

Status and Prospects of IP Regime in India: Implications for Agricultural Education

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Intellectual property rights (IPR) are ideas, inventions, and creative expressions based on which there is a public willingness to bestow the status of property, while technology management seeks to foster effective and efficient use of developed technology. In a dynamic global environment with changing industry and competitor landscapes, management of technologies including effective commercialization strategies using the IPR advantages gathers utmost importance. In an agrarian country like India, the process of IP awareness can be catalysed only by educating the various stakeholders like policy makers, farmers, academia, industry, researchers and consumers about the importance of IPR and technology management. As Indian agriculture is attaining new vistas in development and agri-business is becoming increasingly global, it is time for a 'fresh think' to prevail in the IPR debate by creating much more awareness among academia, industry, policy makers and public. The initiatives taken on these lines by the Indian Council of Agricultural Research (ICAR) and other governmental and non-governmental agencies are explained in this paper. A paradigm shift in agri-education policies is envisaged to build the capacity of agricultural professionals in view of dynamic changes in IPR and technology management areas.

Keywords: Intellectual property rights, technology management, Indian agriculture, IPR education, technology commercialization, technology forecasting

In an increasingly dynamic social and economic environment, researchers are facing accelerating changes in technological development and its commercialization. This can be attributed to the advancement of tools of technology development, changes in supply and value chain management and increasing influence of the industry in developing and commercializing technologies by the public research system. Many see emerging technologies as a solution vector for the global challenges including that of climate change. Management of intellectual property resources has become a key issue in agricultural and resource economics over the past two decades. The changes in intellectual property (IP) dimensions in technologies involving biosciences that have occurred since 1980 make private enterprise possible in many broad research areas of agriculture and the health sciences.¹

Furthermore, universities, cooperatives and other public and non-profit institutions now have the option of licensing or selling research outputs in this area, rather than giving their results away for free. As the scope and power of intellectual property rights (IPRs) in agriculture and biotechnology has grown, their international reach has expanded. The IP regime has set up the stage for healthy competition among

research centres and industries for developing and seeking novel technologies.

However, compared to developed countries, once the technology is created, not much attention is paid in the developing nations on their commercial, policy, environmental, ethical and societal implications. Hence better techniques are needed for their management, to create policy and educate professionals to commercialize and govern them. Due to the critical role of technology in a competitive environment, strategic technology management is important for farmers and agri-enterprises too. For the long-term success, the researchers as well as farmers must develop and sustain their technological capabilities to create internal and external impacts within an ever changing and market driven socio-economic context.

The National Agricultural Research System (NARS) in India is designed to cater and render technical support to farmers and entrepreneurs for managing their technologies through IP protection measures. The institutes of Indian Council of Agricultural Research (ICAR)/State Agricultural Universities (SAU) are driven towards dynamicity and complexity, not only from the intricacy of the technologies that are investigated, but also because of changes in the way research is done. Resource constraints demand interdisciplinary collaboration among research institutes/universities, industries, and

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governmental agencies. This added complexity in turn creates a demand for improved methods and tools for technology management, research and education.

Considering the rapid changes in global research, technology development and market scenarios, educating agricultural students about the ever dynamic and complex environment of IPR and technology management becomes inevitable. They should be made aware about the various tools, techniques, protection measures, issues and challenges in relation to IPR and technology management and also about the changing boundaries of industry landscape. It is in this context, an attempt has been made in this paper to analyse the global system in place for IP education and list out avenues for strengthening IP related awareness among agricultural professionals and farmers in India. The status of existing mechanism along with the new initiatives and challenges with respect to technology management and IP education in India has been also reviewed. Further, suggestive strategies and mechanisms for furthering opportunities and innovations in technology management and IP education in the country are also listed.

IPR and its Management

In an economy based on intangible assets, IP management acquires a key place in the development of a nation. The resources of a typical company/ firm are now more than 80 per cent intangible assets and nearly 20 per cent tangible and capital resources – the inverse of the relative contribution of tangible and intangible assets 50 years ago.² Figure 1 shows the transition of firm’s assets from tangible to intangible during last three decades.

Currently the term ‘intellectual property’ is reserved for types of property that result from creations of the human mind, the intellect. The most accepted definition is the one advocated by the World

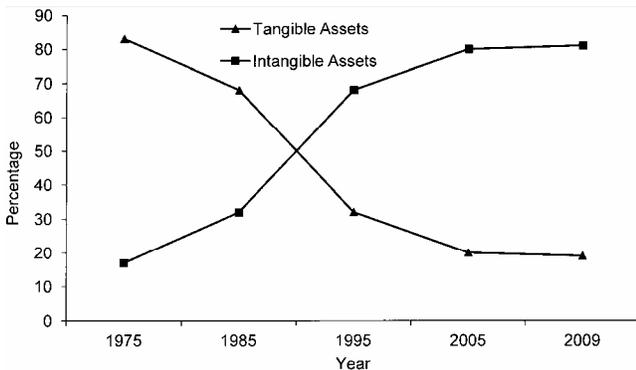


Fig. 1—Transition from tangible to intangible assets of a typical business firm²

Intellectual Property Organization (WIPO). The convention establishing the WIPO defined the term ‘intellectual property’ as³- “Literary artistic and scientific works; performances of performing artists, phonograms, and broadcasts; inventions in all fields of human endeavour; scientific discoveries; industrial designs; trademarks, service marks, and commercial names and designations; protection against unfair competition; and all other rights resulting from intellectual activity in the industrial, scientific, literary or artistic fields”.

