JANUARY 2020

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Indian Farming

Distribution of water at farmer's field through pipeline system constructed by ICAR-IISWC & farmers of village Pawwala Soda under PPP mode

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***Units in metric system*:** Full forms of all abbreviations used in table; source of data should be given in detail. Units of measurement, symbols and standard abbreviations should conform to those recommended by the International Union of Biochemistry (IUB) and the International Union of Pure and Applied Chemistry (IUPAC). Metric measurements are preferred, and dosages should be expressed entirely in metric units (SI units). In exceptional circumstances, others may be used, provided they are consistent.

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Writing for Success Stories: Who has got success in, Introducing new technology/methodology etc., Diversification of any farming system in a particular area for more return, How he/she is inspiration to other farmer, What is cost:benefit ratio of the farm produce?, What are the prospects of that farm commodity?, Show the difference in adoption of that particular technique, variety, seed, tool etc.,

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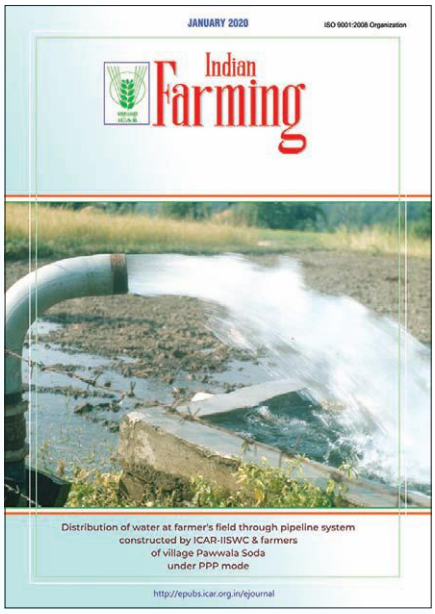
- ☑ Article should not be based on compiled matter or on some survey, report or record of extension education.
- ☑ Article should not be of theoretical nature or only of local relevance. Article text gives complete relevant details of practical utility to the farmer in clear and simple English.



Cover I : & IV **Farmer First Project at village Pawwala Soda.**
Pic Courtesy: **ICAR-IISWC.**

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ICAR

Indian Farming

In This Issue

Agriculture is now a big business

Traditionally farmers have been sowing seeds, taking care of crops, harvesting crops and then looking for marketing the produce. The market may make him or destroy him depending upon the production, market demand, etc. This is the main aspect on which the livelihood of a farmer's family depends. The higher price brings joy to the family, but slump in market may result not only in gloom in the family but may also lead to migration of employable youth to greener pastures i.e. nearby or far-off places for income for sustaining family livelihood. If the agriculture is able to provide employment to its practitioners even during climatically disastrous times, it will check the migrations and provide livelihood to them as well.

India is predominantly an agrarian country and hence agriculture sector has a huge potential for promoting innovations as it has rich resources of traditional indigenous knowledge. Moreover, country is gradually shifting to demand driven and market led agricultural research. ICAR has established Agri-business Incubation (ABI) centres in 25 ICAR institutes to nurture early stage innovative startups and entrepreneurs. ABI centres act as a platform for the speedy commercialization of the technologies and reinforcing of public private partnerships through an interfacing and networking mechanism between R&D institutes, industries and financial institutions, thereby contributing to a knowledge based economy. Technology applications, skill development and developing the service sector that solves the problem of glut, unemployment, and waste management will change the agriculture sector into an organised sector.

This issue of Indian Farming highlights the experiences of ABIs at various ICAR institutes in accelerating entrepreneurship development in sectors like fisheries, handicrafts, livestock, dairy, meat processing, plantation crops, rice-based ecosystems, post-harvest technology, horticulture etc. The issue also contain insights on approach for strengthening of agri-business start-ups ecosystem, business model for custom hiring of agricultural machinery, agri and food startup ecosystem in India.

(Aruna T Kumar)

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New Delhi 110 012

Indian Farming **70**(01): 03–07; January 2020

Accelerating Entrepreneurship

Development in Fisheries Sector through Agribusiness Incubation

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The Indian agriculture sector has witnessed a sustained growth both in terms of investment and technology during the past several years, with a disruptive rise of start-ups providing innovative solutions to the challenges faced by the farming community. As innovation and networking are being increasingly recognized as the crucial factors to enhance the business competitiveness and gain success in the global market, the private sector players are increasingly coming forward to collaborate with public funded R&D Institutes for developing novel technologies with commercial prospects. This is particularly significant in case of agricultural technologies, as most of the research in the domain is carried out by public R&D institutions. Agribusiness incubation centres act as a platform for the speedy commercialization of the technologies and reinforcing of public private partnerships, through an interfacing and networking mechanism between R&D institutes, industries and financial institutions, thereby contributing to a knowledge-based economy. This paper portrays the experience of Zonal Technology Management and Agribusiness Incubation Centre operational at ICAR-Central Institute of Fisheries Technology as an innovative developmental instrument for supporting the growth of competitive enterprises in the fisheries sector by advancing innovation in products, processes, and business models. This entrepreneurial support system handholds entrepreneurs to shift their economic resources through strong technical and advisory support, into new ventures that yield higher productivity and returns. Innovative concepts of Technology Readiness Level (TRL), de-risking and empanelling of manufacturing firms etc. were also introduced and practiced by the centre.

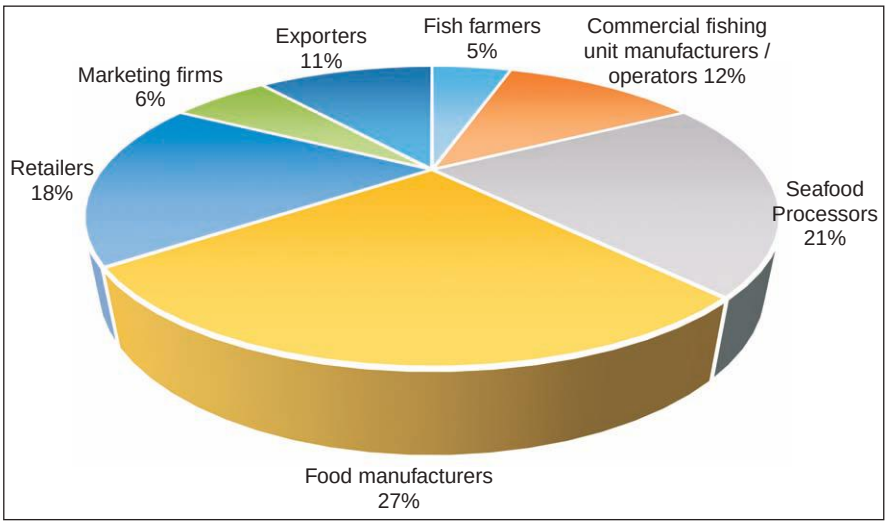
Key words: Agribusiness Incubation, Fisheries, Technology Readiness level, Zonal Technology Management

THE FISHERIES sector with its important role in the socio-economic development of the country has become a powerful income and employment generator, and stimulates the growth of a number of small, medium and large-scale industries. In order to translate the research results arising from the field of fisheries and other agricultural sectors, ICAR has set up an innovation based Zonal Technology Management-Agribusiness Incubation (ZTM-ABI) Centre at ICAR-Central Institute of Fisheries Technology (ICAR-CIFT), Kochi, Kerala. This industry-specific incubator also allows new firms to tap into local knowledge and business networks that are already in place. ZTM-ABI Centre offers their services to industries not only in Kochi but also in other parts of the country through virtual incubation. Beyond promoting business growth, the Centre is also trying to bring its benefits to all the fisheries communities in India. Through this Centre, the Institute has reached out to more than 150 small and medium-sized technology and technology-enabled enterprises and has helped to create a good number of jobs.

Categories of entrepreneurs approaching agri-business incubator

The fishing industry includes any industry or activity concerned with culturing, harvesting, processing, preserving, storing, transporting, marketing or selling fish or fish products. The commercial activity is aimed at the delivery of fish and other seafood products for human consumption or as input factors in other industrial processes. Directly or indirectly, the livelihood of over 500 million people in developing countries depends on fisheries and aquaculture.

The commercial sector of the fishing industry comprises the following chain: (i) Commercial fishing and fish farming which produce the fish (ii) Fish processing which produce the fish products and (iii) Marketing of the fish products.



Categories of entrepreneurs incubated at ZTM-ABI Centre.

The clients approached the centre during the period 2010–19, for various services that are classified based on the area of their expertise in the above figure.

Addressing the common challenges faced by small/medium business owners

As a first step, a pre-incubation surveys all the entrepreneurs approaching the ZTM-ABI will be conducted. Based on the analysis of requirements sought by the entrepreneurs approaching the ZTM-ABI Centre, the common challenges faced by them are identified and represented in the figure. The redressal mechanism of ZTM-ABI is given in Table 1.

Stages of business incubation

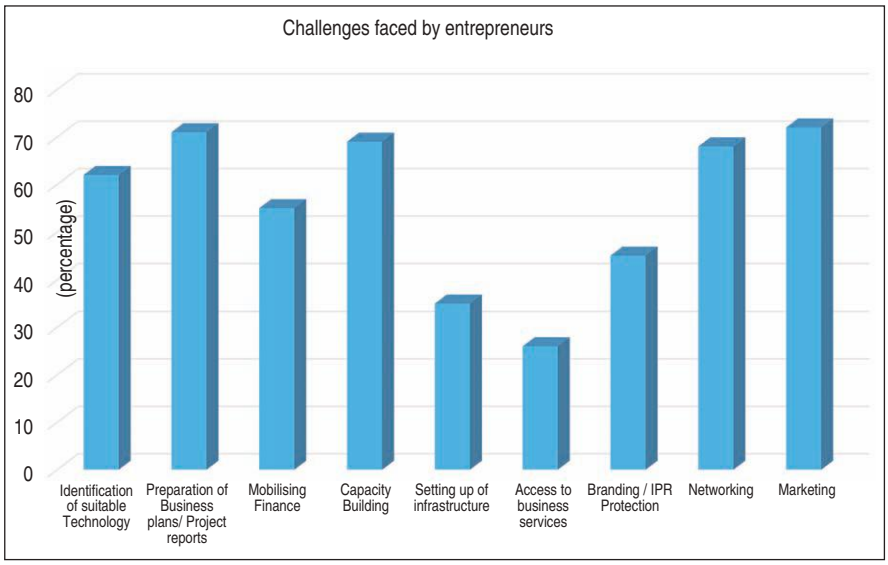
The clientele of ZTM-ABI Centre includes young start-up firms who need basic level technology support and training, to high-end business firms in need of R&D back up for development of diversified products. The Centre possess multi-tenant infrastructure facilities suitable to start a corporate level office for direct incubatees, within the premises of the Institute. Direct incubation is intended to handhold clients during their infancy period. Business Meets and industry-interface programmes are regularly conducted for sensitizing entrepreneurs, and identified candidates with viable business ideas are selected for incubation. Registered incubatees are allowed to meet scientists and business associates whenever required to optimize product formulation and identify suitable business strategies.

This simple networking helps in easy delivery of incubation services and guides the client on basic principles of incorporating a business entity, understand its legal aspects, product branding, measures to ensure intellectual property protection, finance management, market study etc. Normally the residency period for direct incubatees is for one year, which may be extended based on the nature of the business and progress of company development. Whenever the start-up firms mature enough to operate a profitable business, the services and concessions provided, shall be withdrawn. The client, apart from the registration fee to the Incubator, makes monthly payments for office space and pilot plant operations at a subsidized rate than the rates prevailing in the market. After exiting from the incubator, mentoring is continued on need basis.

The centre provides an array of services from idea stage to the product launch. Incubatees are assisted in translating their idea to a technology and further to a market ready product or service. They can also select among the showcased technologies developed in the internal research laboratories and enter into a licensing deal.

These technologies are further classified according to their Technology Readiness Level (TRL). Other services like patent portfolio management, fund mobilization, financial advisory, test marketing, prototype testing, feasibility analysis etc. also would be provided by the ZTM-ABI. Databases and software on IP search, market data analytics, funding sources etc. also are available in the Business incubation centre. The Technology Transfer/Professional Service Functions undertaken by ZTM-ABI Centre, ICAR-CIFT during 2015-19 are depicted in the figure.

The ZTM-ABI differs from traditional Business Incubators as it is tailored specifically for technology-based industries and is operational at an area with a high concentration of



Challenges faced by small/medium business owners.

Table 1. Constraint redressal mechanism of ZTM-ABI

Key challenges	How ZTM-ABI Centre helps	Value to the entrepreneur
Identification of suitable technology	A set of management metrics named Technology Readiness Level (TRL) has been devised to help in the assessment of the maturity period of a particular technology within a specific system and operational environment. ZTM-ABI Centre helps the clients in decision making through a seven-point TRL scale, developed on the basis of various categories of technology development stages and is very useful to clearly understand the project viability, maturity cycle and resource requirements	Cost-effective management of advanced technologies and research results, and this has become an essential entity to ensure the success of new initiatives in a field
Preparation of business plans/project reports	Helps in the preparation of technology specific business plans/project reports detailing technical, financial, commercial and operational strategies for the implementation of the project	Assessment of project feasibility, other requirements, and also very important for securing assistance from financial institutions
Mobilising finance	Even though ZTM-ABI Centre does not have a provision for seed funding, it has tie ups with organisations like District Industries Centre (DIC), Kerala State Industrial Development Corporation (KSIDC) through which the clients can apply for financial assistance	Adequate financing assists in development and growth of a business enterprise
Capacity building	Clients and their team members are provided adequate training to obtain, improve, and retain the skills, knowledge, tools, equipment, and other resources needed to adopt the particular technology and do their jobs competently	Strengthens the skills and resources that are essential for the business entities to survive and adapt
Setting up of adequate infrastructure facilities/machinery	Apart from providing well furnished, air-conditioned office spaces for the clients to set up their office, ICAR-CIFT also provides access to its semi commercial pilot plant facilities. Thus, incubatees can take up commercial production using the machineries and instruments set up in the Pilot plant, without setting up a facility of their own, until successful test marketing phase	Decreases the cost of starting a new business
Access to business services	The Centre provides assistance and guidance in obtaining statutory approvals, registration, licenses, certifications etc.	Accelerates business development activities, saves time and money
Branding/IPR protection	Assist in the development of a product brand and provides guidance regarding proper intellectual property safeguards. Various IP protections can include trademarks, copyrights and patents, and the Centre addresses the client's requirements through Patent Attorney	Safeguards the product identity, develops brand value and gets market advantage
Networking	Mentoring, coaching and interaction with business support entities, fellow entrepreneurs, skill development units, central and state government agencies etc.	Learning, exchange of ideas, partnerships, business relationships etc.
Marketing	The Centre promotes the incubatee products through the Institute's social media, websites, publications and showcase them in national and state level exhibitions, industry meets etc.	Accelerates brand promotion and gets a platform to promote the products and build business network

