district in Karnataka have evolved a compromise between modern and traditional farming practices (Amar Prasad, *pers. comm.*) They cultivate HYVs of rice for sale in the market while for domestic consumption they grow traditional varieties, as these are believed to be more nutritious. Nearly twenty traditional varieties, of rice are still grown in villages around Guwahati town in Assam (Lakhan Terwa, *pers. comm.*) This is partly attributed to failure of local agricultural authorities to successfully introduce the HYVs which could not cope with the annual floods. One of the local varieties called 'Boka' can be consumed simply by soaking in water, without cooking. The agricultural authorities have given little thought to wider application of such varieties that are critical to sustain local life. Thus the responsibility to restore lands either devastated or left untouched by modern agriculture is largely left to the farmers alone. Not just private, even public sector institutions have shown little interest in developing these local technologies. Village level biodiversity registers could serve as an important mechanism to promote people's knowledge and practices, just as the SRISTI network has demonstrated in Gujarat ([url:http://csf.colorad.edu/sristi/institut.htm](http://csf.colorad.edu/sristi/institut.htm)).

People's Biodiversity Registers

The village level documentation of crop cultivars, and other biodiversity resources as well as management practices might take the form of People's Biodiversity Registers for which we now have some practical experience (Gadgil and Rao, 1998). These registers may also serve the important function of promoting sustainable management of biodiversity resources. Based on the documented efforts of conservation or contribution of knowledge, village councils may be rewarded from the national biodiversity fund. These incentives could include venture capital fund for putting innovations into practice, establishing small scale enterprises to add value to the biodiversity fund. These incentives could include venture capital fund for putting innovations into practice, establishing small scale enterprises to add value to the biodiversity resources, for instance, a farm produce processing unit, or to initiate biodiversity friendly development measures like smokeless stove. A part of the fund could be assigned to organised knowledge networks where local healers or traditional farmers across the villages can exchange and validate views, get felicitated or rewarded. Such taluka or district level networks may also promote enterprises such as cultivation of medicinal plants or their processing units. Such units are often non-viable at small scale due to limited resource catchments, high fluctuations in supply and demand and limited expertise. Co-operative arrangements and sharing of information can greatly help in capacity building for managing biodiversity sustainably.

NGO Networks

NGOs all over the country have voluntarily initiated such preparation of registers. Indian Institute of Science (IISc) co-ordinated a countrywide effort with the support of World Wide Fund for Nature - India (WWF-I) during 1996-98. This led to the compilation of PBRs in 50 village clusters from seven states representing various socio-economic and ecological zones (Gadgil and Rao, 1998). Several other NGOs have also initiated preparation of such registers in their own areas, with their own focus. In conjunction with preparation of agro-biodiversity registers, Deccan Development Society (DDS), an NGO from Andhra Pradesh, has embarked on a pioneering programme through the Krishi Vigyan

Kendra (KVK) in Medak district (P.V. Sathees, *pers. comm*). Here, nearly 40 to 50 traditional crop varieties are cultivated in each village. DDS has prompted farmers to conduct controlled experiments on the yield and efficacy of local cultivars vis-a-vis HYVs, taking into account external inputs. Market prices offered to local cultivars are only half that of the HYVs. DDS is therefore attempting to establish direct linkage between conscious consumers and village level producers of ethnic food, grown organically. DDS has also instituted an insurance scheme to cover losses in traditional crops and also implemented a public distribution scheme (PDS) to provide assured market, prices and access to quality food. Most importantly, DDS conducts agro-biodiversity festivals where farmers maintaining high diversity on the farm are felicitated, thus encouraging many others. The networking efforts by DDS have helped to establish an informal federation of farmers from several villages, strengthening the community.

International Follow-Up

Such domestic efforts need to be complemented by efforts at promoting supportive policy and legal frameworks at the international level. The measures suggested here are not inconsistent with the TRIPS provisions and hence will not invite any opposition or penalties. On the other hand, these provisions would place India in a leading position amongst developing countries in fighting the inequities within GATT. Today, most other countries in the world are increasingly providing strong IPR protection in all fields of technology, as recommended by GATT. Even China, which is not a WTO member, provides strong IPR protection (Dronamraju, 1998). It is therefore necessary that we accept the broader IPR framework but with due safeguards to protect and promote customary uses and traditional knowledge of biodiversity through equitable sharing of benefits.

India must therefore lobby with other developing countries in fora such as G-77 for similar changes in IPR legislation worldwide, including in the developed nations. Most importantly, these amendments must be incorporated in the TRIPS itself, when Article 27 is reviewed during 1999 and the entire TRIPS comes up for review in 2000. World Intellectual Property Organisation (WIPO) of the United Nations has initiated round table discussions

to institute mechanisms to protect folk knowledge (WIPO, 1998). Thus, we must make concerted efforts at all levels to promote our own technologies and nurture traditional practices and agro-biodiversity, by tailoring the new IPR regimes to our needs.

IX

CONCLUSIONS

Recent world-wide expansion of Intellectual Property Rights (IPRs) regimes has serious implications for social, ecological and economic sustainability of Indian agriculture, particularly the public sector research institutions and the farmers. However, even in the absence of IPRs, these public sector institutions have promoted narrow genetic and technological base over the last few decades, resulting in severe loss of agro-biodiversity and traditional farming practices. IPRs might further enhance this erosion, besides fuelling biopiracy and retard technology transfer. Recent controversies over terminator and Bt-cotton technology reveal the lack of public participation in technology evaluation. However, the International Convention on Biological Diversity (CBD) has opened up vital spaces that we must occupy to bring in some benefits within the IPR framework which we must inevitably accept. India must harmonise provisions of its patent act as well as proposed legislations on plant variety protection and biological diversity. All these legislations must make it mandatory that all IPR applicants disclose genetic material accessed, its country of origin and prior public knowledge. This information could be used to examine the novelty of the innovation and share the resultant benefits including technology transfer with providers of the genetic resources or relevant knowledge, for promoting their conservation. To protect folk knowledge and practices new forms of IPRs must be instituted such as registration of land races and petty patents, besides information and material transfer agreements (ITA/MTA). These measures need to be complemented by an ongoing programme of documenting village level biodiversity resources, relevant public domain knowledge and practices. This information must then be widely shared through databases and networks with the IPR authorities, entrepreneurs

and farmers, for application of folk knowledge and practices. This would also help in dissemination of appropriate technologies and promote prior public appraisal in an informed fashion.

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