Generally, countries have laws to protect IP for two main reasons. One is to give statutory expression to the moral and economic rights of creators in their creations and the rights of the public in access to those creations. The second is to promote, as a deliberate act of government policy, creativity and the dissemination and application of its results and to encourage fair trading which would contribute to economic and social development.

Science and Technology - National/International Scenario

Post-industrial economies are often called ‘knowledge economies’⁴, reflecting their transition from resource extraction and primary manufacturing to an economy based on a greater proportion of high technology manufacturing and knowledge intensive services. In addition to the changing composition of corporate assets, hallmarks of knowledge economies include literate and numerate citizens, demographic transition and extensive government coordination of R&D in science and technology. To maintain a competitive trajectory in the knowledge economy, countries expend considerable resources directly on the maintenance of their scientific and technological base. Annual government expenditure on R&D in knowledge economies, as a proportion of gross domestic product (GDP), tends to be maintained at two per cent.⁵ Figure 2 depicts the percentage of GDP

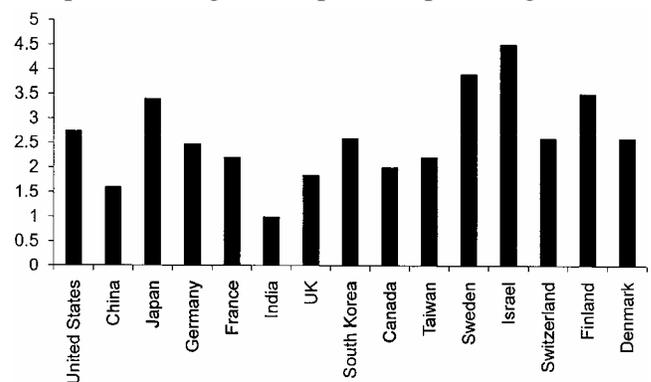


Fig. 2—Percentage of GDP spent on R&D by various countries⁷

spent on R&D by various countries including India. Currently, the Government of India's spending on R&D is near to one per cent of GDP, which needs to be raised to the level of two per cent to promote innovations, technology development and national IP repository.⁶

Evolution of IPR and Technology Management in India

In India, the concept of commercialization of technology from R&D is relatively new in most sectors, especially in agriculture. It is an accepted fact that IP enablement of technology helps to attract and accelerate technology seekers with opening of markets and as agriculture is becoming part of world trade, there has been a market emphasis of IP enablement activities in agri-sector including the NARS. Agricultural sector has been currently striving towards evolving an IPR strategy with better focus and approach on its effective commercialization.

A compilation of the major types of IP assets in agriculture R&D with their qualifying attributes under relevant legislations in India is presented in Table 1. The broad institutional mechanisms, legislative provisions and potential returns to the stakeholders of agri-value chain are also depicted. Considering special nature of use of bio-resources and traditional knowledge (TK) in agriculture, the various provisions and legal mechanisms for protection of these are also enumerated.

The laws and administrative procedures relating to IPR have their roots in Europe. Trend of granting patents started in the fourteenth century.¹⁴ In comparison to other European countries, England was technologically advanced in certain aspects and used to attract artisans from elsewhere, on special terms. The first known copyrights appeared in Italy. Venice can be considered as the cradle of IP system as most legal thinking in this area was done here; laws and systems were made here for the first time in the world, and other countries followed in due course.¹⁵ Patent Act in India is more than 150 years old. The first one is the 1856 Act, which was based on the British patent system and provided a patent term of 14 years followed by numerous acts and amendments.¹⁶ India's colonial status brought with it patent legislation, so by 1911, India's IP regime conformed to developed world status.¹⁷ However, seeking to develop a domestic pharmaceutical industry, in 1970, India abolished patents on pharmaceutical products. This allowed domestic firms to imitate and adapt foreign therapeutic inventions. In

1995, six of the top ten pharmaceutical firms in India were domestic, and employment in the sector had reached half a million people.¹⁸ As in 2010, India accounted for almost half of the total US drug master files (DMFs).¹⁹ However, to gain access to the global market enabled by the World Trade Organization, India had to ratify the Agreement on Trade-related Aspects of Intellectual Property Rights (TRIPS), the most influential treaty on global intellectual property. Doing so included introducing product patents on pharmaceutical innovations, extending patent terms from 5-14 years to 20 years, and allowing limitations on compulsory licensing.²⁰ Under the TRIPS regulations, patenting has accelerated in India in all fields.²¹ Over the eight years from 2005 to 2012, published patent applications originating from India have oscillated between 4,000 and 7,000 in a year but maintained an average over the period of around 5,900 annually, which is around the same level as Australia and Great Britain. However, with a population of over 1.2 billion compared to 22 million for Australia and 62 million for Great Britain, this level of patenting is particularly low. Domestic innovation has remained stable between 2005 and 2012 at around 29 per cent. Nearly two thirds of all Indian patent applications in 2012 are from foreign concerns seeking protection for their innovations in the Indian market. India's share of the top 10 technologies globally is predominantly weighted towards natural products with little relative share in high-tech fields of computing and communications and less in lighting and semiconductor materials.²² The United States, China, Japan and European Union lead in the number of patents application filed in 2010. Canada and China showed the highest year-on-year growth, with 20 per cent each, followed by Australia, the US and Turkey. In contrast, Asian countries like India, Indonesia, Korea and Thailand have shown a diminishing trend. The listed natural products are mainly from agriculture, veterinary and allied sectors. Apart from researchers and agricultural professionals, farmers and local communities are getting more aware about IP and related protection measures. For example, under the aegis of PPV&FR Act, 2001 of India, Protection of Plant Varieties & Farmers' Rights Authority of India has received a total of 642 applications representing 28 crops during 2010-11 for seeking plant variety protection under the Act. The applications belonged to new (395), extant (216), farmer's varieties (30) and essentially derived variety (1) categories.²³ This underlines the urgent