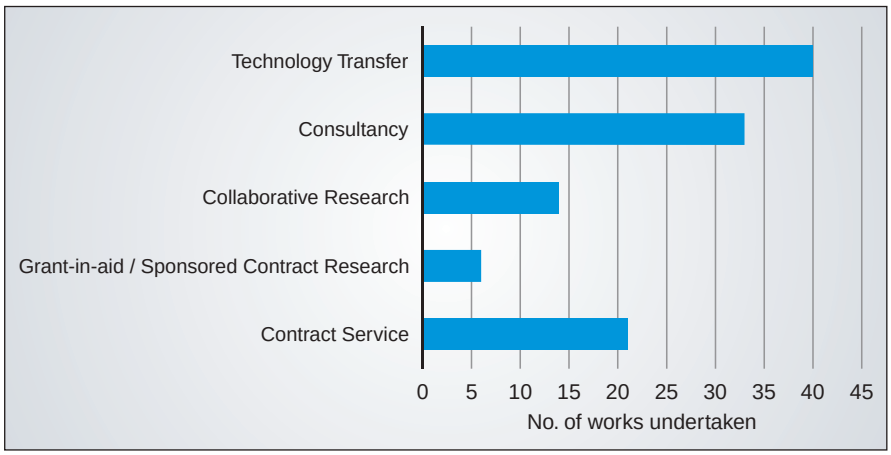
fish production. This industry-specific incubator also allows new firms to tap into scientific knowledge and business networks. Apart from providing the regular incubation and handholding supports, the new system offers innovative programmes such as 'derisking', TRL based technology showcasing joint

HARVEST	VALUE ADDITION	ENGINEERING	WASTE UTILIZATION	HEALTH CARE / QUALITY ASSURANCE
• Fuel Efficient Multipurpose Vessel for Deep Sea Fishing • CIFT Turtle Excluder Device (CIFT-TED) • Device for Juvenile Fish Excluder cum Shrimp Sorting • Fish Aggregating Devices • Foldable Traps • Square Mesh Codend • CIFT - Multi Seam Trawl • CIFT Semi-pelagic Trawl System (CIFT SPTS) • Large Mesh Purse Seine • Short Body Shrimp Trawl • Cut-away Top Belly Shrimp Trawl • Treated Rubber Wood Canoe • FRP Coated Rubber Wood Canoe • Treated Coconut Wood Canoe • CIFT Sun Boat	• Micro-encapsulated Sardine Oil • Seaweed Nutri Drink • Ready-to-serve food products • Ready-to-serve Smoked Products in TFS Cans • Fish Kure - Extruded Product • Seaweed and Fish Enriched Noodles • Seaweed Enriched Cookies • Fish Sausage • Cured and Dried Fish Products • Smoked Masmin Flakes • Fish Wafers • Fish Pickle • Battered and Breaded Products • Laminated Bombay Duck • Diversified Products from Black Clam	• Solar Dryer with Electrical / LPG back up • Solar Cabinet Dryer with Electrical back up • Fish Descaling Machine with variable drum speed • Table Top Fish Descaling Machine with fixed drum speed • Hand Operated Fish Descaling Machine • Energy Efficient Effluent Treatment Plant • Modern and Hygienic Mobile Fish Vending Kiosk	• Fish Ensilage • Foliar Spray • Collagen Peptide • Collagen Chitosan Membrane • Chitin & Chitosan from Crustacean Shell • Carboxymethyl Chitosan • Fish Feed from Processing Discards • Surgical Sutures from Fish Gut Collagen • Succinyl Chitosan based Hydro-alcohol Hand Sanitizer	• Squalene and Squalene Powder • Oyster Protein Hydrolysate (CIFTOPEx) • Fish Protein Isolate from Bombay Duck • Glucosamine Hydrochloride • Natural Hydroxyapatite • Protein Hydrolysate from Tuna Red Meat • Deodorant for Seafood Processing Units and Fish Markets • Antiseptic Ointment for Prawn / Fish Handlers • Fish Calcium Capsules • Test Strips for Sulfite Residues • Chloritest Paper • CIF Test Kit for Ammonia and Formaldyhide Adulteration in Fish • Design and Development of Modern Hygienic Fish Markets

Entrepreneur ready technologies developed by ICAR-CIFT

Innovation projects from students and young entrepreneurs, exhibition and selling platform for clients etc.

Empanelling of manufacturing firms: ZTM-ABI has come forward with an innovative process of technology transfer and commercialization. An expression of interest was called from all interested manufactures and industrial firms who are willing to manufacture/ fabricate CIFT developed machineries and equipments as per the design and specifications provided by the institute. Accordingly, after due diligence process, more than 10 manufacturing firms have been empanelled by the ZTM-ABI to manufacture the CIFT developed machineries for needy clients. ZTM-ABI charges a licence fee and royalty from the empanelled firms and financial transaction for an average amount of ₹ 40,000 has been realized by the empanelled firms annually.



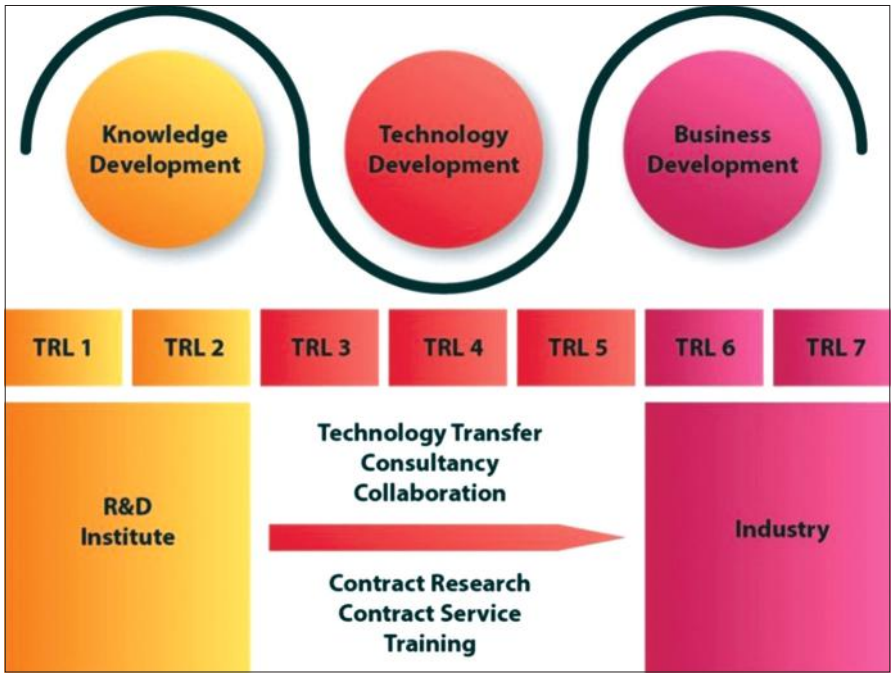
Technology transfer/professional service functions undertaken by ZTM-ABI Centre, ICAR-CIFT during 2015–19.

TRL based technology showcasing: Accurate and timely 'technology readiness assessments' (TRAs) are very important for the cost-effective management of advanced technology R&D portfolios, whether at the program manager level, the prime contractor level or the supplier level. The ability to make good decisions concerning the inclusion or exclusion of new technologies and novel concepts, and to do so in the absence of perfect information, is essential to success of new initiatives in any field. Technology Readiness Level (TRL) is a set of management metrics that enable the assessment of the maturity of a particular technology and the consistent comparison of maturity between different types of technology, all in the context of a specific system, application and operational environment. Businesses conducting product development and commercialization activities often refer to a seven-point Technical Readiness Level (TRL) scale. This scale helps categorize development stages which is helpful to define project scope, progress, timelines, and resource requirements.

The TRL system measures a technology's maturity, from Level 1 (Concept Evaluation) to level 7 (Successful Deployment). Each of the seven levels demonstrate a clear milestone in the technology development project where significant activities are performed. While some stages aren't applicable for certain projects, most research and development projects will pass through each of the nine levels until it's been successfully integrated into the market. Each technology is classified into various levels of TRL based on a few indicators and attributes.

De-risking technologies for successful commercialization

Most of the times, the entrepreneurs find it difficult to take up the technologies which was successful in a lab scale on upscaled



Transition from innovation to business

manner. This is mainly due to the constraints with respect to the economics of scale, precision in process/protocols, management of big scale/sophisticated machineries and instruments, HR management etc. Hence, ICAR-CIFT has experimented a new mechanism called De-risking of technologies using pilot scale facilities. Under this scheme, incubates can take up commercial production using large scale production facilities including machineries and instruments set up in the Pilot plant attached to the institute. This facility is limited to identified entrepreneurs for a limited period, essentially linked with test marketing and market behaviour analysis phase. They have to discontinue the use of pilot plant facilities once they are graduated with successful product in the market. The major facilities provided by the business incubator for de-risking are listed below.

1. Provides technology and know-how backed up with scientific results
2. Initial assessment of product and business
   - Assess the commercial viability of the business plan
   - Benchmark against best practices in the industry
   - Identify technology gaps and requirements
3. Regulatory, compliance and standards support
   - Training in quality regulations and related aspects
   - On-site inspections and formulate remedial measures
   - Provides assistance to secure regulatory and standards certifications
4. Infrastructure and production unit
   - State-of-the- art pilot level production facility
   - Well-furnished office space at prime business location
5. Training and skill development
6. Product development and testing
7. Formulation of company policies
8. Setting up of new facilities and up-scaling

Joint development with student/ young entrepreneurs: In this approach, student entrepreneurs, young innovators and start-ups are encouraged to work with institute scientists and develop new products and technologies out of innovative ideas. The non-official innovators can use all equipments and other facilities for carrying out their research. Once a new technology is developed, it will be further validated, tested and commercialized. If patentable, joint patent applications will be filed.

Exhibition and selling platform for clients: The graduated entrepreneurs are allowed to showcase and sell their products in the CIFT stall in national and international exhibitions.

ICT support to clients: Digital and social media platforms have been used to network among the incubatees, graduated clients, buyers, sellers and other market and industry players.

Technology transfer through empanelled private firms: The developed equipments are made available to the needy clients on payment basis through selected empanelled manufacturing agencies. The agencies are selected by inviting expression of interest and subsequently conducting a due-diligence study.

B2B and B2C Meets: Business-to-Business and Business-to-Customers meets are held at regular intervals to connect new clients to market, industry and empanelled firms. Two-way communication is facilitated among (i) the empanelled/ licensed manufacturing agency and clients seeking institute technology; (ii) Sellers like graduated entrepreneurs and incubates with buyers, both wholesale/retail and national/international.

SUMMARY

Fisheries is sunshine sector of food production providing nutritional security, livelihood support and gainful employment to millions of people. Entrepreneurship is an important tool for promoting this sector and improving the economic development of a country. In this context the role of business incubators that supports the creation and growth of business through organizational and technical assistance, which at the same time contributes to the reduction of entrepreneurial failure, assumes great importance. The ZTM-ABI Centre operational at ICAR-CIFT manages technologies/ innovations, assists the entrepreneurs in seizing new business opportunities, and thus become key players in the growth of industries in fisheries and food processing sector.

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Engaging Stakeholders in the Aquaculture Business Incubation Space

– Expeditions of ICAR-CIBA from 2002–20

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Brackishwater aquaculture has been a dependable subsector of fisheries for food, employment, and prosperity through export earnings since the 1980s. The export of shrimps has superseded the export of all agricultural commodities, taken individually, in 2018-19. From $1.91 billion (₹ 8,607.94 crore) in 2008-09, India's marine exports increased to $7.08 billion (₹ 45,106.89 crore) in 2017-18 which includes $4.85 billion (₹ 30,868.17 crore) from frozen shrimps. About 90 per cent of shrimp exports are today from Pacific White Shrimp. In a decade, shrimp production had gone up more than nine times to roughly 7 lakh tonnes, of which the share of Penaeus vannamei *was 6,23,000 tonnes. Ensuring the supply of quality seeds, feed, and other farm inputs is the key to the continued success of the sector.*

Key words: Aquaculture, Brackishwater, Business Incubation, Shrimp farming

ICAR STARTED technology development efforts in brackishwater aquaculture in 1973 with an All India Coordinated Research Programme on Brackishwater fishes. The encouraging research results which were keenly taken up by farmers summited into the birth of ICAR-Central Institute of Brackishwater Aquaculture in 1987. Since then, the institute has put in concerted efforts in the sustainable development of the brackishwater aquaculture sector.

