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Fisheries technology management at Indian Council of Agricultural Research (ICAR): An IPR perspective

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ABSTRACT

Technology management in intellectual property rights (IPR) is a procedure, which incorporates technology production, promotion and their commercialization. Indian Council of Agricultural Research (ICAR) is an autonomous organization, and is the apex body for coordinating, guiding and managing research and education in agriculture in the entire country. With the aim of utilizing the vast research and development facilities and knowledge available with its institutions, ICAR has started a technology management and business incubation drive, intended for the Indian agricultural sector to promote agribusiness. This apex body has established a three-tier IP management system, which is presently giving a scope of demonstrated results by securing its research assets with different IP tools like patents, trademarks and designs; and commercializing its research outcomes. Six ICAR fisheries research institutes filed 84 patent applications, out of which 55 were filed during the last 5 years. Seven patents were conceded to 3 of these establishments, which fall under the IPC classifications A, B, C and E. Eight trademarks were additionally enlisted at the Indian Trademark Registry for diverse fish based products. To commercialize the fisheries research outcomes, including 142 technologies, 207 partnerships were developed by various institutes with 135 national and international organizations. IP protected technology commercialization is on its higher side with 21.12%, achieved within a short time span. These endeavors of technology management at ICAR, coupled with an effective technology protection and commercialization of the vast and diversified ICAR knowledge base, gave a renewed boost and a decent way for the Indian fisheries research and a new agribusiness paradigm.

Keywords: IPC, IPR, Partnerships, Patents, Technology commercialization, Technology protection, Trademarks

India is the second largest producer of fish in the world with a share of 5.68% of the global total. Fisheries sector is a source of livelihood for 14 million individuals of India. This sector has generated revenue of ₹ 30,213 crore through exports during 2013–14. It accounts for 0.83% of total GDP and 4.75% of the agriculture sector's GDP at current price for the year 2012–13 (DADF 2014). The ICAR has assumed a spearheading role to build up this sector through its research and technology development, which has empowered the nation to increase the fish production by 12.5 times (i.e. 0.75 million tonne in 1950–51 to 9.58 million tonne in 2013–14), therefore having a visible impact on the national food and nutritional security. Fisheries is one of the major research mandates of ICAR, where planning, promotion and coordination of research and education activities is executed through its research institutes Central Institute of Brackishwater Aquaculture (CIBA), Chennai; Central Institute of Freshwater Aquaculture (CIFA), Bhubaneshwar; Central Institute of Fisheries Technology (CIFT), Cochin; Central Inland Fisheries Research Institute (CIFRI), Barrackpore; and Central Marine Fisheries Research Institute (CMFRI), Cochin; one deemed university (Central Institute on Fisheries Education (CIFE), Mumbai), one directorate (Directorate of Cold Water Fisheries Research (DCFR), Bhimtal, Bhimtal) and one national bureau (National Bureau of Fish Genetic Resources (NBFGR), Lucknow) to fulfill its vision 'Fish for all' (www.icar.org.in).

Innovation is the pivotal word for research and education based organizations like ICAR, where intellectual assets / properties are the core resources and their application in field situation is the output (Bloom *et al.* 2005, OECD 2008). To manage these intellectual assets ICAR established a 3-tier intellectual property (IP) management system in the year 2006, where each institute is equipped with knowledge, manpower and freedom for decision, which was governed by its "Guidelines for Intellectual Property Management and Technology Transfer/ Commercialization". To institutionalize this system ICAR had likewise launched a scheme in its XI plan budget, which have completed five years in 2012 and upgraded in the XII plan, viz. Innovation Fund. Under this framework, Institute Technology Management Units (ITMUs) headed by scientific personnel, were formed at all ICAR institutes. To

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facilitate these ITMUs, five Zonal Technology Management Centers (ZTMCs) were opened in different zones, namely, NIRJAFT, Kolkata (East Zone), CIRCOT, Mumbai (West Zone); IARI, New Delhi (North Zone-I); IVRI, Izatnagar (North Zone-II) and CIFT, Cochin (South Zone), for technology protection, promotion and transfer/ commercialization.

At the central level, Intellectual Property and Technology Management (IP&TM) Unit is leading this system by providing budget, case to case basis technical support and assistance for IP related legal issues. The objective of this study is to know the status of technology management aspects at ICAR in Fisheries science institutes, which incorporate technology protection, promotion and transfer/ commercialization.

