Abstract    The Intellectual Property assets owned by the research institutes under ICAR such as processes of animal nutrition and dairy food, milk adulteration detection kits, food processing machinery, and other know-how are managed by protecting them as patents at IPO, and transferred to their end users. A total of 75 patent applications are filed in nine subject specific areas of dairy sciences, out of that 12% were granted for a period of 20 years. As per IPC these applications falls under its six classes viz. A, B, C, F, G and H and spreads in 22 sub-classes. These IP assets were transferred to 26 public and private organizations through 45 partnership agreements. These transferred technologies belong to six different subjects specific areas of dairy science, where transfer of IP protected assets were on its higher side with 34%, which is a success indicator for a research organization. To speed up this process ICAR has taken the initiative with NAIP and established BPD Unit at NDRI, Karnal, which is a leading dairy science institute and also having a functional unit of TBI supported by DST. With these new business dimensions 20 EDPs were organized, where 300 researchers, entrepreneurs, business organizations and dairy farmers came together to explore the untapped IPs for the development of profitable business ventures in the dairy sector.

Keywords : BPD, ITMU, intellectual assets, patents, partnerships, TBI, technology transfer

Introduction
IPRs are important not only because India as a member of World Trade Organization (WTO), but also required to accede to the conditions of The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), but also because they offer possible mechanisms for stimulating research, enabling access to technology and promoting enterprise growth, all for the ultimate benefit of the farming community. One of the objectives of Intellectual Property (IP) management system in Indian Council of Agricultural Research (ICAR) is to protect the intellectual wealth generated at its research institutes. In today's context it has become necessary to do so, for unprotected research results in the public domain can lead to unacknowledged use/ exploitation of such research for commercial gains by other agencies both within the country and abroad. Moreover, protection of IP creates incentive for more knowledge and technology generation as scientists/ innovators are recognized and rewarded (ICAR, 2006).

Dairying perceived as a subsidiary occupation for the vast majority of the farming community in our country is now acquiring an independent status as a main occupation, as it is crucial in providing employment and supplementary income to the bulk of rural families. However, despite these significant achievements, adoption of scientific dairy farming has not been able to make inroads especially among small holders. This has resulted in quite low milk productivity. Scientific information and technologies generated in the field of animal health and housing management, breeding and feeding practices, by various research organizations have not yet reached to dairy farmers. This is one of the major missing links which hinders the milk productivity as well as the quality of milk (NAIP, 2014).

To bridge this gap and to manage these intellectual assets for the end-users, ICAR established an Intellectual Property (IP) management system in the year 2006, governed by its Guidelines for Intellectual Property Management and
Technology Transfer/ Commercialization. As per this system, institutes were equipped with knowledge, manpower and freedom of decision, with the establishment of Institute Technology Management Units (ITMUs) at each research institute headed by scientific personnel to support IP management. Before implementing this system in XIth plan scheme of IP management at ICAR, its intellectual assets were generally used to transfer through the institute extension system, where the gap between demand and supply was unfulfilled. To bridge this gap ICAR as well as its World Bank funded National Agricultural Innovation Project (NAIP) introduced a system, where business aspect was introduced through Zonal Technology Management and Business Planning and Development Units (ZTM&BPDUs).

This new system in collaboration with ITMUs developed a business environment for dairy science technologies. The objectives of this initiative were to promote relationships, communication and collaboration, strengthen of interaction, encourage, support and development of research with commercial potential, conversion of research results into new products and processes, and to secure reasonable compensation (Melvin, 2010).

The National Dairy Research Institute (NDRI), Karnal as country’s premier dairy research institution has developed considerable expertise over decades in different areas of dairy production, processing, management and human resource development. Information generated at the institute and the services offered have contributed to the growth of the dairy industry as a whole (www.ndri.res.in). There search based information and services are the IP assets of NDRI and this study is an effort to evaluate the status of initiatives taken by ICAR-NDRI for managing this IPs and their transfer for dairy business development.

Materials and Methods

This paper is an outcome of assessments of reports, schedules and data of the XIth plan scheme of Intellectual Property (IP) management at Indian Council of Agricultural Research in the field of Dairy Sciences. The objective of this study was to know the status of intellectual assets and their management in Dairy Sciences.

The informations were collected by using three different proformas with relevance of Self Review Reports viz. Self-Review, IP Data-Updation and Result Framework Document (RFD). These proformas were finalized and implemented after vetting from experts in the field of Intellectual Property Rights (IPR) and later revised on case to case basis. These proformas were also included in divisional documents of IP&TM Unit for ISO 9001:2008 Certificate, which was authorized and audited by Bureau of Indian Standards (BIS).