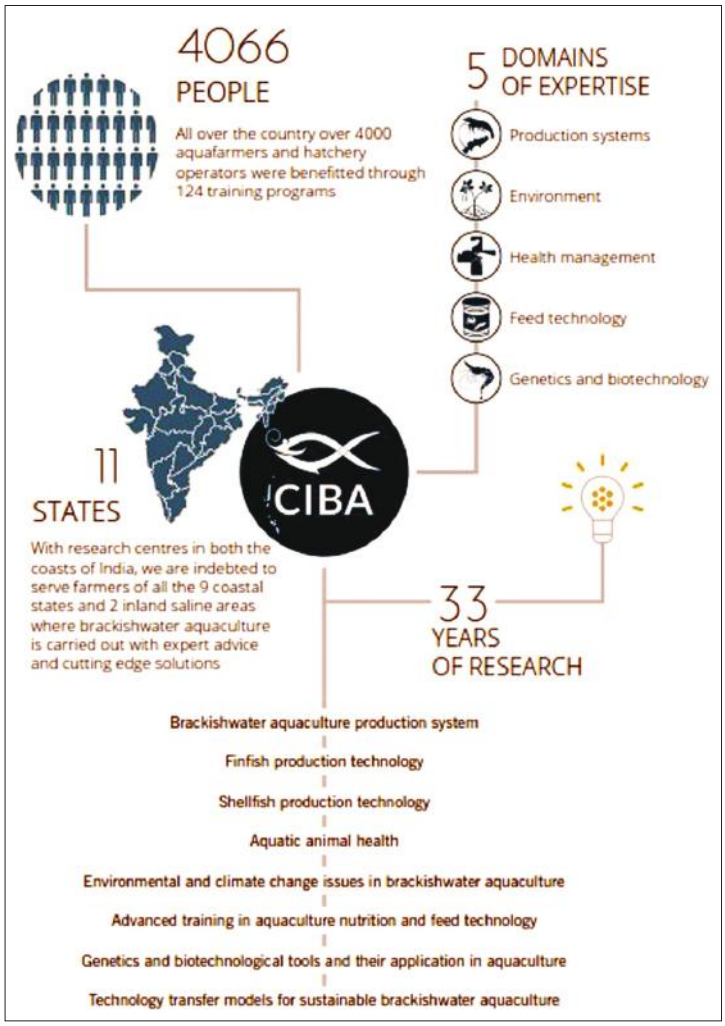
Timeline of technology development

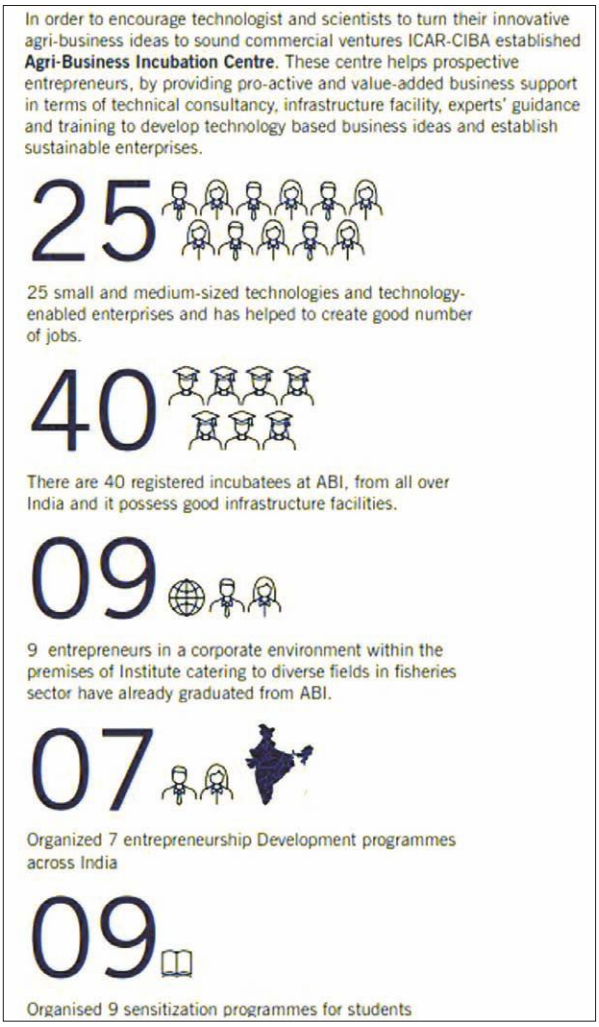
The growth in aquaculture in India has been facilitated by putting in place better management of cultural practices, ensuring supply of good quality seeds and providing feed at relatively cheaper rates and supporting aquaculture activities with disease diagnostics, and analytical kits, immune stimulants, and bio-remediation process, identifying new and emerging as markets, exploring international as well domestic marketing practices have also benefitted Indian Aquaculture.

Seeds: Like in any agricultural enterprise, the quality of seed is a crucial issue in Aquaculture also. In Aquaculture, quality of seeds not only helps in the condition of shrimp larvae but also screening of disease, due to which shrimp seeds are dependent on disease-free status. The seeds produced by hatcheries since the 1990s have helped the sector to grow from 40,000 - 50,000 tonnes to more than one lakh tonnes till the 1990s.

Feed: Feed is the most critical and expensive component in the cost of production of the system of Aquaculture. ICAR-CIBA developed technology for low-cost indigenous feeds, which is being marketed as Vannamei plus by at least seven feed mills across India with the cost of ₹ 55-65. This intervention has helped the farmer to get a reasonably good quality feed at a cheaper cost with feed performance comparable to leading commercial brands. Of late commercial brands have also introduced cheaper products in the feed market lines. CIBA feed technology helped farmers to reduce the input costs by 0.75 to 2.25 lakhs per hectare, increasing the farmers' income.

Inputs: Aquaculture input, including probiotics, immune stimulants, are essential requirements for necessary shrimp farming. Further, the availability of diagnostic foods for effective management of disease and environmental quality is essential. The Institute has developed many products for the benefit of farmers of the Aquaculture sector including a diagnostic kit for WSSV, soil, and water analytical kits for P, K, Mg, Na, and *p*H level, the Institute has also produced a successful immune stimulant marketed as IMMSTIM. Another bio-remediation product named CIBASTIM also has





been successfully commercialized. The above mentioned scientifically developed and tested/validated products have helped the sector to grow sustainably. The inputs also ensure increased production at a reasonable expense in the sector.

ICAR-CIBA has been engaged in business incubation for the last six years with a grant of Business Planning and Development Unit sanctioned by the National Agricultural Innovation Project (NAIP-ICAR) funded by the World Bank in 2013. The Institute conducted three Business meets in Chennai, Kolkata, and Navsari, Gujarat, during 2013-14. ICAR-CIBA has successfully formalized 104 arrangements of technology upscaling with individuals, corporates, and other institutions in the form of MoUs/MoAs.

Thirty incubatees graduated from ABI, ICAR-CIBA, and seven incubatees being handheld at CIBA in onsite and offsite modes, currently. ABI, ICAR-CIBA, has generated ₹ 1.86 crores as revenue from business incubation and technology commercialization activities since 2013.

The Institute has entered into 120 MoUs/MoAs with individuals/ firms and Institutions. Three types of MoUs have been entered with external entities. Firstly, MoUs made with other research entities like IITs, Universities, and Research

Success stories of ABI-CIBA entrepreneurs

Low input based farming of milkfish and its popularization as Deccan Hilsa in Sundarban – an innovative approach

–Amalesh Chatterjee

Mr. Amalesh Chatterjee, an engineer by profession, is a progressive aqua enterpreneur from Khamargachhi, Hooghly, West Bengal. He in association with ICAR-CIBA developed and demonstrated the low input based farming of milkfish and its popularization as Deccan Hilsa in Sundarban region of West Bengal.

Pond based aqua-agri integration for the socio-economic transformation of farm families in the Sundarban region of West Bengal

–Debakinandan Patra

Mr. Debkinandan Patra is a marginal farmer of Madanganj village, Namkhana block of the Sundarban. He has pioneered the aqua-agri integrated model developed by Kakdwip Research Centre of CIBA for the livelihood security of coastal families of Sundarban region of West Bengal.

Biofloc based shrimp nursery rearing the means for sustainable shrimp farming – a success story

–Aditya Pradhan

Shri Aditya Pradhan an innovative aquafarmer from Balasore district of Odisha has about 30 years of experience in brackishwater aquaculture. He established an eco-friendly biofloc based nursery rearing for Pacific white shrimp *P. vannamei* with the support of ICAR-CIBA and popularising this on-farm nursery model in Odisha.

Institutes like CIBA, secondly MoUs with corporate bodies and thirdly directly with farmers/entrepreneurs. The Institute Technology Management Committee (ITMC) scrutinizes new proposals and modifications/amendments required in existing PPP arrangements. ITMC discusses and collectively takes decisions and recommends to In-charge ABI/Director for execution. For scientific brackishwater aquaculture development in the country ICAR-Central Institute of Brackishwater Aquaculture is the nodal research and development center. The brackishwater aquaculture generates about ₹ 30,000 crores of foreign exchange and is a very vibrant commercial activity. Demand by the sector for the supply of quality seed, feed, chemical/biological products, diagnostic, and analytical kits is tremendous. Hence, entrepreneurs - startups to large corporates regularly approach CIBA for technological support.

The ICAR- CIBA technologies and services are of five major categories:

1. Process development like the development of fish breeding protocols and practices
2. Formulation of new feed and improvements in indigenous feed technology
3. Product development automatic feeders, solar-powered equipment
4. Capacity building and training and
5. Technical services like disease diagnosis, soil and water testing, consultancy services.

The institute serves multiple stakeholders and needs of the aquaculture sector, but the effective interface between the Institute and individuals/firms and other entities in the form of the Agri-Business Incubation center is very much essential for promoting partnerships with entrepreneurs/start- ups.

Specific activities are:

A. Strengthening the process of commercialization of technology
B. Handholding small and medium enterprise to develop business
C. Skill upgradation
D. Development of bankable projects for entrepreneurs
E. Consultancy services to the industry, and NGOs
F. One-stop-center for technology exposure to the entrepreneurs, industry

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Converting Scientific Knowledge and Technical Innovation into Successful Business

– Case of freshwater aquaculture

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Agri-business incubation centre of ICAR-CIFA has been operating in the field of freshwater aquaculture since 2013. During last six years, centre has contributed significantly to the entrepreneurship development in freshwater aquaculture. It has leveraged technological strength to showcase successful business models across the country. The setup has generated social impacts in the form of new business creation, income and employment. Establishment of new enterprises in strengthening value chain has been a major achievement.

Key words: Agri-business incubation, Freshwater aquaculture

BUSINESS incubation is the process of nurturing entrepreneurs, start-ups in the early stage of enterprise development. Agri-business incubators are specialised in promoting enterprises relating to the food value chain. Traditionally, agriculture was considered synonymous to farming or husbandry activities but in the modern times, agri-business encompasses much broader activities in the value chain from inputs-supply to food-processing, marketing and export. The enterprises are the economic units that operate within the business environment with the objective to create value in market while earning livelihoods and profit out of it. Therefore, the new age entrepreneurs, start-ups find opportunity in whole value chain. But success of these entrepreneurs depends upon supporting environment, a range of technology, support, services etc. In absence of such support, the failure rates of these new initiatives are quite large. Globally, business incubation is being used as a tool to provide the necessary support to increase the chance of success of new firms in the market environment.

Business incubation is the process in which new business organisations are created from idea through entrepreneurial, social, and economic development process. Business incubators are the physical space in which business incubation process is carried out. Incubators orient its resources, support services and strength to nurture young firms especially at the initial stage. There are diverse categories of incubators, agri-business incubators are one of them. Agri-business incubators (ABI) serve the new firms in the field of agri-business with focus on value addition, market linkages and value chain developments. Agri-business incubators are unique as they help client in dealing with market linkages, high value business models, uncertainties, technology gap to increase chance of survival and growth of new age entrepreneurs.

ABI of ICAR-Central Institute of Freshwater Aquaculture is one such incubator where the primary goal is to develop new enterprises in the field of freshwater aquaculture in India. Freshwater aquaculture sector in India has developed only in last five decades primarily driven by wide range of technologies made available by Indian council of Agricultural Research. The aquaculture research was carried out by Pond Culture Division located at Cuttack of CIFRI, Barackpore since 1947 and later converted into Independent institute as CIFA in 1986. Aquaculture technologies were instrumental in building freshwater aquaculture industry in the tune of ₹ 65,000 crores in 2016-17. The sector is growing at the rate of 6.1% since 1960 and considered as one of the fastest growing sector within agriculture.

Economic growth was possible through creation of new enterprises, adoption of technologies and development of aquaculture clusters across the country. The aquaculture business has been ever increasing as many new players are entering into the sector to take advantages in the economic conditions derived due to

high demand and high price situations. The dynamics of the sector is driven by expansion of the market and increase in specialisation and new enterprise creation. Hence, the new value chain is created and entrepreneurs are attracted towards the sector.

Within this economic context, the ABI of ICAR-CIFA focussed on new business creations in the freshwater aquaculture sector since 2013. ABI is involved in activities like (a) Promotion of business through commercialization of technology, (b) Incubation of small and medium enterprise to develop aqua-business, (c) Skill development of entrepreneurs, (d) Development of bankable projects for entrepreneurs, (e) Consultancy services to the industry, NGO, etc. and (f) act as one-stop-center for technology assessment and exposure for the entrepreneurs and industry.

Demand for incubation services

Incubation is the specialised service provided through strength in domain knowledge and management expertise within particular agri-business space of freshwater aquaculture. Effectiveness and impact of the services depends on the demand of these services by the entrepreneurs. Whether services provided are demanded by sector or not? If demanded, what are the services needed by the entrepreneurs? ABI has assessed the demands from the participation of entrepreneurs in the training programmes, request made to ABI, visit of entrepreneurs and communication in last seven years. As per the assessment, major enterprises in which entrepreneurs were interested were seed production, fish culture, feed production and feed plant, fish processing, pearl culture, carp hatchery, fish waste processing, other aquaculture services like fish health products, aqua-eco tourism, fish marketing etc. Approach of incubation centre has been to openly discuss with the entrepreneurs on their idea about the opportunities within the business ecosystem in which they operate. The centre helps in identifying such opportunities within freshwater aquaculture value chain.

Table 1. Enquires for enterprises during 2013-20

Enterprise	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Seed production	10	15	18	45	63	83	71
Fish Culture	31	44	62	109	121	139	127
Feed Production & Feed Plant	27	29	22	33	41	40	35
Fish Processing	41	22	20	28	37	42	31
Pearl culture	35	24	22	15	92	103	86
FRP hatchery	71	72	78	94	117	152	140
Fish Hydrolysate	4	3	5	15	84	71	91
Others (fish health, tourism, marketing)	45	44	42	111	129	144	136
	264	253	269	450	684	774	717

Technological and business services

Services are the elements of incubation process through which the need of the entrepreneurs and start-ups are served. The services can be categorised into business and technological services. The business services are the typical incubation services provided by ABI while technological services leveraged on technological strength of the institute.

ABI Unit acts as one-stop-center for technology showcasing and exposure to the entrepreneurs. Most of the technologies were provided by the institute on which ABI has provided value added technological and business services leading to successful ventures. Technological services in the form of technological accesses, technology commercialization, hands-on training, laboratory testing, technological design, on site handholding etc. There were also group of enterprises which were unique and innovative in nature, the ideas and technologies were brought in by entrepreneurs on which ABI has provided both technological and business services leading to many innovative ventures.

The business services are in the form of DRP preparation, support for accessing finance and subsidy, development of marketing strategy, support in branding, help with accounting/financial management, links to strategic partners, management team identification, help with regulatory compliance, Intellectual property management, Administrative and secretarial support etc.

Achievements

Firm creations: The entrepreneurs in the freshwater aquaculture were working in whole value chain from inputs supply, production to marketing. Therefore, organizational structure was diverse. The firms engaged in farming and seed production were in the proprietorship or partnerships. Whereas new business models having high growth potential were undertaken in the incorporated companies. Some of the firms developed are given in Table 1.

Value chain development

Value chain development in freshwater aquaculture has been undertaken by ABI to build entrepreneurs in the underdeveloped areas. The value chain development in the Nabarangpur district was under taken during 2019-20 under RKVY project, in Madhya Pradesh in collaboration with TAAL (an NGO) under consultancy project during 2016-17, in Malkangiri and Jharkhand with consultancy project of WASSAN (Section 25 company) during 2014-16. In the value chain developments, linked enterprises were identified, business plan was developed, capacity built and handholding support was provided to successfully establish the value chain from production to marketing in the identified areas.

Skill development

During this period several skill development training programmes were conducted, viz. National Training Programme on Installation and Operation of FRP Hatchery (Training) (5 numbers with participation of 110 operators), value

chain developments (6 numbers training about 300 entrepreneurs), Fish Feed Production and Feeding Management in Aquaculture (3 numbers for 75 entrepreneurs), business orientation for pearl farmers (6 numbers 170 entrepreneurs) etc. The necessary skills required to establish an entrerprises were imparted through these programmes.

Collaborative programmes

Entrepreneurship development programme was undertaken in collaboration with NRRI, Cuttack; MANAGE, Hyderabad; OUAT, Bhubaneswar; APICOL, Odisha; KVK, Khordha; IMAGE, Bhubaneswar; National Innovation foundation, Bhubaneswar; WASSAN, Hyderabad; TAAL, Bhopal in addition to the on-going programme of ABI-CIFA.

