Private Investment in Agricultural Research and International Technology Transfer in India-A Theoretical Investigation.

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Abstract: Agricultural needs in poor tropical countries differ significantly from those in temperate, rich countries. Yet little agricultural research is performed on products for the tropics. Private research is particularly concentrated in rich countries. This is a result of significant failures in the market for research and development (R&D), in particular, the difficulty of preventing the resale of seed in developing countries. To encourage private R&D in tropical agriculture, traditional funding of research may be usefully supplemented by a commitment to reward developers of specific new agricultural technologies. Rewards tied to adoption may be especially useful in increasing up-take. An illustration of how a commitment to reward developers of new agricultural technologies might work is provided.

Keyword: Agricultural research and development (R&D), private sector R&D, Technology transfer.

I. Introduction

The present study addresses the questions of future sources of technology for increasing food and agricultural production by considering the situation in India. This region of the world is particularly appropriate for studying these questions because of the dynamic changes in population and incomes. How much private research is there and what is it producing? Will the private sector compensate for declining public agricultural research investments in India? What can governments do to stimulate private research and protect farmers from harmful or defective technology? Agribusiness firm’s R&D investments were evaluated in selected developing countries during 1996 and 1998 and compared with data from a similar study conducted in the mid-1980s. The largest amount of private research was in India where investment was about $55 million per year in the mid-1990s, followed by Thailand, Malaysia, and China. China’s private R&D spending represents less than one-hundredth of 1 percent of agricultural gross domestic product. In contrast, in Thai-land and Malaysia, firms spent about 0.1 percent. From the mid-1980s to the mid-1990s, private sector R&D grew in real terms in the countries in our sample. However, at this rate, private research will not fill the gap needed to support rapid growth in demand for agricultural products. Foreign firms made an important contribution to private research in all of these countries. The most important policy that helped induce this growth was liberalization of industrial policy that allowed private and foreign firms to operate and expand in agricultural input industries. A second important policy was investments in agricultural research. Patents and tax incentives seem to have had little effect so far, but could be important in the future.

The future of Indian agriculture will be one of knowledge and technology intensive and wider dissemination of the same cannot be accomplished in isolation. Even though the share of agriculture in GDP has declined to one-fifth from one-half at the time of Independence, agriculture remains the predominant sector in terms of employment and livelihood provision for more than half of India’s workforce engaged in it as the principal occupation [9]. Agriculture still contributes significantly to export earnings and supplies raw materials to many industries. To achieve a higher rate of agricultural growth in order to meet the demands of increasing population (expected to reach 1.63 billion by 2050), technological advancement will be very critical.

The advances in biotechnology and their integration with plant breeding will pave the way for achieving higher yield crops. In the significant advances India has made in agriculture during the past half-century, the role of agricultural input industry is very significant. The expansion in the use of seed, fertilizer, agrochemicals, irrigation and agricultural machinery industry has occurred parallel with the growth in productivity of rice, wheat, cotton, corn, sunflower, soybean, sugarcane and vegetables. While the public sector R&D, extension, and seed supply has made substantial contributions to food and non-food crops production, agri-business companies have been working with government to reach out to farmers in the supply of agricultural inputs used from sowing to harvest.

Agricultural science has always played a critical role in economic progress in both developed and developing economies. Through agricultural R&D, welfare improvement has been realized in the form of lower food prices to domestic population, improved nutrition, expansion in rural employment, agricultural
exports and enhanced level of foreign exchange, competitiveness of agricultural commodities in the world markets and strong growth linkages with rest of the economy. During the green revolution period, adoption of new technologies has helped to improve the income distribution across income classes [12].

Royal Agricultural Society of England, founded during 1790s in UK, paved the way for growth of experimental farming. Almost 150 years have passed since US public-sector agricultural research and development (R&D) began in earnest with the establishment of the US Department of Agriculture. Subsequently, in US agriculture, Public and Private agricultural R&D played a major role in bringing about changes.

India saw the beginning of scientific farming with the establishment of Department of Agriculture in each Indian province in 1880 under the British rule. Next step was to establish Imperial Agricultural Research Institute to foster agricultural research and education and decentralization of agricultural developmental activities to the Provincial Governments in response to Montague–Chelmsford Reform (1919). When the country got independence, in the efforts to develop country’s agriculture, promotion of agricultural R&D was considered as the most important. The agricultural review team chaired by Dr M.W. Parker of USDA (1963) suggested far-reaching changes in organization and management of agricultural research in the country.