need to strengthen the educational system with more information on IPR and create awareness among innovators, researchers, farmers, government and non-government organisations about the IP regime and its utilities so that provisions made in various legislations are used by the potential stakeholders to

accrue benefits for themselves and promote innovation at the national level. It is important that all concerned undertake initiatives to get legal grants for any rightful ownership on their inventions and acknowledge original holders of knowledge and biological resources used in the process of invention.

Table 1—Broad institutional mechanisms(s), legislative provisions and potential returns to stakeholders with respect to IP and related forms of knowledge and resources^{6,8-13}

S No	Intellectual Property	Legislation	Administration authority	Qualifying attributes	Possible field(s) of application in agricultural sector	Potential stakeholder (s) to benefit
1	Patent	Patents Act, 1970	Controller General of Patents Designs and Trademarks (CGPDTM)/ Controller of Patents	Novel, non-obvious, capable of industrial application and not fall within the provisions of Section 3 and 4 of the Patents Act, 1970	Agricultural products, processes, value addition	Inventors, traders, economy
2	Design	Design Act, 2000	CGPDTM/Registrar of Designs	New or original; significantly distinguishable from known designs or combination of known designs	Agricultural machinery; post harvest technology products, packaging of processed food/inputs etc.	Industry including SMEs
3	Trademark	Trade Marks Act, 1999	CGPDTM/Registrar of Trademarks	Capable of distinguishing features of goods and services, capable of graphical representation, used or proposed to be used to identify goods/services	Goods and services in agri-business sector	Industry-products and service sector
4	Geographical indication	Geographical Indications (Registration and Protection) Act, 1999	CGPDTM/Registrar of Geographical Indications	Specific geographical origin, possessing qualities, reputation or characteristics that are essentially attributable to that place of origin	Goods, naturally occurring breeds/varieties of commercial value	Communities, traditional practitioners, knowledge holders
5	Copyright	Copyright Act, 1957	Director and Registrar of Copyright	Original expressions of ideas, creations	Software, databases, expert systems, books,	Creators of all works
6	Integrated circuit design	Semiconductor Integrated Circuits Layout-Design Act, 2000	Registrar, Semiconductor Integrated Circuits Layout-Design Registry	Original; not commercially exploited anywhere in India or in a convention country; inherently distinctive; inherently capable of being distinguishable from any other registered layout-design	Automated machineries/irrigation systems/ agri-processing	Electronic industry, traders, SMEs
7	Plant varieties	Protection of Plant Varieties and Farmers' Rights Act, 2001	Registrar, Protection of Plant Varieties and Farmers' Rights Authority/Registry	New, distinct, stable and uniform	Seeds/ seedlings/propagation materials	Plant breeders, farmers, industry
8	Biodiversity	Biological Diversity Act, 2002	Registrar, National Biodiversity Authority (NBA)	Biological resources, herbal remedies, associated traditional knowledge	Access and utilization of biological resources	Knowledge holders, farmers, communities, researchers, etc.
9	Traditional knowledge	None	Secretary of the concerned Ministry(ies)	Traditional knowledge/ genetic resources	TK based products and processes	Knowledge holders in communities by sharing of accrued knowledge

This delicate thread of balancing can be only achieved if there is an awareness of the current intellectual property regime and its operational framework.

In India, educational programmes in IPR and technology management are comparatively new initiatives. While more generalized subjects have been taught in many engineering and management courses such as information technology management, technology/product marketing management etc., the focus on intellectual property management in agri-education has been very recent. Since 2006, IPR has been made a part of course content (non-credit) at post graduation as well as PhD level in all ICAR and SAUs.²⁴ The Indian Council of Agricultural Research also developed a common course curriculum for all NARS education institutes including SAUs in the year 2009. Thus IPR was introduced with name of 'Intellectual property and its management in agriculture' as a non-credit course (e-Course). However, more emphasis needs to be in place while preparing and modifying higher education academic curricula by incorporating advanced courses on IPR and technology management and commercialization in agricultural and veterinary sectors.

Ideas to Innovation and Management of Technology: Changing Face of Indian Agriculture

As the world agriculture and agri-business have become more technology reliant, there is an increasing need for actively monitoring the technology requirements, technology innovations and mapping technologies. Technology change potentially has implications for all businesses including agri-business. In case of agriculture and agri-business, the advances in technologies for increasing input-use efficiency, climate-resilient agriculture, efficient farm machineries, biotechnology etc., and improvements in supply-chain and value chain make drastic and significant changes in terms of business gain as well as customer satisfaction. The uncertainties in climate, which in turn affect the ability of the land to produce food for increasing populations is a major challenge to the developing countries. In this context, technology management with reliable forecasting options can provide information with obvious and immediate applicability and with significant cost implications. A reliable technology management system will aid a firm that sells products vulnerable to the effects of technology change to develop a new product and set up production lines in accordance with the change in technology landscape.