The collected information was analyzed and compared with the different available database and IP parameters and presented in the form of patents, their processing status at the Indian Patent Office (IPO); classification (subject specific and International Patent Classification (IPC) by the World Intellectual Property Organization (WIPO); transferred intellectual assets and their subject specific classification; partnership development; and its impact on the organization as well as end-users.

Results and Discussions

Intellectual Assets: 'Intellectual Assets' means any result and/ or products of research and development activities, of any nature whatsoever (including, but not limited to, knowledge, publications and other information products, databases, improved germplasm, technologies, inventions, know-how, processes, software, and distinctive signs), whether or not they are protected by intellectual property rights. To manage and protect these resources ICAR institutes are using different IP tools. In this paper, the details of patent filing are analyzed and presented as follows:

Patents: It is an important IP tool which governs through Indian Patent Act 1970, where law recognizes the exclusive right of a patentee to gain commercial advantage out of his invention. The term of a patent in India is 20 years from the date of filing. The patentee also has the right to assign the patent, grant license, "or" otherwise deal with the patent, for any consideration (Article 28 of the Trade Related Intellectual Property Rights or TRIPS Agreement) (www.ipindia.nic.in). ICAR institutes are filing their patents through patent attorneys at different regional offices of the IPO. The in-depth web based data analysis of patent applications filed at the Indian Patent office is resulted as follows:

National Dairy Research Institute (NDRI), Karnal is the leading organization under ICAR, which is working in different research aspects of dairy sciences, where it has filed 75 patent applications from 1960 to 2014 (1960 to 2000 (8), 2001-2005 (23) and 2006 to 2014 (45)). These applications spread in nine subject specific areas of dairy sciences viz. Milk Products and Processes (59%), Milk Adulteration Detection Technologies (13%), Animal Biotechnology (7%), Dairy Machines (5%), Animal Biochemistry (5%), Animal Health Diagnostic Kits (4%), Veterinary Lab Tools and Animal Nutrition (3 %each) and Animal Breeding (1%).

Out of these 75 patent applications, 46 were allotted IPC codes of WIPO, which spreads across six sections viz. Section A-Human Necessities (29); Section B-Performing Operations and Transporting (2); Section C-Chemistry and Metallurgy (7); Section F-Mechanical Engineering, Lighting, Heating, Weapons and Blasting (1); Section G-Physics (4); and Section
H-Electricity (3) (www.wipo.in). In a next step analysis of this classification through web searching, it was found that in Section- A: 29 applications were filed under its sub-sections A01, A21, A23 and A61; whereas in Section-B: two applications were filed under its sub-sections B01 and B23. In Section-C seven applications were filed under its sub-sections viz. C02, C06, C07, C12, and C067. One application was filed in Section-F (F28); whereas four applications were filed in Section-G (G01 and G06) and Section-H is having three applications in H02 and H04.

As per IPO database (www.ipindia.nic.in) the present status of these applications shows, different heads of patent grant process whereas, 23% applications are under examination, the possibility of these applications to grant as a patent is highest; 17% applications in the process of grant, which includes Controller's hearing and decisions, and other pendency; 16% recently filed applications are not yet published due to initial formalities and incompleteness of application at IPO; 13% applications are Awaiting for Examination at patent office; 12% applications were granted to the inventors of organization for a period of 20 years from its date of applications; other than this 19% of the applications were abandoned in the period of 2001 to 2006 due to improper knowledge and lack of financial support under section 21(1) and 9 (1) of Indian Patent Act, 1970. After implementing the IP management scheme at ICAR this problem was addressed through ZTMCs and ITMUs.

The above IP protection details reveals that the IP resources and their maintenance in dairy sciences at ICAR is growing in a positive direction, which generates different collaborations, consultancies, contract research and service and open the labs for end users.

Transfer of Intellectual Assets: Intellectual asset transfer through technology commercialization is a parallel process of radical and incremental innovation, the determination of technical and business feasibility, the creation of intellectual assets, and the development of a plan is to essential to enter in the market (Chakraborty, 2013). The data in Fig-I reveals that the transfer of intellectual assets of dairy science were classified in six subject specific areas according to their work domain, which were transferred to public and private organization are as follows: Animal Food Products: Ready to Cook Milk Chips; Animal Nutrition: Cation and anion mineral mixture; Use of rice bran lecithin and phospholipids in dairy cattle feeding; Dairy Food Processing: Process for preparation of herbal Ghee, Acido-whey, Calcium fortification of milk, Iron fortified biscuits, Lab scale process for preparation of low cholesterol ghee, and Long shelf life paneer; Dairy Food Processing Machinery: Mechanized system for continuous production of chhana balls, Continuous paneer/ chhana making machine; Milk Adulteration Detection Technologies: Detection Kits for β-lactum antibiotic group in milk using bacterial spore as biosensor and detergent in milk, novel selective medium and micro-technique for detection of Enterococci in milk, PCR based method for differentiating A1 and A2 milk, qualitative and quantitative test for anionic detergent in milk, colour based test for rapid detection of detergent in milk, strip based test for detection of added urea/ glucose/ hydrogen peroxide/ and maltodextrin in milk, and two stage enzyme based assay for detection of L. monocytogenes in milk.