The research centres across the country came under the one roof of Indian Council of Agricultural Research. Corresponding changes occurred at the state level with the transfer of research and education to State Agricultural Universities (SAUs). All these efforts culminated in the development of agriculture as a modern sector along with rest of the economy and agriculture emerged as key sector. This paper highlights the research, confronts faced and the benefits that was taken place in Indian agriculture.

Research in Indian Agriculture – Confronts and Achievements

Indian agriculture faces daunting challenges. The constraints of low productivity in agriculture were real and thus, central and state governments emphasized the need for accelerated development of agriculture. Despite national food surpluses, wide spread poverty and hunger remain because the growth of agriculture and thenational economy have not adequately benefited the poor, policy reform alone will not be enough to increase agricultural growth and to make it more equitable. The policy reforms must be accompanied by appropriate and efficient investments in public goods such as rural infrastructure, irrigation, agricultural research and extension, and the education and health of rural people. India has proven in the past that agricultural growth can be successfully achieved with the right public investments, even when economy wide policies were unfavourable towards agriculture. Thus, India’s promise of the future lies in combining policy reform with the right levels and kinds of public investments.

Technological change has been the main engine of agricultural growth in India. Strong empirical evidence provides support that high levels of R&D lead to high productivity and therefore improved economic performance. R&D was found to translate into significant rates of return in primary and service sectors, registering as high as 60 per cent [2]. The Total Factor Productivity (TFP) growth, which is the main driving force for the overall growth of agricultural output during 1980s in India, has started slowing down in recent years. Various authors have estimated growth in TFP of agriculture in India [3,6,7]. The growth rates range from 0.9 to 4.0. In few cases, there are negative growths also. The slowdown in TFP is a reflection of poor contribution by agricultural research and almost a near-zero performance by public extension system.

Indian policymakers have created one of the largest agricultural R&D systems in the world. The knowledge generated by investment in R&D was primarily responsible for the green revolution and achieving food security for the huge population. Despite success of green revolution, India still houses one-fourth of the world’s hungry and poor and 40 per cent of the world’s malnourished children and women [14]. The NSSO-2005 survey revealed that 40 per cent of the farmers would relinquish farming if provided alternate options. This is mainly because the economic viability of farming is threatened.

Private Sector Research in Indian Agriculture

The private sector in India has also made large investments in research and development relevant to agriculture. This investment has increased rapidly over time. The amount of agricultural research and development in the private sector is now approximately half the amount in the public sector [3].

The national agricultural R&D system has undergone a structural transformation with the enlarged role of private sector during the past two decades. One of the significant developments is the entry of MNCs making sizable investment in research on seed, agrochemicals and agricultural machinery.

The private sector investment in agricultural R&D has been accompanied by consolidation of chemical, seed and biotechnology companies. With the decontrol of regulations, the private research expenditure increased by 70 per cent between 1985 and 1995 [5] in India and the momentum is continuing. In the year 1991, the public sector investment on research was only 231.7 million and by 2009, the investment got multiplied by almost 14 times. The companies which have made investment in agricultural research fall in the categories of seeds, fertilizers, agrochemicals, agricultural machinery and sugar. While machinery, seeds, and agrochemicals...
categorized have shown an increasing trend in R&D investment, fertilizer and sugar companies have not raised the level of research investment over the years.

The liberalization of Indian economy since early 1990s has opened up opportunities for MNCs dealing with agro-inputs, seeds and agricultural machinery to expand their activities in India and many of them have launched joint ventures. Thus, the private sector agricultural research has achieved a credible performance contributing to increase in TFP in Indian agriculture. R&D on fertilizers can be categorized as one relating to fertilizer production and the other relating to consumption.

On the production side, research comprises fertilizer production processes, product development, and market research and supply chain and is carried out by both public sector and private sector R&D units of their respective fertilizer manufacturing companies. Besides 9 large public sector fertilizer companies, 15 private sector fertilizer companies have established strong in-house R&D centres. Over the years, to ensure that it is well-prepared to meet the challenges of fast-changing world and remain the market leader in the industry, the fertilizer R&D centres are involved in the in-depth surveys to understand the market demand and plan their production. These centres are spearheaded by highly qualified and experienced scientists; engineers and technologists.