Technology management, which *inter alia* aims at planning and developing the technological capabilities of an organization or a nation, has now occupied the centre stage of decision-making in many strategic areas. It embraces several interconnected issues such as: technology policy; technological forecasting and assessment; technology strategy; technology transfer; technology-induced as well as market-oriented R&D; process and product technology and their continuing improvement; human resource management in terms of innovative capabilities, flexibility and contribution; and technology project management. The management, mapping, transferring and forecasting of technologies with respect to food, water, energy and the environment have attained centre stage in view of emerging issues on climate change, carbon foot printing, greenhouse gas emission, deterioration in environment and water, poverty related livelihood and social issues, etc.

Agriculture is and will continue to be the main driver of India's economic growth. India's agriculture did extremely well and was on the ascendancy till the mid-nineties but after that the growth slowed down. The eighth five year plan period showed a growth rate of 4.8 per cent for agricultural GDP.²⁵ But since then (1996-97), the growth rate of agricultural GDP has been, on an average, 1.8 per cent per year.²⁶ On the other hand the farmer has been facing rising input costs, declining returns, an uncertain market, threat from multinational players and market giants and blurring of distinction between the domestic market and the international market. Indian agriculture has also pulled backwards due to many contradicting constraints like lack of infrastructure, investment and infrastructure facilities, fragmented lands, large number of intermediaries, lack of suitable supply or value chain mechanisms, less scale of value addition and many more. To assist the farmer in these changing contexts, new strategies and innovative solutions are urgently required which in turn will require strong technological support. The technology development process in agricultural sector should not only be responsive to farmer's needs, but also support the rapid changes in global innovations. Hence, the agricultural research system which generates technologies has to conduct the business of agricultural research in an innovative way with stronger measures for collaborative and participatory research and streamlining of the activities with global changes. Apart from generating innovative technologies, effort should also be taken to protect

and manage these IP/ technologies and ensure maximum return to the inventors or farmers by technology commercialization. Scouting, cataloguing, conserving and protecting indigenous plant varieties and rural technologies are also important. One of the pre-requisite for achieving these goals is creating awareness among farmers, rural innovators, researchers, academia and students about the changing perspective of IP regime and also about its benefits as well as necessary precautions.

The constant change in landscape of Indian agro-industries in the dynamic IP regime also needs a mention along with the changes in research and rural innovations. While Indian industry has been increasingly realizing the importance and benefits of IP creation and protection, the Indian Government has been doing its best in creating a conducive environment by upgrading infrastructure and bringing in policy level initiatives in the country resulting in sweeping changes in the IP culture and administration in the country. However, there is a lack of an enabling environment for the corporate sector to work with the academic sector on joint research/commercialization, largely due to factors as articulated in the report from Indian industry organizations.²⁷ Some of these are:

- (i) Absence of a clear IPR regime governing the ownership of intellectual property created through government funded projects.
- (ii) Limited incentives for academic institutions/ academicians to partner with corporate bodies and vice-versa.
- (iii) Lack of concrete structured processes and systems for academic institutions to partner with corporate bodies, leading to an ad-hoc approach and poor visibility of outcomes.

These challenges can only be overcome by making ways for stronger and vivid IP policies similar to the Bayh-Dole Act of USA and proper management of technologies. The Bayh-Dole Act introduced in 1980 provided impetus to university licensing offices to use start-up companies to commercialize early stage inventions.²⁸ The introduction of 'The Protection and Utilization of Public Funded Intellectual Property Bill, 2008' (Public Funded IP Bill) in the upper house of Indian Parliament could be a major paradigm shift in the way the outcome is expected of the public funds by researchers in a university or an institute of higher education. The bill makes it mandatory for such grant recipients for time-bound disclosure and IP protection of all R&D supported with public

funding.²⁹ However, given the current innovation environment in India, it is argued that the Bill would likely be premature. The R&D infrastructure in universities, R&D ethos in several R&D institutions, absorptive capacity of its domestic industry, availability of seed capital for entrepreneurship as well as the overall awareness about IPRs need to be strengthened considerably before a system as envisaged under the proposed Bill could have a real impact.³⁰ The Bill was shelved in 2011 due to increasing criticisms and sustained campaign for many amendments. Some thinkers suggest that the Government can pursue the objective of the Bill by amending the General Finance Rules (GFR), 2005 by making it mandatory for government funding agencies to permit recipient institutions to protect, own and license IP resulting from government funded projects.

IP and Technology Management Framework in Indian NARS

Technological assets of ICAR include a number of high yielding and resilient crop varieties, animal and poultry breeds and fish strains, packages of improved crop and animal husbandry practices, natural resources management technologies, improved tools, equipment and farm machinery, improved, dairy, poultry and fisheries technologies, post-harvest technology, computer software and data sets, and several other processes and products of agriculture and allied sectors. Over the years, many innovative tools and techniques have been developed to improve strategic planning and management process with respect to agricultural and rural technologies. Recent, advanced and sustainable technologies on agriculture, veterinary, food, water, energy and environment are being scouted, catalogued and mapped by ICAR.³¹ Subsequently methodology/tools have been developed to link the acquisition of technology to strategic objectives and associated business and market drivers, enabling effective technology investment decisions. Apart from these, systematic attempts are being made to anticipate and understand potential direction, rate, characteristics and effects of technological change, innovation, adoption and application in identified areas. The institutionalization of IP management in the ICAR institutes has been able to create the desired awareness of IP issues and a minimum level of in-house expertise. This needs to be nurtured with the aim to generate an environment in which researchers come forward with ideas and create an effective innovation system.