MATERIALS AND METHODS

This paper is the outcome of assessments of reports, schedules and data of XI plan scheme for IP management at ICAR, and comparison and collection of IP related data from websites of the Indian Patent Office (IPO), World Intellectual Property Organization (WIPO), European Patent Office (EPO), United States Patent Office (USPTO) and other paid software. This scheme was executed between 2007 and 2012 and later reached out for 2013–14. The objectives of this study to know the status of technology management aspects at ICAR in Fisheries science institutes, which incorporate technology protection and technology commercialization.

The information was collected by utilizing three different proforma with every pertinent viewpoint, in particular, self-review, IP data-updation and Result Framework Document (RFD). These proforma were finalized and implemented subsequent to verifying from the experts in the field of IPR and time to time revised according to their necessity. These proformas were additionally included in the divisional documents of the IP&TM Unit for ISO 9001: 2008 Certificate, which was authorized and audited by the 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 Indian Patent Office (IPO); classification (subject specific) and International Patent Classification (IPC) by the WIPO; technology commercialization and their subject specific classification; partnership development; and its impact on the organization as well as end-users.

RESULTS AND DISCUSSION

Technology protection: Technologies in the fisheries sector can receive protection by patents, trademarks, geographic indications, copyrights and designs. These technologies may be secured by one or a combination of different IPRs depending upon the nature of technology (Ravishankar and Archak 2000, Gupta and Reisman 2005). Given the inconceivable and unexplored potential of utilization of aquatic resources, the increasing trend in biotechnological patents in the developed countries, patenting of aquatic genetic resources will have an increasing trend in times to come. The utilization of aquatic resources has a significant potential in pharmaceuticals, nutraceuticals, high value compounds/chemicals, cosmetics and food.

The primary reason for developed countries to choose patents for protection is because of their technological capabilities and the immense financial benefits that a patent system is expected to generate (Holger 2001). Whereas, developing countries like India, have a weak regime due to lack of financial and technical support. Most of the developing countries have confronted several difficulties in protecting inventions related to fisheries which mainly attributes to the lack of strong rules and regulations.

Nonetheless, lately (after 1996) there are incremental trends in patent filing in ICAR institutes including fisheries. In a post WTO era (1996–2000), the average number of patents conceded in fisheries discipline is 6 in a year. Increasing awareness for patent search engines/sites, access to patent information, and the comparatively easier administrative procedures in the amended patent laws are among the various reasons for increased patenting activity. In aquaculture as well, the majority of patents (45%) granted in India are to the foreign nationals (Ninan *et al.,* 2005).

NBFGR has been distinguished as a nodal institute to develop a system to register and document valuable fish genetic resources by ICAR. The registration system will bring elite germplasm into the public domain to promote its use in research. However. for elite fish genetic material in the public domain, there is no IPR enabling provision under the existing Indian laws, nor is there any provision for the registration and documentation of the breeds and strains of fish developed by ICAR (Chakraborty 2013).

Patents: The patent is an important tool of IP which govern through the Indian Patents Act 1970, where the law perceives 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 additionally has the privilege 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). The fisheries research is having a decent history in ICAR, where world's biggest fisheries research organization i.e. CMFRI is showing its vicinity all through the Indian coasts and operating its research by its subject specific research in Fishery Resources Assessment, Pelagic Fisheries, Demersal Fisheries, Crustacean Fisheries, Molluscan Fisheries, Mariculture. Out of eight fisheries science institutes, six are involved in the patent filing activity. The in-depth web based data analysis of patent applications filed at the Indian Patent office is resulted as follows:

Patent applications: The first patent application (192/ MAS-1983) was filed by CIFT for "An antifouling paint composition to prevent marine growth on structures" (Inventor: A G G K Pillai, K Ravindran & R

Balasubramanyam) in the year 1983, which was granted with the patent number IN158294. The second application was filed by CIFA for "A process for the preparation of a composition for use in aquaculture for treatment of epizootic ul creative syndrome (evs)" (1900/DEL/1998) which was granted with patent number IN189179. After that, the effect of the TRIPS agreement and general awareness about IP was expanded and the institutes establishments began filing of patent applications in distinctive divisions of fisheries. Four ICAR institutes filed 19 patent applications from 2000 to 2005. Meanwhile, ICAR had implemented its IPR guidelines and propelled an IP based scheme which reflected its impact in the XI plan period (from 2007 to 2012), where 50 patent applications were filed by 6 institutes (viz. CIBA, CIFA, CIFE, CIFT, CMFRI and DCFR). In the year 2013–14, ten more applications were documented; and the cumulative total of patent applications rose to 84. The majority of the applications were filed by CIFT (40), followed by CMFRI (18) and CIBA (11).

