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An insight of intellectual property management practices in the Agriculture Research System

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ABSTRACT

Innovations are key to economic growth and are major contributors towards enhancing food security, higher social development and environment sustainability. In this study, carried out at ICAR-NAARM during the year 2020, an effort is made to understand the ongoing IP management and technology commercialization practices in ICAR and major challenges/pitfalls involved within, along with suggestive corrective measures. This paper provides evidence to measure technology outputs through patent analytics and other desk-research approaches to assess current level of technology transfer process performed by Agri-Business Incubators (ABIs) to create value and societal impact of technologies developed in the system. Results indicate active patent filings across all agricultural sectors, with a major trajectory after 2008 and a policy-based approach to spur technology commercialization in NARES. It also identifies the roadblocks with suggestive mid-course corrections.

Keywords: Agricultural innovations, Patents, Technology commercialization

Technology-led innovation is a well-recognized trigger to increase livelihood opportunities. It is important to realize that in the context of agri-goods and services becoming part of international trade, defining strong proprietary ownerships are essential to succeed in the market (FAO 2007 and 2018). Therefore, IP portfolios in agriculture leading to innovations form a new source of stimuli in the larger cycle of innovation (Kalanje 2005). ICAR implemented the IP system through XI Plan scheme, viz. "Intellectual Property Management and Transfer/ Commercialization of Agricultural Technology Scheme" leading to an IP-enabled environment in ICAR (ICAR 2018). This was followed by formulation and promulgation of IP policy (ICAR 2006) leading to Intellectual Property and Technology Management (IP &TM) scheme and later Business Planning and Development (BPD) units set up through World Bank funded National Agricultural Innovation Project (NAIP). Success of these schemes led to development of National Agricultural Innovation Fund (NAIF). To facilitate technology commercialization process effectively in ICAR, Agrinnovate India Ltd (AgIn) was incorporated. It acts as an interface between ICAR and the stakeholders of agricultural sector. Continuing its efforts towards effective technology management, ICAR has established Agri-Business Incubators (ABIs) in several institutes and is in process of expanding this network. At national level, a vision document, National IPR Policy came into existence in 2016 (DIPP 2016), Startup India and Atal Innovation Mission are among other schemes to promote a culture of innovation and entrepreneurship in the country. The concerted efforts of ICAR in following years towards IP management and commercialization along with the other GoI schemes are depicted in (Fig 1). It is evident that over the last decade or so, there have several efforts towards creating an enabling ecosystem for developing technology transfer practices and their implementation (Samuel *et al.* 2014, Singh *et al*. 2015).

Using desk-centered approach and secondary data, an analysis was done to gauge the current level of commercialization of technologies in ICAR system through patent analytics. The overall objective is to understand level of implementation of the ICAR Policy on IP and Tech commercialization to identify mid-route blocks and in-house challenges and suggest mid-course correction measures.

MATERIALS AND METHODS

Patents related to ICAR retrieved from various resources, including two patent databases namely: Orbit Intelligence and Patentscope from WIPO (World Intellectual Property Organization). Other sources include ICAR institutions' websites. The search was carried out by applicant's or assignee's name as 'Indian Council of Agricultural Research' and/or its associated institutes' name individually. Retrieved records relevant to ICAR were then subjected to full text search (patent title, abstract, claims and description) and

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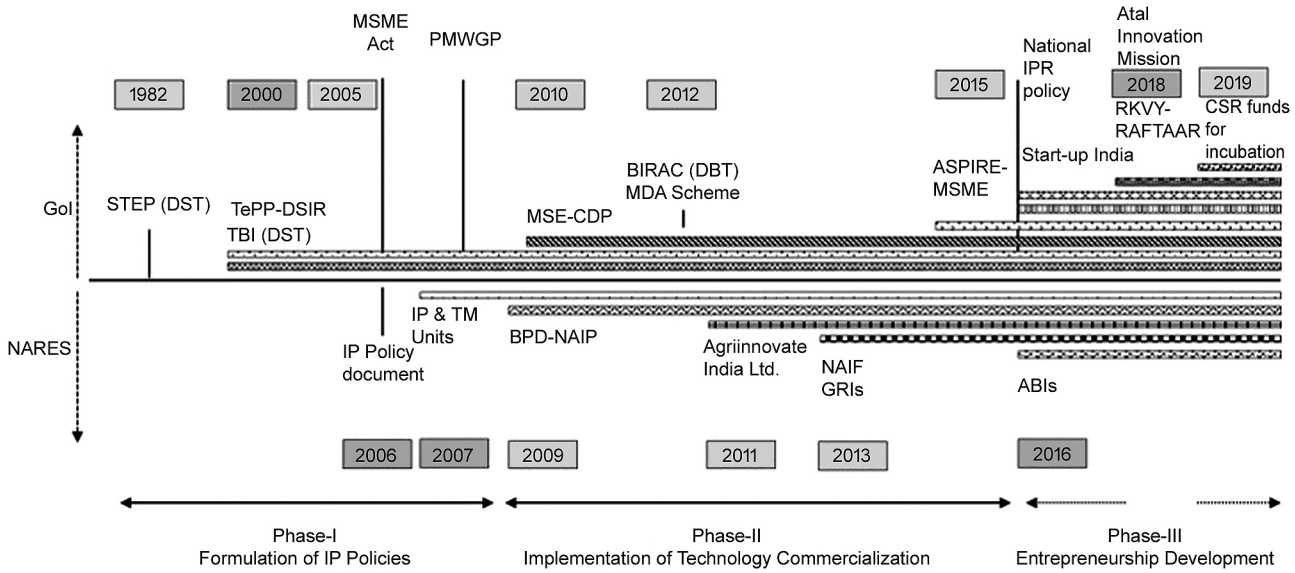