All IP related issues within ICAR are managed by a team headed by Assistant Director General (IPR) positioned at New Delhi under the governance of the Director General, ICAR. Policy support in the areas of agriculture related IPR and technology management is given by its constituent institutes like National Academy of Agricultural Research Management (NAARM)³², National Centre for Agricultural Economics and Policy Research (NCAP)³³ and also academic bodies like National Academy of Agricultural Sciences (NAAS).³⁴ As part of policy initiatives for Intellectual Property Management and Technology Transfer and Commercialization³⁵ undertaken by the ICAR and Department of Agricultural Research and Education (DARE) towards encouraging agricultural innovations and further management and commercializing of the technologies, there is now a framework in place.

ITMU, ZTMU and BPD Units

Since the implementation of the XI Plan Scheme, a three-tier IP management mechanism has been established in ICAR. Accordingly, Institute Technology Management Units (ITMUs) were established in its 100 institutes as a single-window mechanism to showcase the intellectual assets of the institute and pursue matters related to IP management and transfer/commercialization. Five Zonal Technology Management (ZTM) and Business Planning and Development (BPD) units were established at the middle-tier, in synergy with the ITMUs, in their respective zones. Twelve new BPD units have been initiated in 2013-14 to promote business incubation and technology commercialization.³⁶ The IP&TM Unit at the ICAR headquarters performs a key facilitation/coordination role and monitors functions for the implementation of the scheme as stipulated in the ICAR Guidelines for Intellectual Property Management and Technology Transfer/Commercialization, 2006.

The initiatives of establishing agri-incubators have begun being instrumental in formulating business policy, plan and developing models for technology commercialization not only for the institutes where they are located, but also for the identified institutes in the respective zone.³⁶ These efforts by ICAR have been successful in creating an institutional mechanism for commercialization of agriculture research products/technologies generated from public research institutions. The ZTM & BPD units have been supported to provide the physical infrastructure necessary for technology incubation and to launch

new business, including laboratory space, and shared resources such as specialized equipment and technical support services. Appropriate capacity building in terms of human resource has also been undertaken by engaging/contracting professional help and providing required training to the existing inter-disciplinary professionals in the area of technology management and enterprise creation. This has led to enhanced production, diffusion and use of new and economically useful knowledge and provides desired credence for further scaling up these components.³⁵

National Agricultural Innovation Project (NAIP)

The World Bank funded National Agricultural Innovation Project (NAIP) with a total budget of US\$ 250 million has been undertaken by the ICAR since 2007 to pilot and accelerate agricultural and rural innovations in agricultural research. The project is expected to be complete by the year 2014. One of the basic objectives of the project is to give the agricultural research and technology development system an explicit development and business perspective through innovative models.³⁶ On completion of the project, the agricultural research system should be able to support agriculture as a business venture and also as a means of secure livelihood of the rural Indian while maintaining excellence in science.

Agri Innovate India Ltd

Agri Innovate India Limited, a registered company under the Companies Act, 1956 is owned by DARE, Government of India. It aims to work on the strengths of ICAR, which is under DARE and promote the development and spread of R&D outcomes through IP resource protection, commercialization and forging partnerships both nationally and internationally.

The company has been set up with an authorized share capital of Rs 1000 million with an initial paid up capital of Rs 500 million. The company is an extended independent commercial outfit, which capitalises on the vast network of ICAR institutes, where the researchers innovate and harness science to provide access to food, nutrition, livelihood and income security for all engaged in agriculture and its allied sectors. The company through a corporate framework should add to the availability of such quality products and services in the market and take initiatives for global brand building. The major objective of the company is protection and management of IP generated in the system and its commercialization/ distribution for public benefit.

Other Initiatives from ICAR

The ICAR has more recently focused on demand based research and technology development with creation of its own innovation systems. This is because, the general focus on strengthened research systems while increasing the supply of new knowledge and technology, may not necessarily improve the capacity of in-house innovation mechanism. The research activities that take place within NARS albeit within the context of its external linkages and government policies are just one component of the innovative system and therefore there is a need to revisit them time-to-time based on the global changes in market, technologies and innovations. In general, the advantages of any innovation system are based on the ability of an organization to (a) successfully define its scope, (b) manage and coordinate technology within the organization as well as in relation to stakeholders, and (c) be aware of market demand characteristics and respond to them appropriately. In this context, apart from frequent farmer interfaces, the ICAR has initiated comprehensive consultations with other stakeholders through ICAR industry meets, interaction meets with NGOs and farm entrepreneurs and agri-tech investor meets, etc.^{31,35}