Patent classifications: These innovations were classified according to the orientation of their subject area in fisheries science. There were eight research areas, where these inventions were filed for patenting, viz. Fish Based Products and Process (23%), Fish Farming Tools/ Devices (22%), Fish Biotechnology (13%), Fish Nutrition (13%), Fish Diagnostic Kits/ Methods (11%), Functional Food Supplements/Products for Human Health from Sea (8%), Fish Production Technology/Process (6%), and Fish Health Management (4%).

One more classification, which is known as International Patent Classification (IPC), an outcome of the Strasbourg Agreement of 1971, entered into force on 7 October 1975, accommodates for a common classification for patents for invention including published patent applications, inventors' certificates, utility models and utility certificates (www.wipo.in) were used to know the expansion of subject area as well as diversity of inventions. The vast majority of the applications were in 4 major sections viz. Section A-Human Necessities (58%); Section B-Performing Operations, transporting (23%); Section C-Chemistry, Metallurgy (17%) and Section E- Fixed Constructions (2%) of this classification, whereas the total number of sections are eight (A to H).

In a next step analysis of this classification through web searching, it was found that in Section- A: 14 applications were under A01 (agriculture; forestry; animal husbandry; hunting; trapping; fishing); 6 applications in A23 (foods or foodstuffs; their treatment); 7 applications in A61 (medical or veterinary science; hygiene); whereas in Section-B: one application in B32 (layered products); four applications in B62 (land vehicles for travelling otherwise than on rails); and six applications were in B65 (conveying; packing; storing; handling thin or filamentary material). In section-C one application in each of C02 (treatment of water, waste water, sewage, or sludge) and C07 (organic chemistry); two applications were in C08 (organic macromolecular compounds; their preparation or chemical working-up), and seven applications in C12 (biochemistry; beer; spirits; wine; vinegar; microbiology; enzymology; mutation or genetic engineering). One application was also filed in Section-E in E04 (building). Altogether these applications were spread in 28 subject specific areas (Table-1).

Publication status at the Indian Patent Office (IPO): According to the Indian Patent office database, the publication status of these applications (till December, 2014) was as follows: Seven applications were conceded to three ICAR institutes (CIFA-3, CIBA-2 and CIFT-2), out of that four patents (IN251022, IN252072, IN256424, IN256572) are in force, two patents are in process for renewal fee payment and one patents was expired (cross the 20 years time period). The remaining applications are in different steps of grant at Indian Patent office viz. 7– applications are under examination, 28-applications awaiting examination, 25-applications not yet published (most of the newly filed applications), 9-deemed to be withdrawn U/S 11B (4) (requests for examination not filed within time), 2- applications abandoned U/S 21(1) (requirement(s) not met by applicant) and 1– Application withdrawn. This status shows the activeness of fisheries institutes concerning the technology protection. Same time ICAR has increased the awareness about patent writing and their follow-up activities through its new IP management system which minimize the cases of withdrawn and abundance.

Trademarks and design

Trademarks are any sign or combination of signs capable of distinguishing the goods or services of one undertaking from those of the other. TRIPS Agreement provides initial registration and each renewal for a term not less than 7 years and shall be renewable indefinitely. As per the fourth schedule of Indian Trade Marks Rules, 2002 for classification of goods and services; there are 45 classes. By utilizing the importance of this IP tool, CIFA had enrolled its first trademark at the Indian Patent Office's Trade Marks Registry with the name of 'CIFAX' in the year 1998, which is a chemical formulation to prevent and cure ulcerative disease of freshwater fishes, followed by 'JANYANTI ROHU' (a fish developed through selective breeding of *rohu, (Labeo rohita*) in 2005 and 'CIFABROOD' (food stuff for animals) in 2009. Every one of these trademarks were registered by the patent office in class-1 and class-31. CMFRI had filed trademarks on imprint Cadalmin under class-31 (food for fish, seeds) and class-35 (trading and marketing) in the year 2009 which was likewise registered during December 2014. In the year 2010, CIFT had additionally sought for two trademarks viz. 'MARICREAM' in classes 29 and 30 for ice-cream and jellies made from marine sources and ready to eat products; and 'FIFERS' in class-29 for wafers made of fish and prawns, and others. As of late, CIFE registered a trademark with the name of 'Fish Paneer' for different fish based eating items in class-29. CIFA had two designs viz. mechanical fish harvester and a diesel operated new aeration device