Network development

The network created by ABI CIFA across the organisations was key to success of new enterprises as it provides necessary support to the entrepreneurs in various aspects of the business. Through these networks the access to the services from various organisation had been easy. For example, the network with APICOL (apex body for subsidy delivery to entrepreneurs in odisha) had been helpful for entrepreneurs in getting financial support. Network with the NABARD helped in getting support from banks on the matter of credit. The related institutes like CARI, NRRI, IIHR, CIFT etc. were also supported entrepreneurs in technology access. MSME, Odisha has been helping the entrepreneurs in start-up Odisha programme.

Coaching, mentoring and consultations

Coaching, mentoring and consultation are important tools of information sharing and guiding the firms and entrepreneurs. The entrepreneurs in the pre-incubation phases spent a large amount of time in discussion with the incubators before taking their decisions. Similarly, large number of organisations were also benefitted by these processes to strengthen their capabilities in dealing with the emerging aqua- business enterprises. Some of the examples of such consultations were with DCMSME, Paradip on formation of dry fish cluster in Paradip; IL&FS on Aquaculture Cluster Development in Balasire; CESC- RP Sanjib Goenka group company in Aquaculture Cluster Development in Haldia, West Bengal; Mission Skakti Odisha in development aquaculture based women entrepreneuts etc.

Similarly, some of the entrepreneurs consulting with ABI to develop enterprise based on new technologies were Saurava Kumar Biswal (Jayanti Rohu), Kailash Ch. Sahu, Gope Odisha (Fish feed), Navneesh Nalwa Sumrihi Seeds, Haryana (Fish manufacturing), Himmat Raghunath Rao Morey, Nagpur (Fish processing), Maalaxmi aquaculture (P) ltd. (Jayanti Rohu), Sidharth Roy, Chandikhol (Aquaculture farm), Zoo Fish Ltd, Bhabanipatna (Live Fish Marketing System) etc.

Incubatees

Incubatees were only a small percentage of total entrepreneurs with whom ABI is engaged. The incubatees were committed resources and time on particular enterprises and taken advantage of the incubation centre. Details of the incubatees across enterprises and their status is given in Table 2.

Economic benefits

The operations of agri-business incubation centre has been beneficial to the entrepreneurs, host institute and society at large. The entrepreneurs were able to find a platform to get exposure, discuss and decide on enterprises, access to technology, access to resources and enter into the networks. The host institute was able to find large number of entrepreneurs to take up the technologies developed by them. Scientists were able to interact with large number of entrepreneurs on the technical matters pertaining to their subject. The market information and dynamics of the sector was better understood by the entrepreneurs and acted as a bridge between economy and research institutes. The ultimate benefits of the incubation process lies in generation of new business out of it. Since business generation is a long term process, it is difficult to assess the social impact of incubation. However, the business generation and capital investment made by selected entrepreneurs can provide indicators of the economic impact of incubation. Following are the few firm having generated capital based on the DPR prepared by ABI-CIFA.

Success stories

Success Story of Zoofresh, Bhawanipatna, Odisha (Live fish system)

The entrepreneur Mr. Sadananda Satapathy shown interest to become an incubatee of ABI of CIFA to provide fresh, local, safe products for approx. ZooFresh Foods Private Limited was established on 23 March 2016 and operates in Western Odisha. ZooFresh Foods is incubated at CIFA, Unltd India, a-IDEA NAARM, Hyderabad. It is recognized by Startup India and Startup Odisha, and was selected by the Ministry of Food Processing

Table 2. Status of incubatees of ABI-CIFA during 2011-19

Enterprise types	Graduated	Continue	Total
IMC breeding	0	3	3
Murrel breeding	0	2	2
Catfish breeding	0	2	2
Fish feed production	0	2	2
Pearl farming	1	0	1
Fish processing	2	1	3
Fish waste based fertiliser	0	3	3
Plastic gadgets	2	0	2
Jayanti Rohu	5	0	5
Aqua-field school (technical service	0	3	3
Market development	0	1	1
Total	10	17	27

Table 3. Start-up enterprises by Incubatees

Entrepreneur's Name	Address	Technology/Enterprise
Maalaxmi Aquaculture (P) Ltd	Kalna, West Bengal	Jayanti Rohu, Anabeas seed production, Fish hydrolysate
Zoo Fish Ltd	Bhawani Patna, Odisha	Live Fish Marketing System
Mr. Sanjay Agarwal	M/s Agarwal Trading Corporation, CG	CIFAX, Feed manufacturing
Mr. Sushanta Pradhan	Sheraton Eco, Bhanja-nagar, Ganjam, Odisha	Aqua-tourism
Mr. Akash Mishra	M/s. Farbon India (P) Ltd.	Aquaculture
M/S Aishrya Aquaculture Pvt. Ltd	Naihati, West Bengal	Broodfeed manucaturing

Industries (MoFPI) as one of India's top 20 food startups at World Food India 2017. It is a part of FSSAI's Food Innovators Network, and has a PPP with the Odisha Poultry Federation, Govt. of Odisha.The start-up enterprises developed by ABI-CIFA are given in Table 3.

Success Story of Farbon India Pvt. Ltd., Gop, Puri, Odisha (Integrated Fish Farming)

Two friends Mr. Akash Mishra and Dr. Pravas Panda started an initiative in the year 2018 in Integrated fish farming which includes poultry, goat farming and horticulture at Gop, Puri. They have been trained at ABI-CIFA before starting their enterprise. Now they are successfully producing sustainable quantity of products from different farming systems. Looking into their excellent contribution towards integrated fish farming in aquaculture sector, they have been awarded Best Fish Farmer by ICAR-CIFA, Bhubaneswar on the occasion of National Fish Farmers Day (10th July, 2019). In the present context, Farbon India has set an example to prospective entrepreneurs in the field of integrated fish farming as an incubatee of ABI-CIFA.

SUMMARY

The entrepreneurships were developed through wide range of services provided by ABI-CIFA. Incubatees were the primary focus of incubator with Incubatees (27) engaging in large number of enterprises in the freshwater aquaculture value chain. In addition, the entrepreneurs were also provided support through skill developments, mentoring and consultancy. During last 6 years, 79 entrepreneurs/firms were supported through 27 numbers of DPRs and entrepreneurs were able to attract funding to the tune of ₹ 26 crores and assets generated at about ₹ 34.2 crores. It is estimated that revenue generation by the entrepreneurs amounted to ₹ 13.72 crores per year. During this period 8 technologies were commercialised. Some of the brands like Tisya Pearls Pestolyset, Bindadd, fish Mount, Veggie Plus, freshterian etc. were developed by the entrepreneurs.

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Inclusive Approach

for Strengthening of Agri-business Start-ups Ecosystem

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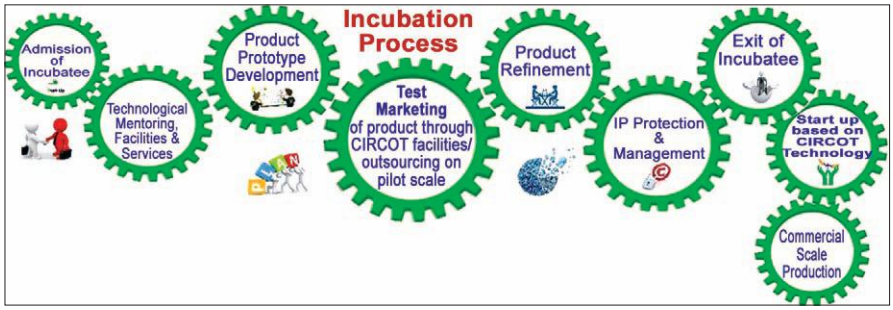
ICAR-Central Institute for Research on Cotton Technology (CIRCOT) has served the cotton community since its inception in 1924 and has evolved over the years to address the changing needs of its stakeholders. The institute is committed to carry basic and strategic research on processing of cotton and its agro-residues leading to development of value added products as well as quality assessment of fibre. It is the first textile institute in India to become a Referral Laboratory for Cotton Textiles. Calibration cotton, a standard reference material is hallmark of the institute's R&D with 300 corporate users. It is preferred over USDA Calibration Cotton which is an import substitute. Further, institute is working on value addition to cotton biomass through particle board preparation, compost making, nanocellulose production, cottonseed oil etc. to provide additional income to cotton growers.

Key words: Agri-business, Cotton community, Start-up

THE CIRCOT has diversified its ambit to cover other natural fibers (Banana, Coconut) and started pioneering work in nanotechnology and its application in textile finishing, natural fibre based composites and environmentally benign technology for processing cotton textiles. The technology transfer activity was revitalized by inculcation of a business orientation through the establishment of a Business Planning and Development Unit to commercialize the technologies developed at the institute. The institute has good number of IP enabled technologies and patent related products and processes. ICAR-CIRCOT is providing the facilities regarding technology mentoring, IP management, product development activities, test marketing, canvassing of technologies, funding for the incubatee in focused and consistent manner.

National Agricultural Research System (NARS) through the World Bank aided National Agricultural Innovation Project (NAIP) has taken an initiative in 2008 across the country by establishing the Zonal Technology Management (ZTM) and Business Planning & Development (BPD) units. Taking into consideration its past credence as a unique technology institute within the ICAR system with rich experience in technology commercialization, technology transfer and Intellectual Property Rights management the first ZTM-BPD unit was launched at ICAR-CIRCOT.



Different steps of incubation process.

Agri-Business incubation

ABI centre was established in 2016 under 12th plan scheme of National Agriculture Innovation Fund (NAIF) for the benefit of prospective entrepreneurs who wish to start their business using institute technologies on post-harvest processing of cotton and value addition to its by-products. This centre envisages facilitating incubation of new startups/ entrepreneurs and enterprises for innovative technologies by providing need based physical, technical, business and networking support, facilities and services to test and validate their venture before successful establishment of enterprises. The centre is also responsible for conducting techno-entrepreneurial activities in cotton value chain for building prospective clientele and facilitate skill development in selected stakeholders related to cotton sector.

Pilot plant facilities and testing facilities available at ICAR-CIRCOT, Mumbai.

Taking into consideration the broad spectrum of Innovation, Incubation, Start-ups, Stand-ups, Make in India, etc. major thrust is being given on how to make our country "Greener" and "Cleaner".

The ABI centre focuses on mentoring (incubation) entrepreneurs to bring the dream of "Waste to Wealth" into realization with twin goals of "Doubling farmer's income" and "Propelling a Cleaner and Greener India. The pictorial representation of various steps of incubation process are depicted in the figure above.

Agribusiness Incubation consists of recognizing potential incubatees, provide them with infrastructure facilities, technological consultancy, fund facilitation and product development for commercialization. The innovative technology in contemporary world needs to be protected to evade the exploitation of innovations developed through application of intellect and consistent research efforts. Thus, appropriate registration of Intellectual Property enables protection of R&D efforts.

ICAR-CIRCOT has a strong industry interface, has developed and commercialized high impact and innovative technologies pertinent to growth of the industry, provides high end testing facilities to industrial clients as well as promotes entrepreneurship among start-ups. Having an established reputation

Table 1. Detailed list of incubatees along with their technologies and product

S.No.	Incubatee Name and Technology	Product
1.	Degossypolized cottonseed cake for fish, poultry and pigs M/s Sana Agro Industries Limited, Raichur, Karnataka	
2.	Antimicrobial cotton bedsheets for hospitals M/s Green Globe Mumbai, New Delhi	
3.	Nanocellulose application in textile yarn spinning for making towels M/s The Kadri Mills Limited, Coimbatore	
4.	Cotton reinforced rubber baton for protection forces M/s Life Long Combines, Aluva, Kerala	
5.	Gin cotton lint opener M/s Precision Tooling Engineers, Nagpur	
6.	Cotton blended T-shirt (Menswear & Womenswear) M/s Greyy, Navi Mumbai	
7.	Development of thermal and bath blankets using cotton and biodegradable polyester M/s Bloom Textile, Sivakasi, Tamil Nadu	

8. Preparation of value added products using banana fibre M/s FNV Pack, Pune. Technology to produce eco-friendly and biodegradable dishware from a blend of banana fibres extracted from the pseudostem and sugarcane bagasse.




9. Preparation of value added products using naturally coloured cotton M/s Kotak Commodities, Mumbai. These eco-friendly cottons are unique as they grow in colours and do not need to be dyed. Naturally coloured cotton has inherently softer feel, high UV protection factor, good colour stability and fastness properties.


10. Production of biodegradable kitchen utilities directly from the whole banana pseudostem M/s Paras Gold Industries, Gujarat. Technology involves the use of whole banana pseudostem without any wastage and hence, the productivity of the biomolded item is very high. No external binders are added for the production of molded products. This eco-friendly product will be a better alternative for plastic based products.


11. Ecofriendly, efficient and rapid burning crematorium using cotton stalks/biomass briquettes M/s. Vidarbha Sales, Nagpur. Developed briquette technology which is ecofriendly, efficient and rapid burning green crematorium as an alternative to traditional fire wood based cremation. Briquettes made from agricultural biomass like cotton stalk, sugarcane bagasse, groundnut and castor seed shells, rice husk and paddy straw etc. can be used as alternative fire wood in cremation.

12. Sustainable rubber pots with natural fibre reinforcement M/s. Rubber Engineers Pvt. Ltd.ICAR-CIRCOT has provided the intervention by developing innovative agro-residue reinforced natural rubberized composite with higher strength and optimal flexibility.

13. Sleeping bags M/s. Shree Agro Invent Tech Pvt. Ltd. Inner layer is prepared using nano-based anti-microbial finish for enhanced comfort. Outer layer is prepared using synthetic fabric having mosquito repellant property. These nanofinished high performance sleeping bags provide improved protection and comfort to user and enhances sleep experience.

14. Innovative fibre reinforced paper carry bags M/s. Udayprasth Industries Pvt. Ltd. This bag was prepared as an alternative to plastic bags and it can be used for day to day packaging uses. It is bio-degradable, cost effective and eco-friendly due to use of recycled material. Having excellent load bearing capacity with durability. Prepared using GSM 127 paper with special properties like Ant-repellent and Insect repellent and load bearing capacity of up to 7 kg.

among textile industries, ginning industries and cotton farmers, ICAR-CIRCOT catalyses the penetration of technologies among the masses. With a strong foothold in various zones of India through its regional stations, the needs of stakeholders are met with this experience and expertise. Apart from thousands of benefitted cotton growers, notable industries include M/s. The Kadri Mills Limited, Coimbatore, M/s. Green Globe Mumbai, Navi Mumbai, M/s. Sana Agro Industries Limited, Raichur, Karnataka, M/s. Life Long Combines, Aluva, Kerala, M/s. Greyy, Navi Mumbai, M/s. Precision Tooling Engineers, Nagpur, M/s. Bloom Textile, Sivakasi, Tamil Nadu, M/s. FNV Pack, Pune, M/s. Kotak Commodities, Mumbai, M/s. Paras Gold Industries, Gujarat to name a few (Table 1). Presently the ABI centre is promoting entrepreneurs in fields of antimicrobial textile finishing, degossypolised cottonseed meal for poultry feed, cotton rubber composite batons for police force, various application of nanocellulose in paper and composites.