Status and Future of Agri- related IPR Education: Indian Perspective

One of the earliest entrants in IPR education at international level was the WIPO Academy which continues to play a leading role in IPR education worldwide.³⁷ The Academy adopts an interdisciplinary approach to IP education focusing on its links with trade, innovation, health, applied sciences, information technology and creative industries. The rich WIPO portfolio of general and specialized courses on IP caters to different target audiences: inventors and creators, business managers and IP professionals, policy makers and government officials of IP institutions, diplomats, students and teachers of IP and the civil society. The WIPO also offers post graduate courses on IP law in seven countries across the globe in collaboration with leading institutions. It also offers an intensive course on IP and business entrepreneurship and facilitates distance learning programmes, executive programmes, professional development programme and summer school programmes.³⁸

The Global Network of Intellectual Property Academies (GNIPA) is a network of training and research institutions (IP Academies) established within national or regional IP offices as well as certain intergovernmental organizations. The GNIPA offers joint master degrees in IP law, advanced courses for teachers of IP, and summer schools for students and young professionals across the globe.³⁸ There is also the National Intellectual Property Organization (NIPO) in India with the objectives of catalysing awareness about the rights of IP owners and promoting knowledge of intellectual and industrial property law.³⁹ While India has high innovation potential, the conversion ratio from innovation to a marketable product is very low. Hence more efforts have to be made to strengthen the weak links and improve the knowledge level of the stakeholders on the changing landscapes of IP resources and technology management.

As discussed earlier, IPR is a part of course content (non-credit) at post graduation as well as PhD level in all ICAR managed academic institutions and SAUs in India. The major areas covered by the course are fundamentals of IP and its management in agriculture, regulatory mechanisms and intellectual property rights and management of R&D and innovation. The Tamil Nadu Agricultural University, Coimbatore, Anand Agricultural University, Haryana Agricultural University, Hissar and Gandhi Krishi Vigyana Kendra (GKVK), University of Agricultural Sciences (UAS), Bangalore are pioneers in agri-related IPR education in India. The NAARM, Hyderabad initiated a one year post graduate diploma programme in Technology Management in Agriculture (PGD-TMA) in collaboration with the Central University, Hyderabad on a distance learning mode in 2011 (ref. 40). The programme is one of its kind and covers the subject of technology management in agriculture and thrust on the intricacies of building and managing IP.

Apart from this, other streams of education, which have indirect links to agriculture such as law, management, environmental studies, civil engineering, plant science etc., are also given priority while shaping up an IPR friendly curriculum. The NAAS recommended setting up Masters of Law (LLM) degree programmes in 'IPR laws in relation to agriculture' at various law schools in the country.⁴¹ Establishing an Indian academy like the WIPO Academy may be a progressive and futuristic step towards a giant leap in the international IP landscape.

In its policy document³⁵, the ICAR contemplated the following suggestions in relation to IPR education in SAUs and deemed-universities of ICAR:

- (a) One course on IP and technology management in agricultural research and education at post graduate level to be included in curriculum, which in turn would aid in skill development for greater participation in agri-business activities by turn outs; encourage entrepreneurship; and equip agricultural graduates to become job creators rather than job seekers.
- (b) Publish text books, and compendia on IP protection and technology transfer in mandate/crop/commodity/areas for use as reference books to teach IPR.
- (c) Develop a network of e-libraries to support on-line data search and literature for latest information and data on IPR in national and global contexts.

It is also envisaged that a national programme on technology management and forecasting to be conceived in collaboration with existing similar platforms of ICAR such as NAIP, Agri-innovate India, etc. A technology transfer protocol for forward integration with the government machinery, policy makers and other clients and the backward integration with the framers, research institutes, NGOs and other organizations such as IIMs, IITs and business houses have to be designed with clearly defined channels of communication and data flow. The operational protocol of IP education and technology transfer with commercialization in NARS environment is depicted in Fig. 3 (ref. 31,35,36).

As part of the Ministry of Human Resource Development's (MHRD's) focus on IP education, the Indian Institutes of Management (IIMs) and Indian Institutes of Technology (IITs) have been working to promote awareness on IPR and technology management. A few universities and law schools in the country have also already included IP education in their syllabus. IP courses at higher education institutes will aid growth and focuses on the economic and strategic aspects related to IPR.

New Initiatives and Processes in IP Resource and Technology Management in India

Apart from ICAR, many other governmental agencies and departments, professional societies and NGOs have taken up initiatives in IP and technology management both in national as well as in regional perspective.

Technology Information, Forecasting and Assessment Council (TIFAC)

The Technology Information, Forecasting and Assessment Council is an autonomous organization set up in 1988 under the Department of Science & Technology (DST), Government of India to look ahead in technologies, assess technology trajectories, and support innovation by network actions in selected technology areas of national importance. TIFAC embarked upon the task of formulating a technology vision for the country in emerging technology areas. The Women Scientists Scholarship Scheme (WOS-C) of TIFAC⁴² is a progressive step towards training women having qualifications in science/ engineering / medicine or allied areas in the area of IPR and their management for a period of one year.

IP Facilitation Centre (IPFC) for MSME

The Confederation of Indian Industry (CII) in association with the Ministry of Micro Small & Medium Enterprise (Mo-MSME) has established an Intellectual Property Rights Facilitation Centre (IPFC) in three cities of India. This is the first of its kind to be launched with a primary objective to 'boost IP culture' which would enhance the intellectual capital that is vital for the economic development of the state.

India IP Owners Forum

The India Intellectual Property (IIP) Forum acts as single window service for all those who are interested in protecting their IP. The portal will serve as a platform where members would get to voice their concerns and issues. It facilitates interaction and acts as a knowledge networking gateway for all IP users.