Fig 1 Advancements in IP management, technology transfer & commercialization processes in ICAR (adopted and modified, Subash *et al*. 2016). TePP-DSIR: Technopreneur Promotion Programme-Department of Scientific & Industrial Research; MSE-CDP: Micro and Small Enterprise-Cluster Development Programme; BIRAC: Biotechnology Industry Research Assistance Council; MDA: Market Development Assistance; GRI: Grass Root Innovations; ASPIRE-MSME: A Scheme for Promotion of Innovation, Rural Industries and Entrepreneurship-Ministry of Micro, Small and Medium Enterprises.

quantitative analysis was performed during the year 2020 at ICAR-NAARM, Hyderabad (Fig 1).

All search results combined and resulting patents reduced to one patent per family. Duplicates removed, and temporary work sheet exported in xls format. Using this approach, a set of 899 patent records retrieved. Data on technology commercialization retrieved from websites of various ICAR institutes hosting ABIs and then subjected to further analysis.

RESULTS AND DISCUSSION

Year wise patent filing trends in ICAR: An analysis of patenting activities in ICAR reveals a major increase in patent filings from 2008 (Fig 2A). The intense peak post 2014 attributed to institutional efforts through implementation of IP policy from 2008, which sensitized the researchers through series of capacity building initiatives, and under World Bank-ICAR sponsored NAIP focused on giving an explicit perspective of business to technologies from agricultural research. The lowered rate of filing specifically in 2017 and 2018 needs to be looked; and corrective measures needs to be taken immediately to keep pace achieved in earlier phase. The data set of 899 patents also indicated 0.3% of foreign filings (PCT or non-PCT). From an organizational point of view, low percent filings beyond Indian jurisdiction may hamper its plans to enter new markets. While there is evidence of clear guidelines for institutes to strategize foreign filings, efforts needed to sensitize researchers and Institute Technology Management Units (ITMU) personnel on developing long-term strategy for reaching wider markets and ensure timely decisions for investing into developing robust patent portfolios.

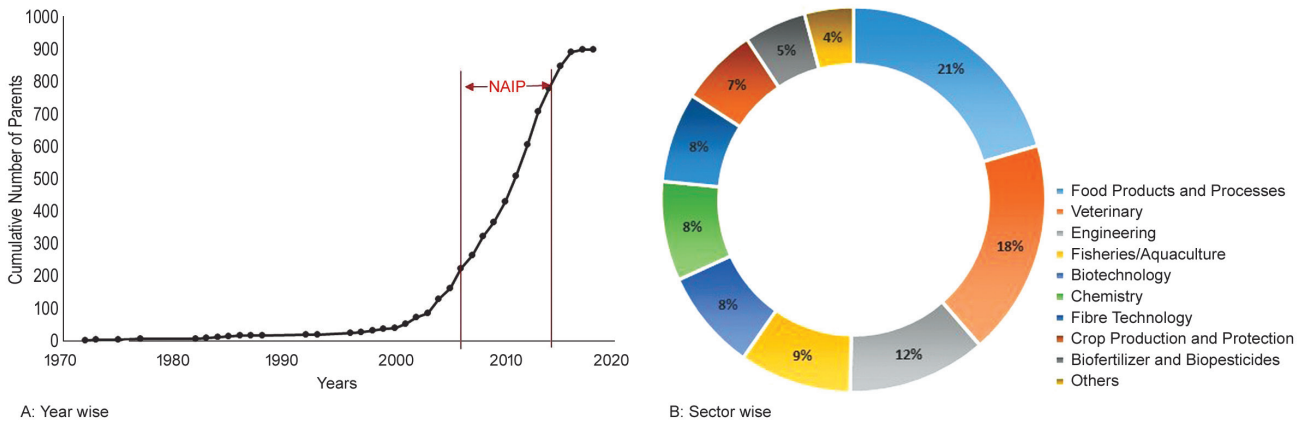

Fig 2 Trends of patent filing in ICAR (n=899) (A) Year wise (B) Sector wise.