Facilities available for incubation

The institute is instrumental in the establishment of well-equipped pilot plant facilities for nanocellullose, particle board, saw ginning, roller ginning, computerized sample preparation machine and cottonseed oil extraction. In addition, there are modernized testing facilities are also available for the assessment of developed technology.

Conclusion

ICAR-CIRCOT ABI centre facilitates incubation of new enterprises based on innovative technologies by providing technical mentorship, physical space, networking support and services. The institute is putting its constant efforts to provide an inclusive approach to nurture the incubatee/ startups a full proof, sustainable mode of development for a successful business enterprise. There has been an increased awareness and consumer preference towards use and development of different sustainable products.

In this similar line, ICAR-CIRCOT has developed numerous technologies to utilize the agro residues along with empowering the agripreneurs/incubatees through its ABI scheme by encouraging, nurturing and supporting innovative agribusiness ideas and turning them into sound commercial ventures. The supportive initiatives by government organizations and capital support by various private and government agencies will further encourage youth and startups for venturing into agriculture based technopreneurship.

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A Business Model of Custom Hiring of Agricultural Machinery

for Enhanced Farm Mechanization in Madhya Pradesh

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Farm mechanization has become inevitable for augmenting agricultural production and achieving the steady growth in agriculture in synchronization with population growth. Increasing shortage of agricultural labours also necessitates availability of agricultural machinery at right time and at an affordable cost to farmers. Further, utilization of appropriate farm machinery reduces the unit cost of production through enhanced input use efficiency and their judicious use. The farm mechanization necessitates substantial investment on farm power sources and implements which is neither essential nor feasible for small and marginal farmers, who constitute over 80% of the total farm holdings in India. In this situation, custom hiring of agricultural machinery appears to be logical and most appropriate best institutional intervention pushed forward in recent years.

Key words: Agricultural machinery, Custom hiring, Farm Meachanization, Small-marginal farmers

THE Directorate of Agricultural Engineering, Government of Madhya Pradesh has made an attempt to develop a business model to accelerate setting up of enterprises which would facilitate availability of agricultural machinery to farmers at an affordable cost. The Directorate has made the partnership with custom hiring in private sector, with the help of financial assistance from Ministry of Agriculture and Farmers' Welfare, Government of India under Sub-Mission on Agricultural Mechanisation and other welfare schemes for establishing custom hiring centres. For the first time, ICAR-CIAE as the knowledge partner to the The Directorate of Agricultural Engineering, Government of Madhya Pradesh acted as the nodal agency for this programme ensuring transparent selection of the entrepreneurs, coordinating with financial and training institutions and releasing the back-end subsidy to the selected entrepreneurs. Public sector and cooperative banks extended financial assistance in the form of bank loan and the training and capacity building, development of basic skills and expertise on operation and maintenance of farm implements and development of business skills was developed to the entrepreneurs by ICAR-CIAE. During 2012-13 to 2017-18, a total of 1,153 custom hiring entrepreneurs were trained at ICAR-CIAE.

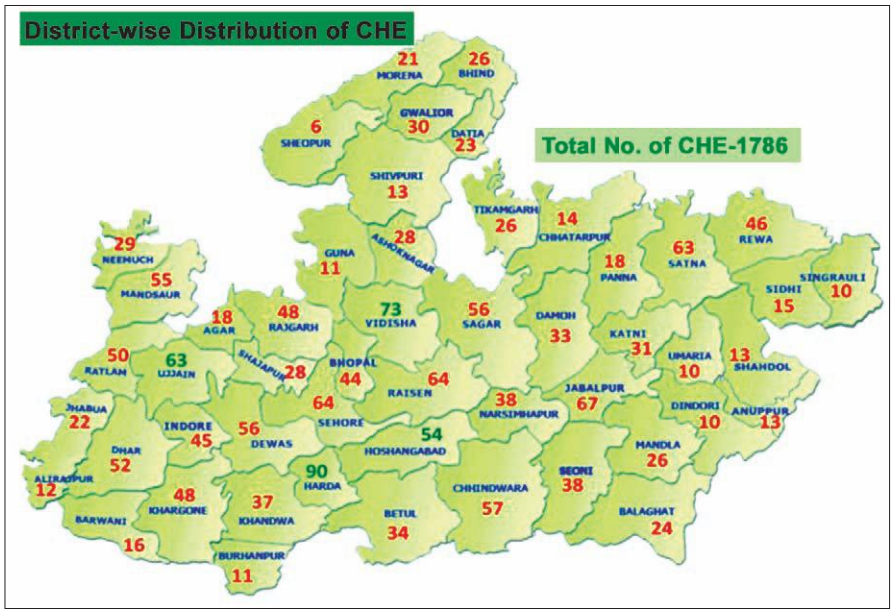
The trend towards over-capitalisation in agriculture and the increasing cost of production are becoming the new challenges for competitive production. The basic requirement to meet this competition is to reduce the unit cost of production and maximize resource productivity which depends greatly on the availability and judicious use of mechanization means by the farmers. Custom Hiring of Agricultural Machinery is one of the best institutional innovations established in recent years as a panacea for all these problems. Pace of mechanization of agriculture in Madhya Pradesh has not been at par with the developed states like Punjab and Haryana. To increase the availability and adoption of agricultural machines and thereby increase the level of mechanization, 'Custom hiring model and skill development for improving farm mechanization level in Madhya Pradesh', in association with Directorate of Agricultural Engineering, Govt. of Madhya Pradesh, was launched to help the farmers to raise the farm productivity through custom hiring of machines and introduction of improved farm machinery and equipment.

The model

To ensure that the benefits of the mechanization aptly reach the

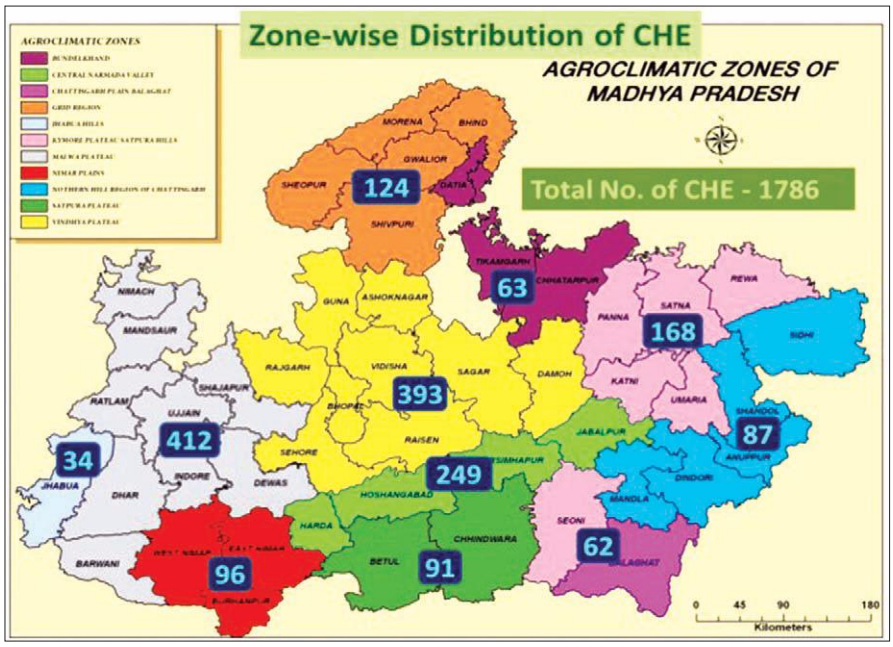
farmers, it is vital to make appropriate machines accessible to the farmers along with professional services at affordable cost and time. One of the ways of doing so is creation of bank of high capacity – high efficiency machines along with suitable prime mover and then making them available to farmers with trained operator. Selection of machines vis-à-vis utility, demand, cost and market availability is vital and so is awareness about operation, adjustment, repair and maintenance for optimal performance of machinery. ICAR-CIAE, Bhopal already engaged in development of machines and protocols for different farming operations, besides a two pronged approach – developing skills in farm-machinery management and creating awareness of availability of machines across the country – was implemented in collaboration with Directorate of Agricultural Engineering, Government of Madhya Pradesh.

While implementing the custom hiring model and skill development for improving farm mechanization level in Madhya Pradesh, entrepreneurs were given 1-2 weeks training at CIAE, Bhopal by scientists and technical officers, who educated them about the usage and benefits of advanced agricultural techniques. These trainings were provided without any gender bias. The skill development programme included classroom field practical sessions (20% classroom and 80% practical) and exposure visits to other organizations. Each programme essentially included exposure to all the agricultural machines required for carrying out tillage operations, seedbed preparation, sowing-planting and transplanting, weeding & plant protection, harvesting, threshing, straw management and selected post-harvest operations, besides technically correct and safe operation of tractors and its maintenance. Thus, a number of Technological Agents of Farm Machinery have been produced through this model.



solutions to small farm holders who cannot afford to have their own machines, and that way to increase the mechanization of agriculture in the state. In order to ensure the availability of complete package of farm machines to the small farmers, the scheme has been introduced with certain measures as following:

- Eligibility: Persons below 40 years of age belonging to all categories. An applicant must be a graduate. (Preference to Agricultural Graduates).
- Custom hiring centres costing ₹ 10–25 lakh
- Subsidy: 40-50 percent subsidy upto to maximum ₹ 10 lakh. Subsidy only on loans obtained from banks. "Back Ended Subsidy" (4-years lock-in period).
- Each unit should have at least one tractor, plough, rotavator, cultivator, disc harrow, seed-cum-fert drill and one thresher. Besides, selection of other suitable implements can be made on the basis of additional area and crops.
- Under the scheme tractors of 35 to 55 horsepower can be obtained.
- A centre will have to give tractor and agricultural implements on custom hiring for minimum ten years.
- Even if bank loan is repaid within this period, custom hiring services will have to be provided to farmers up to stipulated period. Sanctioned



Scheme details

The scheme has been introduced for providing mechanization

loan will be recovered in maximum 9 years.

During 2012-13 to 2016-17, 1786 enterprises have been established, out of which 55% (986 participants) were trained at ICAR-CIAE.

Out of those participants who have established and running there custom hiring centres for more than a year (Sample size 110 entrepreneurs and 330 beneficiary farmers) were surveyed through personal visit. The data collected from various custom hiring enterprises and famers broadly include the financial details of the enterprise, machines owned, crops and operations for which custom hiring services being offered, custom hiring rates etc. and feedback, future requirements and constraints faced by entrepreneurs and farmers both.

Overall business-service scenario of custom hiring centres

Data from Custom hiring service centres was also collected for profitability and the services they are providing in terms of area coverage and number of families being served, which has been summarized as below in Table 1.

Table 1. Profitability from CHC.

Particulars	Annual Profit (₹ Lakh)	No. of Families Served	Area Covered-Annual (ha)
Average	2.50	103	153.2
Min.*	0.40	6	20.0
Max.	7.00	400	414.0

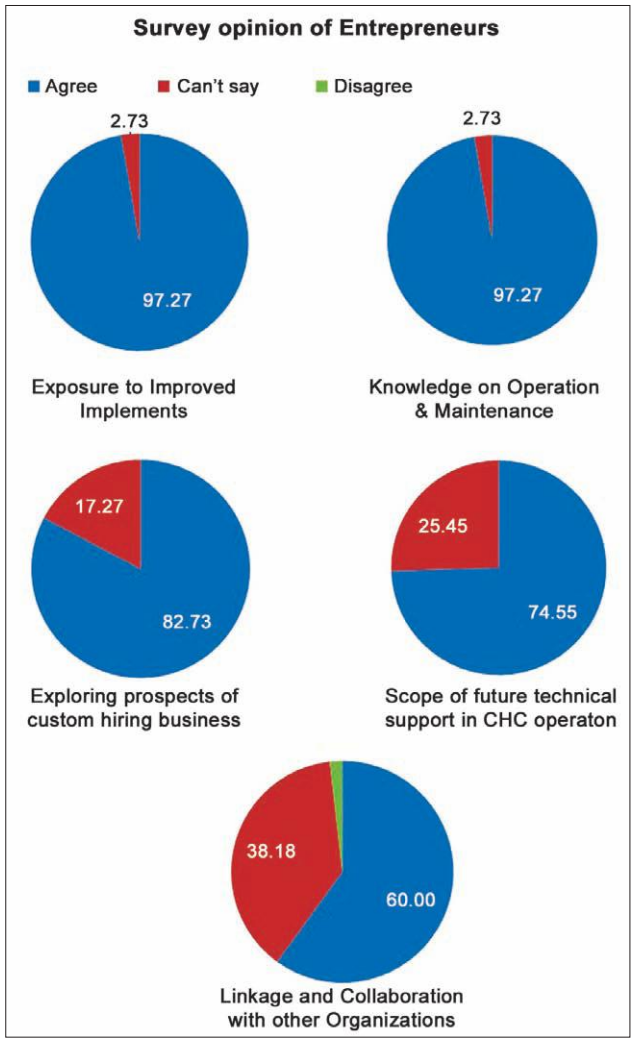
*Exceptional cases.

Constraints faced by entrepreneurs

During survey, opinion of the entrepreneurs was also collected for the constraints being faced by them. The analysis of the same is given below.

i. **Availability of repair-maintenance facility:** 65.5% told that adequate repair and maintenance facility was available in their area for the machines available with them. While, 33.6% showed concern about timely availability of the facility even when adequate Repair-Maintenance facilities are available within the vicinity.

ii. **Delay in payment:** This has been observed as the biggest constraint, as almost 90% entrepreneurs told that they worked on credit basis and sometimes they received the payment from season to season. Only 10.9% didn't have any problem related to payments from the farmers.



iii. **Availability of driver/operator:** Approx. 28% entrepreneurs are facing problem in availability of experienced operator. 72% didn't face any problem in this matter.

Benefits of training at ICAR-CIAE, as perceived by entrepreneurs

The entrepreneurs trained at CIAE also shared their opinion about the way they have been benefited with training at ICAR-CIAE.

- 97% custom hiring entrepreneurs said that they got wide exposure to advanced agricultural machinery during the training at ICAR-CIAE which has been immensely helpful to them in selection of quality machines for their enterprise and also for future planning and expansion
- As far as knowledge on optimal operation and maintenance of machinery is concerned, 97% said that because of the practical knowledge and tips they got during the training, they have been able to minimize the operational expenses.
- 82% entrepreneurs also agreed that they learned about the further prospects in the field of custom hiring so as to maximize the annual use of machinery being owned by them and increase the profitability.
- 75% entrepreneurs are willing to receive support and guidance from ICAR-CIAE, in future too on technical aspects.
- 60% entrepreneurs realized that the training at ICAR-CIAE has also been helpful for them in developing linkages and collaboration.