National Science & Technology Management Information System (NSTMIS)

The National Science and Technology Management Information System, a division of DST, Government of India has been entrusted with the task of building an information base on resources devoted to scientific and technological activities for policy planning in the country on a continuous basis. It is also responsible for collection, collation, analysis and dissemination of information with respect to S&T activities in the country.

Society for Technology Management (STEM)

The Society for Technology Management is a not-for-profit organization, which provides a facilitative environment for successful technology transfer processes and promotes best practices in technology management. It provides a supportive environment for

entrepreneurship and networks with referral links for information and other resources. It contributes to the professional development of technology management professionals and provides proper guidance and assistance to inventors and corporations in matters of intellectual property.

The efforts of these agencies led to awareness creation among institutions and stakeholders, linkage between service providers and clients and voicing of emerging issues and constraints of the stakeholders and figuring out appropriate strategies. If these agencies regularly come together to establish a

common platform for sharing experiences and expertise, such initiative may facilitate arriving at a roadmap for effective technology management in agriculture.

Global Perspective of Agricultural Technology Management and IPR Education: Emerging Opportunities and Challenges

Intellectual property rights could play a significant role in encouraging innovation, product development and technical change. Developing countries like India tends to have IPR systems that favour information diffusion through low-cost imitation of foreign

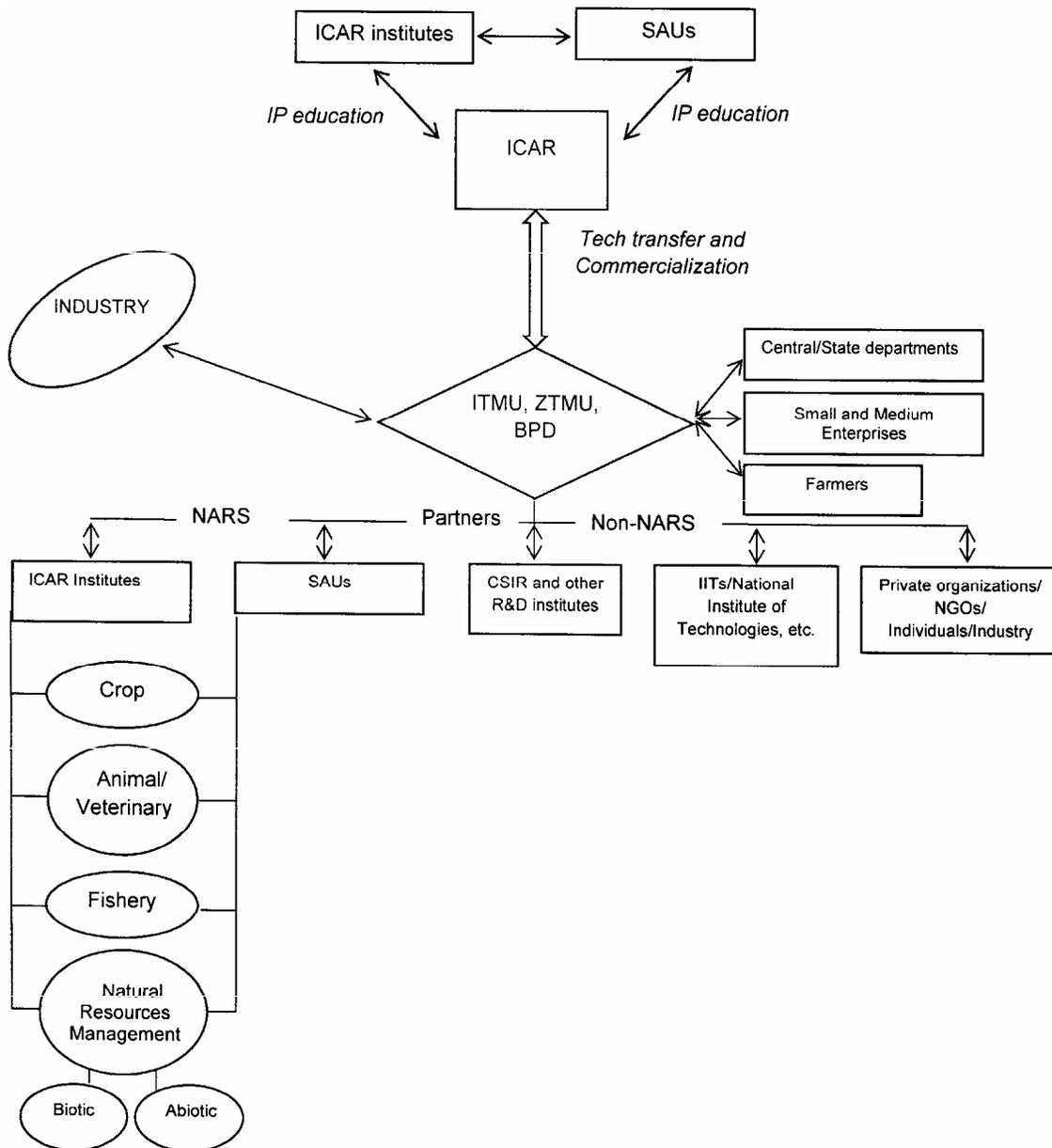


Fig. 3—Operational protocol of agri-related IP education and technology commercialization in India