Now the emphasis of private sector R&D units of fertilizer companies is on creativity and ingenuity to develop products most suitable for the end-users. They are also seeking the recognition by the Department of Scientific and Industrial Research, Govt. of India and look for obtaining patents and allow the researchers to publish scientific papers. R&D in micro irrigation is getting priority in investment. Private companies having known the huge market ahead for micro irrigation are investing sizeable quantum of funds on R&D in micro irrigation.

**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 advancements 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 term 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 footprinting, greenhouse gas emission, deterioration of environment and water, poverty related livelihood and social issues, etc.

Agriculture is and will continue to be the maindriver of India’s economic growth. India’s agriculturedid extremely well and was on the ascendency 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. [17] But since then (1996-97), the growth rate of agricultural GDP has been, on an average, 1.8 per cent per year.[16] 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 and a 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 innovativetechnologies, 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-requisites 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 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. 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. 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. 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 is envisaged under the proposed Bill could have a real impact. 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. 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)[1], National Centre for Agricultural Economics and Policy Research (NCAP)[19] and also academic bodies like National Academy of Agricultural Sciences (NAAS)[20]. As part of policy initiatives for Intellectual Property Management and Technology Transfer and
Commercialization[21] undertaken by the ICAR and Department of Agricultural Research and Education (DARE) towards encouraging agricultural innovations and further management and commercializing 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 reestablished 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. The IP & TM Unit at the ICAR headquarters performs a key facilitation/coordination role and monitors functions for the implementation of the scheme stipulated in the ICAR Guidelines for Intellectual Property Management and Technology Transfer/Commercialization[22], 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.[22] 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 businesses, including laboratory space, and shared resources such as specialized equipment and technical support services. Appropriate capacity building 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.[21]

**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.[22] 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 strength 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 capitalizes 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 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. [18,21]

**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 selecteotechnology areas of national importance. TIFAC [23] embarked upon the task of formulating a technologysvision for the country in emerging technology areas. The Women Scientists Scholarship Scheme (WOS-C) of TIFAC 42 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 a 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 non-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 tend to have IPR systems that favour information diffusion through low-cost imitation of foreign 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. [13] 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 precautionary measures.
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 economics tend to orient their research programmes towards 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 innovation [4], 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 endowment 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 stakeholders along with policy makers on the dynamic environment of the IPR regime is a vital pre-requisite for conceiving and enforcing strong IPR legislations. Apart from encouraging their innovation and accelerating returns from investments, the stakeholders should also be taught to extract profit from their innovations on traditional and 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 the 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.

II. Conclusion

The future of Indian agriculture will be one of knowledge and technology intensive and wider dissemination of the same cannot be accomplished in isolation. All categories of players, viz. public and private, and large and small must be involved in promoting the technologies. The agro-input industry has to closely work with government to realize the objectives. Policy environment must ensure a continuous encouragement to the private sector for attracting more investment. Mechanisms can be evolved for accreditation of private R&D, MOU for forging functional relationships and protocols for transferring/sharing technologies, materials and unique facilities. There is ample scope for intensifying human resource development through initiation of fellowships and professorial chairs by the private sector in focused areas of research. Private sector has a good amount of expertise which can be used in agricultural management process within NARS.

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 acountry rich in its biodiversity and traditional knowledge base, India should take extra steps for ensuring due benefit and recognition to actual stakeholders while making use of them. The following measures will prove helpful in cultivating an IP-friendly community among farmers and agricultural professionals in the country:

(i) Education in IP should start at least from the postgraduate 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 specialisation can support global industries and business houses. Its IP friendly community will attract more foreign direct investment into India. As Indian agriculture is reaching 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 aspect among academia, policymakers and the public.

References

[1.] The National Academy of Agricultural Research Management (NAARM) was established by the Indian Council of Agricultural Research (ICAR) at Hyderabad, in 1976, to address issues related to agricultural research and education management.


[19.] The National Centre for Agricultural Economics and Policy Research (NCAP) is a premier agricultural economics research institution in India. It strives towards integration of economics input in planning, designing, and evaluation of agricultural research programs and enhancing the competence in agricultural policy analysis within the National Agricultural Research System.

[20.] The National Academy of Agricultural Sciences (NAAS), established in 1990, focuses on the broad field of agricultural sciences including crop husbandry, animal husbandry, fisheries, agro-forestry and interface between agriculture and agro-industry. Its role is to provide a forum to agricultural scientists to deliberate on important issues of agricultural research, education and extension and present views of the scientific community as policy inputs to planners, decision/opinion makers at various levels.