Benefits to farmers

Besides survey of entrepreneurs, the associated/client farmers, who have been availing the custom hiring services form the entrepreneurs were also surveyed for the benefits realized from them. A total of 330 farmers (3-4 farmers associated with each entrepreneur) were interviewed and it was observed that the small farmers have been getting the machines for various operations timely from these entrepreneurs, which has precisely been the objective of the scheme i.e.

Table 2. Landholding wise client farmers

Marginal (< 1 ha)	10.8%
Small (1-2 ha)	21.0%
Semi-medium (2-4 ha)	26.9%
Medium (4 - 10 ha)	28.7%
Large (> 10 ha)	12.6%

to ensure the availability of complete package of farm machines to the small farmers. About 32% farmers availing the facility are those who have a loan holding of 1-2 ha only. Land holding wise distribution of farmers availing custom hiring services is tabulated below in Table 2.

Client farmers' opinion about benefits: The opinion of farmers was collected about the following:

- Increase in production
- Saving in input
- Saving in time
- Reduction in losses
- Reduction in cost of production

Data collected from client farmers during survey have been analysed and tabulated in Table 3.

Due to increased mechanization level and easy availability of improved machinery through custom hiring entrepreneurship, even small farmers are now getting encouraged to replace their traditional and time consuming farming practices with improved and mechanized protocols.

Outcome

Until so far, the growth of these custom hiring centres has not only contributed in increasing farm productivity but also in improving rural employment generation. It is raising the self-esteem of the youths associated with it and discouraging the rural migration as well. On the basis of a survey of farmers hiring various machines, major impact of "Custom Hiring Entrepreneurship Development" scheme on farmers and farming practices in Madhya Pradesh are as following:

Entrepreneurship

The entrepreneurs belonged to the age group of 22-40 years with graduates in any discipline as educational qualification. The investment made on custom hiring centre was ranged from 10 to 25 lakhs, inclusive of 40 to 50% subsidy (maximum ₹ 10 lakh) provided as Back Ended Subsidy with 4-years lock-in period. This investment was made to procure at least one tractor, plough, rotavator, cultivator, seed drill or seed-cum-fertiliser drill, thresher and trolley. Besides, procurement of other suitable implements can be made for other farm operations like harvesting and residue management. The aim of this entrepreneurship development programme was to cater the mechanization needs of small farm holders who cannot afford to have their own machines as well as to increase the mechanization of agriculture in the state. The skill development programme included classroom as well as field practical sessions (20% classroom and 80% practical) and exposure visits to other organizations. Each programme essentially included exposure to all the agricultural machines required for carrying out various operations from tillage to post-harvest operations, besides technically correct and safe operation of tractors and its maintenance.

Till the end of 2014-15, a total of 413 aspiring custom hiring were trained and subsequently established their custom hiring centres in different villages across the state of Madhya Pradesh. Based on a sample survey conducted on a randomly drawn sample of 81 entrepreneurs and their 232 client farmers, it was observed that on an average, the entrepreneurs were earning a net profit of ₹ 2.51 lakhs from the business by serving 103 customers per year covering an area of 153.2 hectare per annum. The custom hiring entrepreneurs also generated an average employment of 1455 man-hours (equivalent to 182 man-days) per enterprise by hiring operators for their machinery either on daily wage or monthly salary basis.

The client Success Stories of Custom Hiring Centres of Agricultural Machinery, M.P. farmers opined that the total production in their farms was increased by about 26% due to higher area coverage within the critical time available for farm operations, better uniformity in operation and greater input use efficiency due to mechanization (Table 4). At the same time, the losses in quantity and quality of output were also observed to be reduced by about 21% due to timeliness especially in harvesting, threshing and transport operations. They unanimously agreed that the

Table 3. Increase in average productivity of major crops

Major crops for which custom hiring services utilized	Average yield of crop before intervention (kg/ha)#	Average yield/expected yield after intervention (kg/ha)#
Soybean	Soybean – 1450	Soybean – 2580
Wheat	Wheat – 2800	Wheat – 4600
Gram	Gram – 1110	Gram – 2025
Paddy	Paddy – 1950	Paddy – 3500
Pulses & Lentil*	Lentil – 620	Lentil – 1460

*Contributed to significant increase in Cropping Intensity as Pulses family crops (Black gram, Green Gram etc.) are being taken as Third Crop in many areas, which could become possible only because of Increase in Mechanization Level.
#*Source:* Data made available by Directorate of Ag. Engg., Govt. of Madhya Pradesh

Mandatory Machinery

- Tractor
- Plough
- Rotavator
- Cultivator
- Seed Drill/Seed-cum-Fertilizer Drill
- Thresher
- Trolley

Table 4. Farmers' opinions on CHC Benefits.

Values (%)	Production	Losses	Input	Time	Cost
AVG	26.1	21.1	28.4	51.0	33.2
Max	40.0	50.0	60.0	80.0	50.0
Min	10.0	0.0	5.0	15.0	15.0

saving of time during the critical period was the most crucial benefit of farm mechanization, particularly in unfavourable climatic conditions. They claimed that the problem of unavailability of casual farm labourers during peak period of cultivation coupled with exorbitantly rise in wages for farm labourers resulting into escalation of cost of farm operations, can only be addressed by mechanization of farm operations. As a result, a saving of about 33% in cost of operation has been realized by them.

The entrepreneurs trained at CIAE also shared their opinion about the way they have been benefited with training at ICAR-CIAE. About 97% of the custom hiring entrepreneurs said that they got wide exposure to advanced agricultural machinery during the training at ICAR-CIAE which was immensely helpful to them in selection of quality machines for their enterprises and also for future planning and expansion. They were of the opinion that the practical knowledge on appropriate operation and maintenance of machinery provided during the training at ICAR-CIAE also enabled them to minimize the machine break-down and increase the service life. About 83% of them also agreed that they learned about the further prospects in the field of custom hiring which may be helpful for them to adopt larger machinery. Keeping high expectations on ICAR-CIAE for technical support and guidance, about 75% of the entrepreneurs were willing to seek alliance and cooperation on technical aspects from this institute in future also. At the same time, 60% of the entrepreneurs realized that the training at ICAR-CIAE was also helpful for them in developing linkages and collaboration with other government departments and agencies. Overall, they found that the training imparted at ICAR-CIAE, Bhopal was immense helpful to shape their maiden venture in the field of custom hiring services of agricultural machinery.

Table 5. Year wise detail of Trained Entrepreneurs and their establishment

Year	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	Total
Trained	240	173	295	251	194	213	1366
Established Centres	219	146	277	238	172	191	1243

Business Economics of Custom Hiring Centre

- Age Group of the entrepreneurs = 22-40 years
- Investment made on machinery = ₹ 10-25 lakhs
- Back-end Subsidy = 40%–50% (Max. 10 lakhs)
- Lock-in period = 4 years
- Average annual net income = ₹ 2.51 lakhs
- Average number of farmers served annually = 103
- Average area covered / annum = 153.2 hectare
- Employment generated / annum = 182 man-days.

A Typical Package for Custom Hiring Centre

- Tractor 50 to 60 hp
- Reversible Moldboard plough (2-3 bottom)
- Tractor drawn cultivator (11 tyne)
- Tractor operated rotavator (2 m width)
- Tractor front mounted leveler
- Seed-cum-fertilizer drill (11 rows)
- High capacity multi-crop thresher
- Combine harvester (14 feet)
- Straw reaper
- Tractor drawn trolley

Economic Advantage of Mechanization (%)

- Increase in Productivity 12-34
- Saving in Seeds 20
- Saving in Fertilizers 15
- Enhancement in cropping intensity 5-22
- Increase in grass income of farmer 29-40

Total 1366 Entrepreneurs have been trained by ICAR-CIAE, Bhopal and more than 1240 have been established Custom Hiring Enterprises (Table 5).

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Need to harness youth's potential to end hunger

FAO Director-General speaks at World Youth Forum

16 December 2019. "Youth face immense challenges, reason why it is imperative to scale up youth-focused initiatives and harness their potential to reach the UN Sustainable Development Goal 2." This was FAO Director-General QU Dongyu's main message at a panel on food security in Africa at the World Youth Forum.

"We live in a challenging time," said the FAO Director-General.

Qu went on to highlight the challenges young people in Africa and Middle East are grapping with — rising hunger and malnutrition, uptake of increasingly unhealthy diets, lack of stable jobs and income opportunities, climate change, water scarcity, and in some countries, conflict.

"But we must not feel discouraged by these challenges. There are more solutions than challenges," said the FAO chief.

"We need the energy and potential of young people to achieve rural transformation, and achieve the Sustainable Development Goal (SDG) 2," added Qu.

Failing to achieve SDG2 places reaching all SDGs at risk, stressed Qu.

Making the most of innovation, digital technology, investments, encouraging youth's greater appreciation of sustainable and healthy food systems and enhanced policies are some of the solutions mentioned by the FAO Director-General.

To this end, Qu also presented FAO's recently announced Hand-in-Hand initiative, which seeks to match donors and recipients in a more targeted way to assist the most vulnerable people and help to achieve the SDGs.

Courtesy : http://www.fao.org/news

Indian Farming **70**(01): 23–25; January 2020

Agri Business Incubation Centre

at ICAR-NINFET

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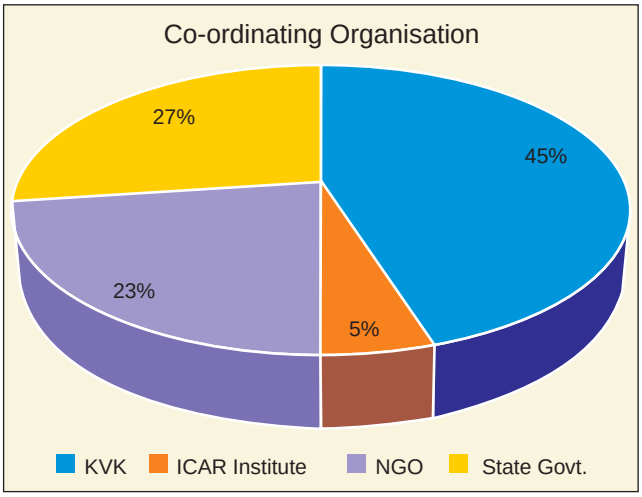
India is one of the important suppliers of Agri-Business products including handicrafts items to the world market. The Indian Agri-Business industry is highly labour intensive farm and cottage based industry and decentralized, being spread not only in the eastern part, but all over the country in rural and urban areas. Numerous entrepreneurs /artisans are engaged in crafts working on full-time and part-time basis. The industry provides employment to over six million artisans, which include a large number of women and people belonging to the weaker sections of the society. In addition to the high potential for employment, the sector is economically important from the point of low capital investment, high ratio of value addition, and high potential for export and foreign exchange earnings for the country. Located in the gate way to the entire eastern India, West Bengal specially Kolkata and suburbs is considerably having great opportunity to create and extend business opportunity. Located in the transit place on the way to Bangladesh and Nepal, Kolkata is bordering with Jharkhand, Orissa, and Uttar Pradesh. Thus, people from various cultures gather over here for many purposes. From the angle of exporting the agri-business products including handicraft items to other countries also, the place has also been considered viable.

Key words: Agri-business products, Artisans, Handicrafts, Handlooms

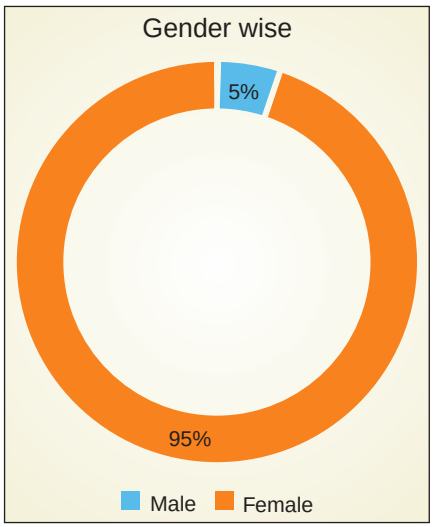
ICAR-NINFET (erstwhile ICAR-NIRJAFT) is unique of its kind in India as no other institute in Public sector or private sector is involved in R&D activities related to natural fibre specially lignocellulose fibres and its byproducts. Hence the products and technologies developed in this institute have high potentiality of generating business. The institute has both scientific manpower to provide all scientific, technical support and consultancy related to the technology commercialization and highly skilled technical manpower to provide operational facilities of pilot plant and laboratory.

The journey of ICAR-NINFET (erstwhile ICAR-NIRJAFT) in the area of Agri Business Incubation started with sanction of World Bank sponsored BPD project under NAIP Component I and with the launching workshop on 14th August 2009. ICAR-NINFET is one of the first five ICAR institutes where BPD project was launched. Enormous experience was gained in ABI during the execution of NAIP-BPD project and commercialization of technologies. Setting up of BPD unit at NINFET has helped in setting up different facilities and performing different activities for agribusiness and its incubation. Establishment of pilot plant was successfully made to provide pilot/lab scale production facilities of jute stick particle board, handmade paper and decorative jute fabric to the registered incubates. Business Incubation Centre of total 335 sq. mt. carpet areas were established to provide fully furnished, air conditioned office space to 13 incubates at a time with facility of internet, fax and xerox. In addition to all these NINFET has well equipped pilot plant spinning mill with machine, which are scares in jute mill, training and farmers' hostel for accommodation of 40 persons at a time, conference room, meeting room, air conditioned dining hall for 200 persons, which are rented to incubates at a reasonable charge. Since many of the technologies developed at NINFET are for the benefit of small scale and cottage industry, small and marginal farmers and rural artisans, we are constantly doing our efforts to find out suitable entrepreneurs who are really interested to establish manufacturing units specially at village level.

Handicrafts and handlooms are two such industries in India that have their special identity. With a mode of expressing one's mind, soul, traditions and modern outlook, these two industries have created magic all over the world. The variety and expertise of handicrafts speaks



Coordinating organisations of training programmes.



Gender of trainee participants.

23% and ICAR Institute – 5%. It clearly shows the accessibility of trainees through Krishi Vigyan Kendra. Ninety five percent (95%) of the trainees are female showing that more and more female are interested in taking up entrepreneurship in jute handicraft sector.

through pottery, metal work, different fibre based products, jewelry, wooden art, marble or stone work, handmade paper items, toys etc. On the other hand, the glory of handloom industry can be stated in the form of designer clothes with a variety in fabric, printing styles, designs, patterns and specialized embroideries. In fact, almost every state in India has their own style of handicrafts and handlooms to boast their distinctiveness.