products and technologies. This policy stance suggests that prospects for domestic invention and innovation are insufficiently developed to warrant protection. However, an inadequate IPR system could stifle technical change even at low levels of economic development.²⁷ This is because much invention and product innovation are aimed at local markets and could benefit from domestic protection of patents, utility models, and trade secrets. Moreover, IPR systems could help reward creativity and risk-taking among new enterprises and entrepreneurs. Countries that retain weak standards could remain dependent on technologically inefficient firms that rely on counterfeiting and imitation. It is therefore necessary that a development oriented country like India must have strong IPR legislation and policies and strive to create awareness among industry, academia, students, farmers and public on the IP regime and precautions to be taken to protect their intellectual assets. India is rich in its indigenous technical knowledge and therefore, the avenues to cash upon the traditional wisdom should be opened to the grass root innovators and farmers. A general awareness of the global scenario and clear understanding of the modalities under the IPR is inevitable to the above mentioned stakeholders and it can be cultivated only through educational programmes at the degree level and above especially to the students of agriculture, law, engineering and management.

Inventive firms in developed economies tend to orient their research programmes toward products and technologies for which they expect a large global demand and that may be protected by IPR. This means that a disproportionately small amount of global R&D is focused on the needs of developing economies with low incomes and weak IPR protection. The efforts to strengthen IP protection in developing countries like India could induce greater R&D aimed at meeting the particular needs of the country. The evidences suggest that IPR protection could generate more international economic activity and greater indigenous innovation⁴³, but such effects would be conditional on circumstances. These circumstances vary widely across countries and the positive impacts of IPR should be stronger in countries with appropriate complementary endowments and policies. Countries face the challenge of ensuring that their new policy regimes become pro-active mechanisms for promoting beneficial technical change, innovation, and consumer gains. Educating all stake holders along with policy makers on the

dynamic environment of the IPR regime is a vital pre-requisite for conceiving and enforcing strong IP legislations. Apart from encouraging their innovativeness and accelerating returns for re-investments, the stakeholders should also be taught to extract profit from their innovations on traditional or modern technologies using the means provided under IPR by commercializing them through licensing or similar agreements on an international arena.

The lack of formal IP education makes future agriculture professionals incompetent in the face of global business and technological challenges and therefore, a well-structured and comprehensive academic programme in IP and technology management should be included as part of curriculum at the university level. The future global economies will largely be governed by climate change/GHG emission approach, carbon trading, environmental issues and sustainable livelihood based food and water policies. Hence IPR and technology management educational programmes should also be directed towards these issues and related socio-economic factors. The factors such as changes in global and local businesses, dynamics of supply and value chain systems, advances in technology management protocols, change in preference of consumers and industry should be considered while formulating education policies with respect to IPR in agriculture.

Conclusion

India has begun to see some positive results as awareness of the need for greater IP protection has increased. But these results are only the first steps on the path to full development of India's knowledge based economy. When examining potential investment sites, investors in the knowledge industries will look at the IPR regimes of various countries and choose those countries that offer the greatest protection for their investments. In this context, the country must continue to improve its IPR protection, or risk being left behind as other countries in the developing world implement protection and build their own knowledge based economies.

Educating all the stakeholders from farmers to innovators to industry players is vital for achieving the benefits of IP regime as well as for standing strong among global competing players. Being a country rich in its biodiversity and traditional knowledge base, India should take extra steps for ensuring due benefit and recognition to actual stake

holders while making use of them. The following measures will prove helpful towards cultivating an IP friendly community among farmers and agricultural professionals in the country:

- (i) Education in IP should start at least from the post graduate level in all agricultural and management schools/ universities in the country.
- (ii) More importance should be given to creating IP enabled business environment and macro- and micro-level technology management in agri-business management courses offered in SAUs and other organizations across the country to ensure competitive advantage and aid in strategic decision making process.
- (iii) The current system of offering non-credit courses may be upgraded to credit courses on IP management which will promote budding of IP professionals rather than just giving away basic awareness.
- (iv) Training programmes to progressive farmers on IP management, plant variety protection and TK management and its potential benefits may be conducted through the KVK system and other training institutes under NARS.
- (v) A coordinated effort should be in place for integrating the various IP related activities initiated by institutions under different agencies such as research and academic institutions, NGOs and government departments. A national level agency or a consortium in this regard may be constituted. It can support the innovators, farmers and communities who want to preserve innovation, biodiversity and TK for IP filing, protection and benefit sharing process.
- (vi) The Government of India can either bring the Public Funded IP Bill in a new form or amend the GFR incorporating the provisions to protect, own and license IP resulting from government funded projects

Early implementation of a strong patent regime includes a comprehensive IP education plan that would strengthen India's agricultural research and development sector, attract more foreign investment, and provide a basis for Indian firms to begin tackling shortcomings and problems that seriously affect the country. As India's knowledge based economy grows, it will benefit not only India, but the rest of the world as well, especially the developing world it leads. The country's IP specialised manpower can support global industries and business houses and its

IP friendly community will attract more foreign direct investment into India. As Indian agriculture is reaching to new vistas of development and business is becoming increasingly global and also in view of the country's mammoth consumer market, it is time for 'new and fresh think' to prevail in the IPR debate by creating much more awareness through formal education on this aspects among academia, policy makers and the public.

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