Sector wise filings of patents: Patent applications retrieved, studied in detail and classified in categories based upon the technological domain of inventions. Sector wise classification showed that 21% of the inventions are from food processing sector, which tops the list followed by veterinary (18%) and agricultural engineering (12%) (Fig 2B). A scrutiny of the patent documents through claim analysis indicated several patents with applications across several sub-sectors.

Citation analysis: Citation analysis is a critical measure to assess quality and impact of patents (Karki 1997), also accepted as a useful metric for measuring knowledge spillovers and technology growth. Our analysis indicates a low figure of citations. Only one patent cited more than 10 times (Ref:Publication Number IN0541/DEL/2002, 'Development of a process for conversion of paddy husk ash into bleaching material for edible oil'). This invention utilizes paddy husk, which is otherwise thrown as waste, as a substitute for bleaching earth used in edible oil refining. However, high citation rate indicates the value and promise of this technology, filed in India only and available data shows it is not commercialized yet. A planned patent filing strategy needs to be developed for such valuable inventions to reach more markets. It is important for a public research organization to identify such high revenue generating technologies and put them on a fast track development of strong IP portfolios.

Top contributors in patent filings: Patents further studied to figure out top contributing laboratories in ICAR system. IVRI, Bareilly ranks first with 87 patent filings. Maximum number of patents filed by IVRI related to animal vaccines and disease diagnosis followed by CIPHET, Ludhiana (38 patent filings), which has to its credit a large number of filings related to food processes and allied machineries. NIRJAFT, Kolkata (33) ranked third in this list having patents related to yarn machines and spinning equipment and processes. Other top contributing institutes are CIFT, Kochi (30) and CIAE, Bhopal with 22 patent filings.

Legal status of patents: Since patent prosecution process is time consuming, an analysis of current legal status of patent filings helps organizations/inventors for decision making during technology commercialization activities. Nearly 69% of documents in the data set indicated an early stage of examination. Since most of the filings in recent past (2014 onwards) and considering the rate of pendency in patent offices, it is expected that office action may take some more time. Analysis indicated 16% of the patents granted, 10% lapsed, 3% expired and status of 2% patent documents were unknown. The grant of few PCT applications in the dataset at other national patent offices and awaiting grant in India can be used as indicator of strength of the technology (Table 1) and leveraged for commercialization by ICAR in those countries first and then in other markets including India.

Collaborative ownership of patents: Our analysis shows that only a small percentage of ICAR's patent applications are outcome of collaborative work. Out of total patent applications, only 50 applications are indicative of research collaborations between ICAR and other Indian organizations/institutes such as SAUs/DBT/CSIR/IISc/DRDO etc. This calls for a need to rethink about having flexible approach in research management. On positive note, the data indicates maximum filings in partnership with SAUs indicating a systematized approach of ICAR towards technology creation for resolving local-based problems with concerned University system.

Technology transfer and commercialization process in ICAR: Like any other sector, economic development in agriculture too warrants dissemination of innovative outcomes from the laboratory or to the marketplace through an efficient technology transfer system (Mysore 2015). In ICAR, the IP Policy as implemented through the IPTM scheme received a thrust with NAIP Scheme. After the successful performance of BPDs under NAIP, ABIs were introduced in 2016 to speed up technology commercialization process in ICAR by supporting potential agri-technologies towards enterprise development and by providing incubation support to emerging agri-entrepreneurs. During 1st Phase, 25 ABIs established in various institutes of ICAR. ABIs' main work is to enable and promote the transfer of technologies developed at ICAR institutions, to stakeholders that can create impact and value. ABIs are providing an impetus towards the growth of many incubated agri-startups through which technologies developed at ICAR are reaching market (Srinivas *et al*. 2018).The role

Table 1 Few PCT applications granted in other countries while still pending in India