During last four years, ABI, NINFET conducted a number of Institute-industry meet, Agri-investors meet for technology transfer and fund mobilisation through signing of MOU and MOA of NIRJAFT technologies. Promotion of entrepreneurship by providing hands on training in well equipped "jute diversified product manufacturing" laboratory as well as consultancy services to stakeholders including women and unemployed youths has become a regular activity. Outreach training programs on the manufacture of jute and some other natural fiber (viz. banana, pineapple and yak fibre) based diversified product has been conducted in West Bengal and other eastern and north eastern states.

The trainings organised were coordinated through various government and non-government organizations. The trend shows that, highest percentage (45%) were organised by the Krishi Vigyan Kendra's (KVKs) followed by State Government – 27%; Non-Government Organizations (NGO) -

ABI NINFET has got a very good success in micro entrepreneurship development through establishment of value chain in jute based handicraft manufacture where a large group of village people, especially women, who have easy access to the raw jute fibre, converts the raw fibre into 'braids'. These breads in raw form or after value addition through bleaching and dyeing is used by another group of people (artisans) who do not either have the easy access to jute fibre or having better skill than making breads, to produce finished beautiful handicraft item like table and floor mats, pen stand, decorative carry bags, rakhi, dolls, different models, hats and numerous other item. These handicrafts are marketed by these artisans in different fairs or supplied to different agencies that have their own marketing channel.

ABI-NINFET is constantly working to create new group of artisans through hands-on training not only on handicraft but also other products like jute based bags, file, folders, slippers, ornaments, specialty garments, handmade paper and paper items, bleaching and dyeing and supporting them after completion of training through supply of raw materials (jute yarn and braids – natural, bleached and colored, decorative and ornamental fabric etc.) through a 'raw material bank' set up for the purpose, providing information and help to participate in different fairs, and limited support of marketing through its 'Product Display cum Sales Counter'. During last four years ABI-NINFET has provided free of cost training to 440 number of unemployed women (419) and youth (21) and supported more than 231 artisans with raw materials worth ₹ 4.5 lakh from its raw material bank. Total revenue generated during these four years is approx. ₹ 27.52 lakhs.

ABI-NINFET has also stressed on the development of entrepreneurs in the area of jute and some other fibre based decorative and ornamental fabric production in handloom and its product. We are regularly supplying unique jute based fabrics from our pilot plant to our incubates and also guiding them with supply of new designs to produce different types of bags, file folders, slippers, dress materials including sarees etc. Thus the endeavour towards the establishment of small and micro entrepreneurship lead to different success stories.

Few Success stories

Success Story 1

ICAR-NINFET has provided advanced training on Jute and Handicrafts to Smt. Smita Mitra, proprietor of M/s. SMITA HANDICRAFTS. After receiving the training, she became a member of ABI and a Start-up under the ICAR-NINFET. She has become a regular master trainer of NINFET and NJB (National Jute Board). She is receiving all the specific and specialized raw materials from the Raw Material Bank of ICAR-NINFET from time to time. This year

Products prepared by M/s Smita Handicrafts.

Bag prepared by M/s. Quality Exports supplied to Bihar Agricultural University.

(2019) she has received an order through ICAR-NINFET for making 250 pieces of jute dolls, 200 pieces of jute coaster, 100 pieces of hanging chain and other decorative items from the organizer of Durgotsab Committee, Tollygunge, Kolkata, to decorate the Puja Pandals of Durga Puja. The theme of the Puja is to create awareness of utilizing natural products in our daily life. She is employing around 40 women artisans of SHG groups from Village Bargachia, Howrah District; Village Canning, Piyali and Sonakhali from South 24-Parganas District. These artisans have also received the training from ICAR-NINFET and now living their livelihood with this occupation.

Success Story 2

Mr. Sumantra Roy, MD, M/s. Quality Exports, one of our Incubatees, has become a member of ABI NINFET on 03/08/2018 and hired an office space in BIC NINFET on 02/11/2018. He is manufacturing jute bags of different design. Since August 2018 he has made business of approx. ₹ 55.0 lakhs with a net profit of around ₹ 11.0 lakhs and created around 3,100 man days of skilled labour. Recently ABI NINFET has helped him to get an order of 850 Jute conference bags which he has supplied to Bihar Agricultural University, Sabour, Bhagalpur for International Conference for a total order value is ₹ 3,27,500/- (pre GST). ABI NINFET provided the design of bag and arranged specially designed Juco and Jute canvas fabric, from its pilot plant facilities to manufacture these bags. The fabric was not available anywhere in the market and without this active support of ABI, they could not have executed this order.

Preetilata Jute Manufacturing (REH) Industrial Co-Operative Society Ltd. products displayed in Sabala Mela, Kolkata.

Success Story 3

Mrs. Sabita Paul Roy, Secretary, Preetilata Jute Manufacturing (REH) Industrial Co-Operative Society Ltd. has taken training programme on Manufacture of Jute Handicrafts from ICAR-NINFET along with 20 other village women. She has formed a co-operative Society with them and they are engaged with production of jute handicrafts and bags. After receiving the training all of the members of the Society have registered themselves under Udyog Adhar Registration under Ministry of Micro, Small and Medium Enterprises. They have participated at least 6 Exhibition cum Mela at various parts of West Bengal. Recently they have also participated Sabala Mela at Karunamoyee Area of Salt Lake, Kolkata during 29th November to 8th December, 2019.

Conclusion

ABI, ICAR-NINFET is playing a pivotal role in developing entrepreneurship through hands-on training programmes on "Jute based diversified products", viz. handicrafts, bags, ornaments and hand-made paper. These programme are gaining popularity among the rural mass particularly the women community. The required facilities i.e. raw material supply and market linkage are also provided by ABI NINFET for the sustenance as well as growth of the entrepreneurs.

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Rise of a New Era:

Strengthening of Indian Agriculture by Virtue of Agribusiness Incubation

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Agriculture is considered as a noble profession in our country since ages. The farming activity had always been enterprising by its nature of providing a scope for innovation in terms of practices adopted or the resources used. Agricultural research and innovation had been making its mark since many years before the formal establishment of agricultural research system in the country. Since green revolution, it has taken its rapid pace and made India self-sufficient in food production. At the same time, many problems and challenges have also arisen that need serious attention i.e., soil degradation, agricultural waste, less availability of water for irrigation, post-harvest losses and many others.

Key words: Agribusiness, Internet of things, Pusa Krishi Incubator, Startup India Portal

AGRIPRENEURSHIP is an important link in converging various disciplines into agriculture, bringing out solutions to its troubling challenges and make them reach to its users. Only 16.8 % founders of agri based startups belong to agriculture and allied sciences as their core discipline of qualification. This figure highlights the importance of agribusiness incubators in two ways i.e. strong guidance to the founders regarding minute details of agribusiness and orienting agricultural students towards agripreneurship. These startups generate fabulous technologies that have great applications in agriculture. But at the same time, they lack expertise in the way it should be applied to overcome the challenges of Indian agriculture. An agribusiness incubator is the place that provides every support to nurture these startups to make their idea a viable business entity. As per the data obtained from Startup India website, there are 456 incubators registered in our country out of which 100 provides business incubation in agriculture and allied areas.

ICAR-IARI has taken steps in establishing its tech transfer office 'Zonal Technology Management Unit' in 2009 with the support of ICAR. In 2014, coupled with ICAR's ambitious National Agricultural Innovation Project (NAIP), a foundation for agribusiness incubation was laid and the unit was renamed as 'Zonal Technology Management and Business Planning & Development Unit'. The unit operates as IP management and tech transfer office at the Institute level and hand holding unit for other ICAR institutes at the zonal level. At the same time, it works as an incubation facility for nurturing ideas into commercially viable start-ups.

To give impetus to innovative research and its applications, in 2017, ICAR launched its new scheme National Agriculture Innovation Fund (NAIF) and created incubation fund under the same. Simultaneously after gaining a good experience and crossing some milestones, the unit has become a DST supported Technology Business Incubator (TBI) in 2018. In the same year it has made its mark by becoming Knowledge Partner (KP) in DAC&FW's ambitious scheme 'Rashtriya Krishi Vikas Yojana-Remunerative Approaches for Agriculture and Allied Sector Rejuvenation's (RKVY-RAFTAAR) Innovation and Agri Entrepreneurship Cell'. 'Pusa Taksay Society' has been registered with the Registrar of Societies, New Delhi and is progressing on the way of shifting all of its agribusiness incubation activities under it by making it a one stop solution for startups. The incubator was named as 'Pusa Krishi Incubator (PKI)' by continuing the 114 years of IARI's legacy. The unit has been in a close connection with various government wings i.e., DAC & FW, Ministry of MSME, Technology Development Board, various embassies and few international organisations. Its long association with industry giants also supports its startups to pilot, network

and be guided in their venturesome journeys. Currently, the unit operates under three verticals i.e., IP Management, Technology Commercialization and Agribusiness Incubation.

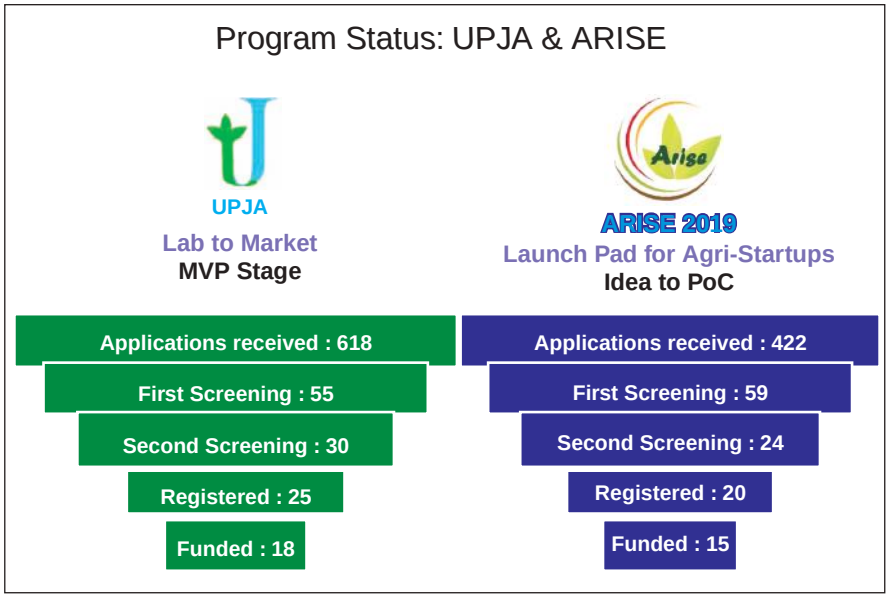
Agribusiness incubation and acceleration programs

The unit operates through a foray of incubation and acceleration programs under which it nurtures agri startups to reach to new heights. To streamline all of its incubation and acceleration related activities, the unit formulated 'Pusa Krishi Incubator' in 2019.

Focus area for incubation: Under its various programs, it supports startups under the mentioned thrust areas:

- Farm mechanization
- Biotechnology and bioinformatics
- Post-harvest processing and food technology
- Agricultural inputs
- Agri and food supply chain
- Natural resource management
- Precision farming, artificial intelligence and machine learning
- Internet of Things (IoT) and Information and Communication Technology (ICT) in Agriculture
- Agri allied areas

Facilities provided to the incubates: The unit has so far worked with 100 incubates under its various programs and assisted them with a plethora of services and guidance. A brief checklist of the support provided is given in Table 1.



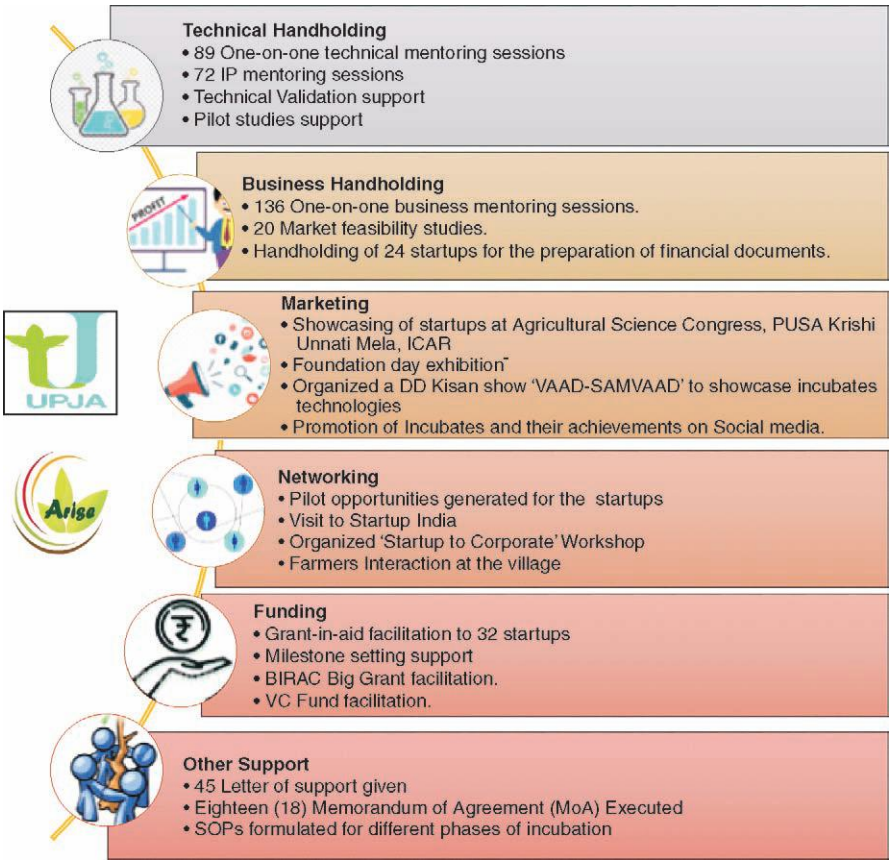
Selection Funnel for the programs 'UPJA' and 'ARISE'.