Table 1. International patent classification (IPC) of patent applications filed by fisheries institutes

IP-Class	Sub-section	Subject area	No of applications
Section A — Human necessities			
A01: Agriculture; forestry; animal husbandry; hunting; trapping; fishing (14)	A01B	Soil working in agriculture or forestry; parts, details, or accessories of agricultural machines or implements, in general	1
	A01H	New plants or processes for obtaining them; plant reproduction by tissue culture techniques	1
	A01J	Manufacture of dairy products	1
	A01K	Animal husbandry; care of birds, fishes, insects; fishing; rearing or breeding animals, not otherwise provided for; new breeds of animals	10
	A01N	Preservation of bodies of humans or animals or plants or parts thereof	1
A23: Foods or foodstuffs; their treatment, not covered by other classes (6)	A23L	Foods, foodstuffs, or non-alcoholic beverages; their preparation	6
A61: Medical or veterinary science; Hygiene (7)	A61B	Diagnosis; surgery; identification	1
	A61K	Preparations for medical, dental, or toilet purposes	6
Section B — performing operations; transporting			
B32: Layered products	B32B	Products built-up of strata of flat or non-flat	1
B62: Land vehicles for travelling otherwise than on rails	B62B	Hand-propelled vehicles, E.G. hand carts or perambulators; sledges	4
B65: Conveying; packing; storing; handling thin or filamentary material	B65D	Containers for storage or transport of articles or materials	6
Section C — Chemistry; Metallurgy			
C02: Treatment of water, waste water, sewage, or sludge	C02F	Treatment of water, waste water, or sewage	1
C07: Organic Chemistry	C07K	General processes for the preparation of peptides: Growth factors; growth regulators	1
C08: Organic macromolecular compounds; their preparation or chemical working-up; compositions based thereon	C08B	Polysaccharides; Derivatives thereof	2
C12: Biochemistry; Beer; Spirits; Wine; Vinegar; Microbiology; Enzymology; Mutation or Genetic Engineering	C12N	Micro-organisms, e.g. protozoa; Compositions thereof	4
	C12Q	Measuring or testing processes involving enzymes or micro-organisms	3
Section E — Fixed constructions			
E04: Building (1)	E04F	Finishing work on buildings, e.g. stairs, floors	1

for large aquaculture ponds which were filed in 2009, granted/registered with the patent office.

Technology commercialization

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 to enter into the business sector. Objectives of technology commercialization are to promote relationships, communication and collaboration, strengthening 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.

Fisheries technology fundamentally is an input, device, process, practice, implement, tool or group of multidisciplinary approach, know-how which developed through continuous selection, improvement, upgradation, and association of existing and traditional practices, by utilizing new methods of diagnosis / treatments from biological, physical and chemical sciences. Eight ICAR institutes commercialized 142 technologies (CMFRI-92, CIFT-16, CIBA-13, CIFA-9, CIFRI-6, NBFGR-3, CIFE-2, DCFR-1), which includes products, process, methods and know-how. These technologies were classified in 10 subject specific areas, where 9% share contributed by Fish Biotechnology, Fish breeding and Fish processing each; followed by 8% in fish farm implements and Fish (Shrimp) nutrition each; 6% by Fish farming; 3% by Fish education; and 2% share is by functional food supplements/ products for human health from sea and fish health technology each. A noteworthy part these technologies were originated from the marine fish farming consultancies which lead with 44% share (Fig.1).