Publication No.	Title	Priority date	Granted in	Indian status
IN0933/MUM/2012 A	Analyte sensor chip	2012-03-29	Australia (AU2013100381 A4)	Pending
IN3470/DEL/2015 A	Porous polymer scaffold useful for tissue engineering in stem cell transplantation	2015-10-27	United States (US9925298 B2)	
IN1502/DEL/2004 A	Recombinant chimeric g-protein of rabies virus produced in transgenic plants and a synthetic gene for development of vaccine	2004-08-13	Vietnam (VN0010188 B) US* (US7901691 B2) China* (CN101065145 B)	

* Granted but lapsed

Table 2 Status of IP management through ABIs

Categories	No.	
Total technologies	1032	
Patented technologies	362	
Grants pending	237	
Granted	61	64
Lapsed	37	Commercialized
Expired	2	
Status unknown	25	
Commercialized technologies (Non Patented)	230	

Data taken from ICAR Institutes' websites, IPTM Unit (ICAR Headquarters) until March 25, 2019.

of these ABIs in technology transfer and commercialization process was studied in detail through the total number of technologies patented, commercialized etc. A summary of the observations given below in (Table 2). It is seen that out of total 1034 available technologies, only 35% are patented. Among these patented technologies, only ~18% are commercialized (12 having active patents, 52 pending for grant). With large number of patent applications in early filing stage, it should be encouraged that commercialization be initiated soon after filing, though, granted patents are more negotiable.

It is interesting to note that large numbers of non-IP enabled technologies have also been commercialized. While, it may not be remunerative but it strongly indicate a positive measure to take forward public goods to all stakeholders including smallholder farmers and users. Among non-patented technologies, about 22% commercialized non-exclusively. With establishment of AgIn, an effective commercialization of technologies at national and international levels is anticipated. Emergence of institute-based research to spin-offs strengthens the link between research institutions and industry and impact local economic development. While policy allows for such initiatives with well laid out guidelines, there is an absence of such trend in ICAR system. ICAR should take a cue from many leading research organizations like IITs and CSIR and encourage its scientists and researchers from the traditional role of research and academics to a more advanced role of creating spinoffs and promoting academic entrepreneurship (Chandra 2018). Startup creation through student-led research is triggering an innovation environment in the country, especially after launch of Startup India in 2016. The recent award of BRICS Young Innovator Prize carrying USD 25000 to student of ICAR-National Dairy Research Institute (NDRI), Bengaluru at 4th BRICS-Young Scientist Forum–2019 (ICAR 2019) is encouraging and such initiatives needs to be institutionalized. Policy intervention to encourage research-based technologies in its large network of 71 SAUs and Deemed Universities under ICAR needs to be taken as special drive. To encourage student-led entrepreneurship, special grants towards student-led research for start-up initiation may be considered.

ICAR has made noteworthy contributions, reflected through significant reforms made in agricultural practices in the country. However, importance of IP protection of inventions in ICAR system is not pursued aggressively. ICAR needs to take more pro-active measures to motivate researchers for the development of IPR since IP protected inventions are suited for commercialization and can enhance economic development of all stakeholders. Moreover, the quantum of IP generated also serve as a criterion to rate academic and research institutions. Based on our analysis, following are few suggestions towards management of IPs developed at ICAR and streamlining the current commercialization process.

Role of ITMUs and Zonal Technology Management Units (ZTMUs) should be precisely defined towards filing and managing Intellectual Property. ITMU and ZTMU should be more vibrant with professionally qualified workforce to manage emerging portfolio and negotiating licensing deals. These professional activities require subject-trained human resources well versed in straddling science-law-business triangle. Scientists or laboratory-based researchers may need techno-legal backend advice to develop robust IP portfolio on a continuum.

Dynamic database, linked appropriately to all institutes, should be maintained by ICAR. An alert mechanism in meeting timelines in patent prosecution may reduce large number of abandoned patent applications due to sheer noncompliance to timelines. Developing best practices for harmonizing the early investments made towards building IP portfolio. If organization is developing technology for revenue generation, market intelligence needs to be studied upfront and plan concurrently with IP filings to make commercialization more viable. Revenue generation through commercialization of technologies needs to be documented to recognize impact of technology. An independent body like AgIn may focus on high level deals and collaborations at pan India and at global level for NARES. ABIs should work at tandem with ZTMU and develop Standard Operating Protocols for identifying potential licensors in their niche. However, these should be harmonized with AgIn initiatives to avoid any overlap. Further, ZTMU and AgIn together need to explore opportunities for licensing the current technologies for which patents have filed and are at early stage of prosecution.

A more enabling environment for emergence of wider expanse of players like start-ups and spin-offs should be provided. Customized research programs with identified market pull needs to promote early entrepreneurship should be encouraged on mission-mode approach. Special funds to be given to ABIs towards promoting student entrepreneurship and spin-offs from research

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