These assets were transferred to 26 national and international organizations by signing consultancy/contract research/ contract service agreements. These organizations were classified as Local (at district or block level) Organizations (10), National Level Companies (8), State Level Companies (4), State Government Departments (2), Multinational Companies and International Organizations one each.

Some important technologies which were transferred are as follows: Animal Food Products: Ready to Cook Milk Chips; Animal Nutrition: Cation and anion mineral mixture; Use of rice bran lecithin and phospholipids in dairy cattle feeding; Dairy Food Processing: Process for preparation of herbal Ghee, Acido-whey, Calcium fortification of milk, Iron fortified biscuits, Lab scale process for preparation of low cholesterol ghee, and Long shelf life paneer; Dairy Food Processing Machinery: Mechanized system for continuous production of chhana balls, Continuous paneer/ chhana making machine; Milk Adulteration Detection Technologies: Detection Kits for β-lactum antibiotic group in milk using bacterial spore as biosensor and detergent in milk, novel selective medium and micro-technique for detection of Enterococci in milk, PCR based method for differentiating A1 and A2 milk, qualitative and quantitative test for anionic detergent in milk, colour based test for rapid detection of detergent in milk, strip based test for detection of added urea/ glucose/ hydrogen peroxide/ and maltodextrin in milk, and two stage enzyme based assay for detection of L. monocytogenes in milk.

These efforts achieved an important success, where 22% of transferring assets were filed as patents at IPO against the world average, which is less than one percent (Melvin, 2010).

 transfer of continuous production of Chhana Balls and continuous paneer/ chhana making machine) were transferred in 2006. These partnerships were increased with support of the IP management scheme of ICAR and NAIP based BPD initiative. Due to these efforts 38 partnerships were developed from 2007-08 to 2014-15.

These efforts achieved an important success, where 22% of transferring assets were filed as patents at IPO against the world average, which is less than one percent (Melvin, 2010).

![Fig. 1. Classification of Transferred Intellectual Assets](image-url)
Business Initiatives: The BPD Unit of NDRI has progressed well towards its set goals, where it organized 20 Entrepreneurship Development Programmes (EDPs) in the field of "Commercial Dairy Farming", "Milk and Milk Products Processing" and "Specialized Training". These programmes attracted more than 300 participants across the country. Research and development and incubation facilities were also developed by the unit, where 5 incubatee were facilitated and also 20 entrepreneurs were assisted to start their ventures.

Technology Business Incubator (TBI) is an initiative of the Department of Science and Technology (DST), Government of India, promoted by Society for Innovation & Entrepreneurship in Dairying (SINED), hosted by NDRI to promote the concept of growth through innovations and applications of technology, support, economic development strategies for Small Business Development. The mission of this initiative is providing a holistic, enabling environment for potential entrepreneurs and graduating students so as to translate knowledge and innovation into the creation of successful entrepreneurs in the areas of Dairy and Food Processing, Feed Technology, Dairy Farming, Fish farming, Apiculture and Honey Processing, Biofertilizers, Biopesticides and Panchgavya products based on dung and urine.

Conclusions

The outcome of this study emphasizes that intellectual property and their management in dairy science research is an important aspect, where protection, promotion and production of research outcome are key parameters. The protection gives priority to research and assurance for its security. In dairy sciences, NDRI gave encouraging and proven results by filing 75 patents applications in different sector of dairy research, which motivates its scientists and open the research gateway for the scientific community. To promote dairy science research different public and private organizations were entered in 45 research and technology partnerships for transferring the research outcomes. This initiative gave the business to different dairy stakeholders as well as the dairy industry. Research conducted on pilot or lab scale, may not completely fulfill the demand of consumers on pilot or lab scale, where it is not possible to fulfil the demand of consumers. So, it is essential to transfer the intellectual assets to the respective industry for its multiplication as large scale and thus reach the target market. All these three steps were taken care by NDRI with the support of ICAR's IP management scheme and NAIP funded BPD unit.

These efforts opened the path for dairy research to grow in its respective industry for the betterment of dairy entrepreneurs and society.

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