IP Protected Technologies: A total of 84 patent applications were filed by six ICAR institutes in fisheries, out of that 30% were commercialized to different organizations, which is an important indication, as the world average is less than 1% (Melvin J. DeGeeter. 2010). These commercialized technologies are in force at the patent office in the form of patent applications, whereas 12% are already granted to CIFT (production of absorbable surgical sutures from fish gut collagen) and CIFA (a manually operated low cost handy cryofreezer for gamete cryopreservation, and male specific protein of Indian major carp *Labeo rohita* (L), (a key for sex differentiation and brood stock management). Other than this, five commercialized technologies were secured by utilizing trademarks, namely, CIFAX, JAYANTI ROHU, CIFACURE, CIFABROOD, and CADALMIN. Consequently 21.12% commercialized technologies were IP protected within a short time span (1997 to 2014), which is a success indicator for ICAR as a research organization.

Partnership Development: To commercialize these technologies, ICAR institutes developed 207 partnerships with 135 national and international organizations, during the period 1997 to 2014. The major parts of these partnerships were led by CMFRI, followed by CIFT, CIBA, CIFA, CIFRI, NBFGR and DCFR. The partner organizations were classified according to their domain area, regions, administration and control. Out of these 135 partner organizations, 37% were State level companies, followed by 19% State government departments, 14% National level companies, 7% Central government departments and farmers' / Producers' associations together, 4% Multinational companies, 3% National institutes and non-governmental organisations, and 1% International

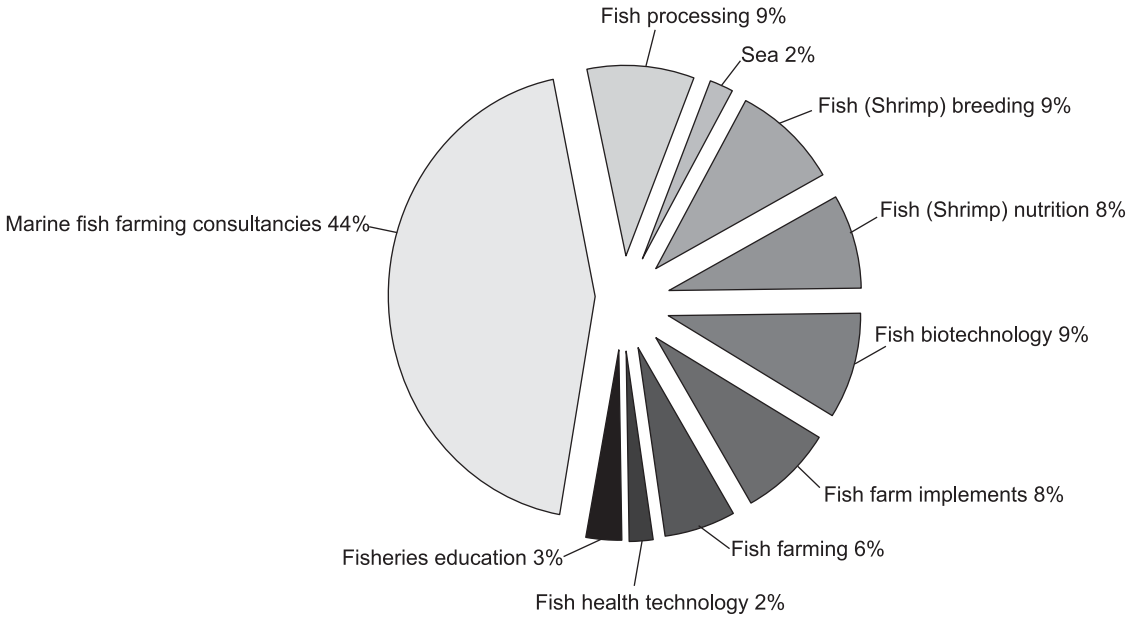

Fig. 1. Subject specific classifications of commercialized technologies.

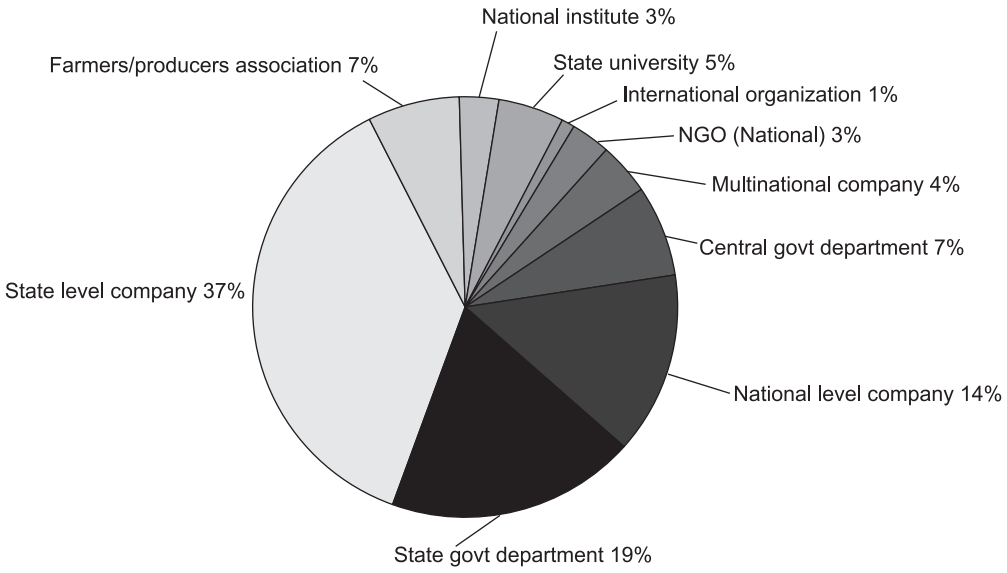

Fig. 2. Technology partner organizations.

organisations (Fig.2).

Time scale: Technology transfer is the mandate of most of the ICAR institutes and is considered as a continuous activity in their respective subject area. During 1997, two agreements were signed for cooling water system design parameter and spawning of Indian major carps with hormone "OVATIDE" by two of these fisheries institutes. Following this initiative, 35 partnerships were developed between 1998 to 2000, and 38 partnerships in 2001 to 2005. Due to the awareness and market demand, this figure expanded in 2006–2010 to 54. The impact of IP scheme and NAIP incubation efforts during the period 2010–14 were assessed, where 91 partnerships were developed for different technologies.

Mode of transfer: To transfer the technologies, ICAR institutes used different modes of transfer, which settled the obligation of the partner as well as respective institutes for security, sensitivity and technical feasibility. All these technologies were assigned to the partners through the signing of consultancy agreements (66.18%), memorandum of understandings (20.28%), memorandum of agreements (8.21%) and contract research agreements (5.31%). The score of the consultancy was high; in light of the fact that the majority of the technologies were in the form of know-how, which were transferred through technical assistance; advice, suggestions, on-site guidance and so on.

Impact of technology commercialization: A big gap exists between the available technologies and their rapid transfer to the farmers / end-users. It is estimated that only 20–25% of the modern technologies developed are used under actual field conditions in India. Prior to the implementation of National Agricultural Innovation project (NAIP) and IP management schemes of IP&TM Unit, technology transfer in ICAR institutes was directed either through the extension divisions or Agricultural Technology Information Centers (ATIC), initiated under National Agricultural Technology Project (NATP). Technology commercialization opened the way for entrepreneurs, businessmen, government projects and food processing industries to harness the benefits from fisheries research outcomes. The Business Incubation Centre (BIC) under the Zonal Technology Management and Business Planning and Development (ZTM-BPD) platform, at CIFT is a unique example of success for technology commercialization, which support operations on business projects as a measure of enhancing the foundation for new technology based commercial enterprises and establishing a knowledge-based economy. It focuses on finding new ways of doing business in fisheries and allied agricultural fields by finding doors to unexplored markets. The centre aids prospective entrepreneurs, by providing pro-active and value-added business support in terms of technical consultancy, infrastructure facility, expert guidance and training to develop technology based business ideas and establish sustainable enterprises. It goes about as a stage for the rapid commercialization of the ICAR technologies, through an interfacing and networking mechanism between research institutions, industries and financial institutions.

Technology management in IPR is a process, which incorporates technology production, its promotion and commercialization. ICAR has built up a three tier IP management framework which is presently giving proven results by securing its research assets with different IPRs like patents, trademarks and designs. Protecting the technology is not adequate, till it achieves its destination, end client or target market. To fill these crevices, ZTM-BPD Units of ICAR initiated technology commercialization aspect of developing partnerships with different stakeholders throughout the country with significance to business perspectives. These endeavors of technology management at ICAR gave a decent way to fisheries research by providing proper identity with individual satisfaction and its use for beneficiaries.

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