Modus Operandi of PUSA Krishi Incubator

- **Selection process:** The Incubation or Acceleration Programs are carefully curated at PKI with a stringent selection process. Whenever the call is made open for entrepreneurs to apply for a particular program, the applications are being invited on various online forums i.e. Startup India Portal, F6S, Incubator's website and offline. The received applications are then screened on the basis of their technical feasibility and business potential. The incubator has a huge network of scientists and business evaluators that evaluate the applications. After first screening, the qualified entrepreneurs based upon the order of merit are being called for second round of the selection process. In this round they are being asked to make presentation of their offering with its detailed information in front of the selection panel. The panel evaluates every detail of the technology, financials and team of the startups and selects few. These selected startups then become the incubates of PKI under that particular program.
- **Incubation process:** The selected startups are then being facilitated with either letter of support or MoA depending upon the program. The startups then undergo a compulsory incubation/acceleration workshop whose duration may range from seven days to two months as per the program. These workshops comprise of detailed one-on-one mentoring sessions with technical and business mentors, expert lectures, interactions with farmers, industry giants, policy makers and regulatory machinery. The composition of the workshops and relative intensity of its various facets vary as per the batch's requirement and stage of development. The mentoring sessions are need and milestone based and are being conducted on each and every aspect of a business i.e. Intellectual Property (IP), Marketing and Distribution, Finance, Valuation and Business

Table 1. Support pillars of Pusa Krishi Incubator comprising provision of services to incubates

Infrastructure support	Technical support	Business support
• Incubation Office space	• Technology Commercialization	• Pre-incubation consultation
• Training Room	• Technology Development	• B Plan Development facilitation
• Meeting Room	• Technology Validation and Field Trials	• Training to develop business skills
• Conference Room		• Business Mentoring
• Internet and communication facility	• Technology Upscaling	• Secretarial Services
• Video conferencing facility	• Technical Mentoring and Backstopping	• Market Assessment/ research
• Well equipped Laboratories: Biotechnology, Tissue Culture and PHT	• Agripreneurship Development Programs (ADPs)	• IP Services
		• Fund Facilitation
		• Assistance in running market feasibility and financial feasibility studies
		• Fund Facilitation

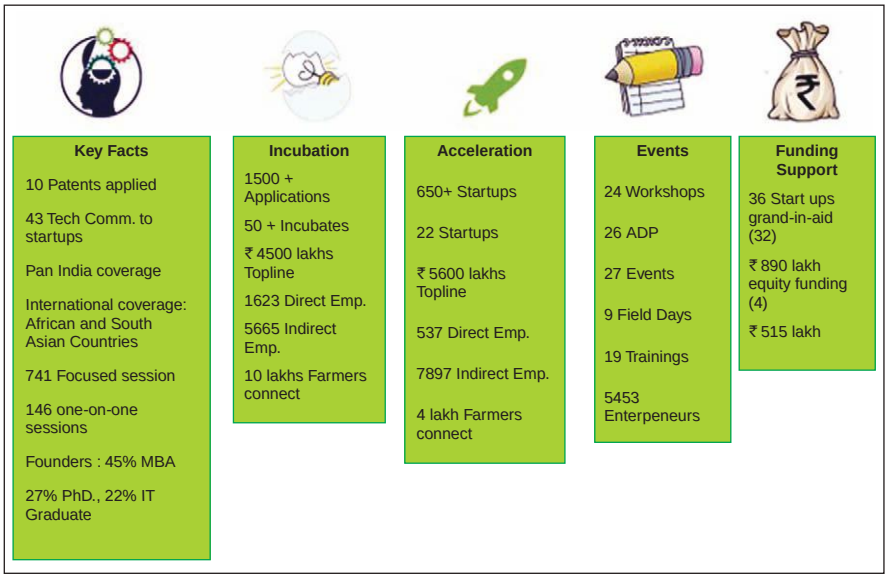


Key achievements of 'UPJA' and 'ARISE'.

Modelling. After the workshop either they are being incubated for asset duration of time or they are virtually associated with a curated mentoring process for the set duration or till fund facilitation.

Current programs: Currently the Incubator is running four programs for its different clientele as given.

- **SAMARTH - Innovation and Incubation Induction Program:** It is a curated Incubator handholding and capacity building program that is inculcating the values and standards of agribusiness incubation in budding incubators. A total of 28 incubators got benefitted out of it. It has held four carefully designed workshops for Incubator heads, its managers and other professionals. Various sessions on Incubator planning and management, marketing, processes and protocols of incubation, funding and frontier areas have been executed. The discussions with industry specialists and Policy-makers was the highlights of the workshops. Apart from the workshops, handholding of the RAFTAAR Agribusiness Incubators was done by participating in their selection process of startups, developing their processes and protocols and physical visits at their centers.
- **UPJA- Launchpad for Lab to Market:** This is an acceleration program that was designed for the startups that have reached to the stage of making Minimum Viable Product (MVP). These startups have been selected by standard protocol of the incubator as described earlier. The startups belong to various sub-sectors of agriculture including precision farming, mechanization, food processing, biotechnology and allied agricultural activities and thriving to make their technologies reach out to Indian farmers. Under this program, a two months in-residency workshop was conducted and eighteen (18) startups were funded with a grant-in-aid up to 25 Lakh INR. The facts of the selection process is given in figure.
- **ARISE- Launchpad for Agri Startups:** This is an incubation program organized for idea/ prototype stage startups to reach to a level of product development. Arise 2019 also held a two-months in residency workshop and the funding assistance was up to 5 lakh INR to 15 startups. These startups are in the process of developing solutions to change the face of Indian agriculture. The combined key achievements under both the programs are illustrated.
- **MAITRI- Indo-Brazil Agritech Cross Border Incubation Program 2019-20:** It is a cross country agri business incubation program that is being operated in collaboration with Brazilian embassy. To excel the best of talent, technologies and start-ups across both nations, this program aims at promoting innovation in Agri



Key facts of incubation and acceleration programs.

sector to explore synergies across both countries. Under this program, five startups were selected by each country that will supposedly explore the market opportunities in the other country. A 15 days incubation workshop in both of the countries separately was an essential part of the program that introduces the startup ecosystem, various regulatory parameters being followed in that country, insights about the customers, networks, distribution channels etc. The workshop in India has already been conducted and the one-on-one mentoring sessions to refine their business model and other variables as per the Indian situation was the strength of the program.

- **Agripreneurship Development Programs (ADPs):** It is another wing of the incubator that provides entrepreneurial skills on proven technologies to people who don't have an idea to build a venture around. These are fixed duration programs ranging from three to ten day where anyone can participate and learn how to venture in for a particular technology, product or an area. So far, 34 ADPs have been conducted in various areas including IP Management, Seed Production, Soil Science, Agricultural Chemistry, Tissue Culture, Post-Harvest and Food Technology, Biofertilizer formulation, Biopesticides and others and 424 participants got benefitted.

A summary of the key facts of the incubation and acceleration programs is depicted in figure.

Road ahead: The Incubator is creating its mark in the country's journey of taking Indian agriculture to an advanced level by the virtue of agripreneurship. It believes in taking all the stakeholders together and creating a comprehensive value. Hence, it gives immense impetus to make connections by the virtue of various workshops, training programs and dialogue events with corporate, farmers, policymakers and others and will continue with the same in the future. It is going to drive on the roads of developing innovative startups for the most typical challenges of Indian agriculture with full enthusiasm. It will work on bringing the indigenous technologies on the global forum and simultaneously help global technologies to reach to Indian Farmers. The Incubator also holds a vision to strengthen the agribusiness incubation ecosystem by nurturing budding incubators with the help of various stakeholders and it firmly believes that combined efforts of everyone whomsoever associated will make the ecosystem reach to new heights.

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Nurturing Entrepreneurial

Ecosystem through Agri-Business Incubation Activities in Livestock Sector

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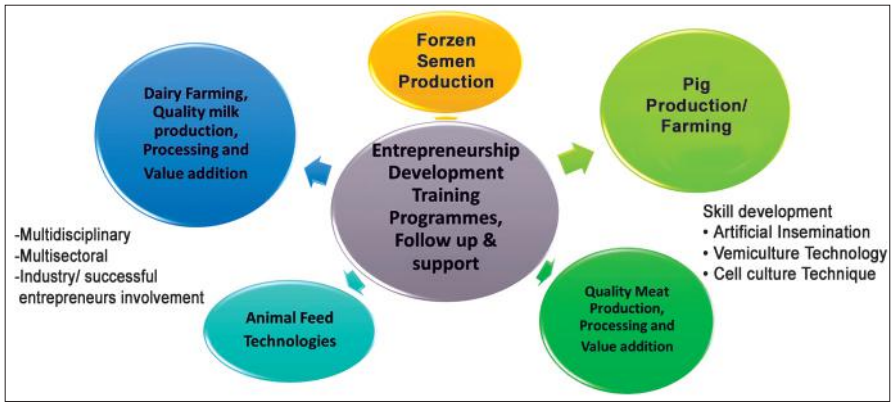
Agri-business Incubation (ABI) centre at ICAR-Indian Veterinary Research Institute, Izatnagar is mandated to create an ecosystem for entrepreneurship development in diverse areas of Animal Science Sector. Entrepreneurship development training programmes (EDPs), Incubation facilities and further follow to create complete value chain is the main focus of ABI at this Institute.

Key words: Agri-business Incubation, Pig-farming, Udyog Aadhar

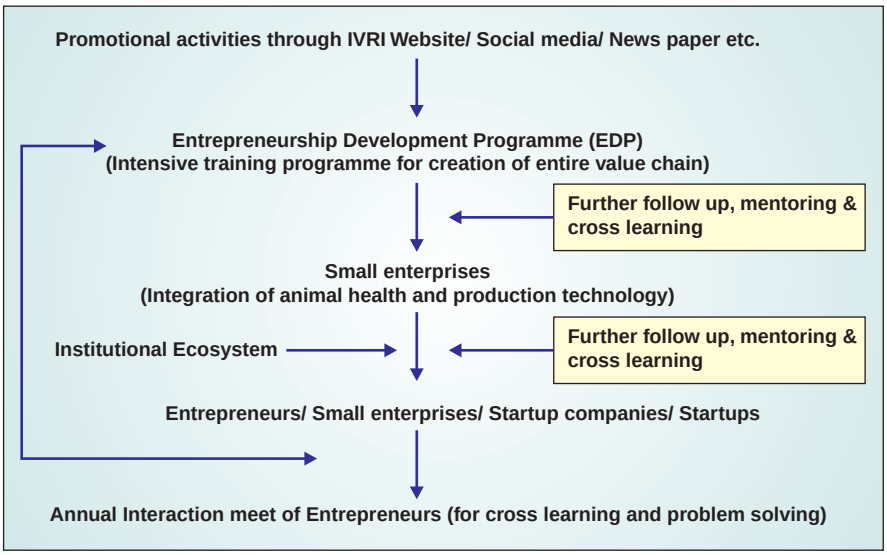
ICAR-INDIAN Veterinary Research Institute Agri-business incubation (ABI) centre is involved in conducting a series of "Entrepreneurship and Skill Development Programmes (EDPs)" with the support of competent resource persons of the Institute, experts from aligned department and successful entrepreneurs. These include EDPs on pig production, quality meat production, meat processing and value addition, frozen semen production, dairy farming and milk processing, vermiculture technologies, animal feed technology, cell culture techniques, virus handling techniques etc. In addition, long term orientation and incubation programmes for need based entrepreneurs and startups in livestock sectors are also being organized. This center is also planning to initiate new programmes as per the need felt in the areas of detailed project report formulations, nurturing entrepreneurs to become successful startups and intellectual property management. Number of entrepreneurs graduated through the EDPs started their own enterprises at a good pace. As a follow-up of all these programmes the ABI center at IVRI provides a platform for interaction to all these entrepreneurs at the end of each financial year in the form of organizing Interactive Meet for entrepreneurs as mega event. The center has already supported to graduate about 335 entrepreneurs in animal science sector from different parts of the country. The center has also strived hard to establish a model to make the ABI activities financially self sustainable through its various activities. As a result Agri-Business Incubation (ABI) Centre generated more than ₹ 20 lakhs as revenue during the last two years exclusively from these activities.

All the EDPs organized by ABI are multidisciplinary, multisectoral in nature and also involve successful entrepreneurs as well as experts from financial institutions for creation of complete value chain in specific domain areas of animal science. Following EDP all the entrepreneurs are mentored by domain experts and also cross-learning within the group and through various various social media networks.

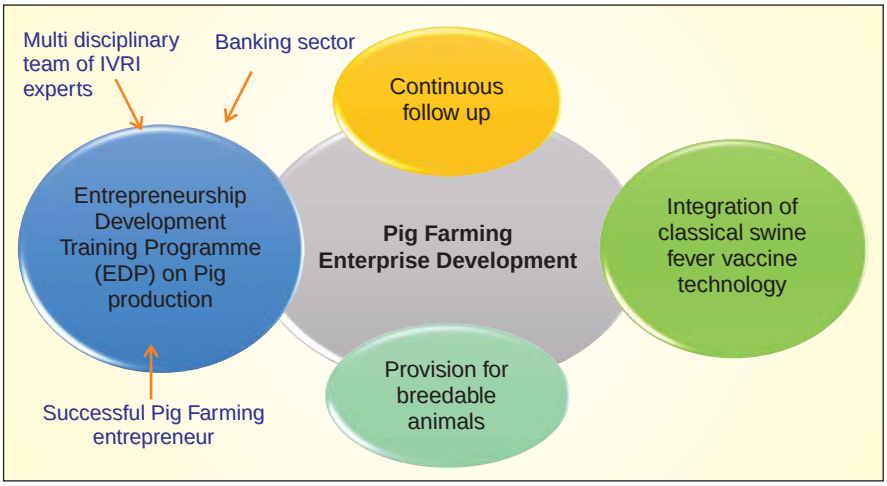
In additions a series of Institute Industry Interface meet have been organized for developing linkages between Academia, Industry and entrepreneurs at various locations of the country. This leverages strength of each other for development of better and vibrant entrepreneurial ecosystem. The prospective



Entrepreneurship Development Training Programmes (EDPs).



IVRI-ABI Model for Entrepreneurship Development.



Model for Pig Farming Enterprise Development under IVRI-ABI.

entrepreneurs in this process get acquainted with commercially viable technologies developed at institute and propagate.

Pig Production

The programmes on "Entrepreneurship Development through Pig Production" cover important topics which includes both theory as well as practical. These include Introduction to pig farming, selection and procurement of best animals stock, housing, management of various categories of pigs, balance feeding, use of unconventional feed and fodder for economic rearing of pigs, male and female reproduction, project proposal for small pig farm, financing, marketing and insurance of pigs. The practicals related to measures to maintain hygiene at pig farm, management and breeding, pig by-products utilization, record keeping, measures to prevent and control the diseases, reproductive disorders in pigs and their remedies, identification systems (tattooing, tagging, marking), routine activities of pig farm, , attending farrowing and management of new born, feeding and management of various categories of pigs (piglets, weaners, growers, gilts, boars, finishers), restraining animals and first aid, preparing and maintaining records so that entrepreneurs can easily perform day to day activities of farm without any hassle are also demonstrated. In addition to domain experts provisions for interactions of entrepreneurs with successful entrepreneurs, banking sector, are also facilitated. Visits to successfully operating pig farms both in private and government sector are also arranged for the participants.

The impact of EDPs was visualized as some of the trained participants started their own work within 30 days of EDP. Continuous technical support has been rendered to these entrepreneurs by Agri-Business Incubation (ABI) Centre and technical experts of IVRI. To provide identity and authenticity to these entrepreneurs registration through Udyog Aadhar (MSME) was encouraged.

Quality meat production, processing and value addition

Entrepreneurship development programme on quality meat production, processing and value addition is another important programme conducted under ABI which attracts lots of participants. The programme covers important topics, viz. entrepreneurship opportunities and overview of meat production and processing in the country , detailed project report for establishment of experimental abattoir, basic tools and equipment of slaughter house and their handling, detailed project report for establishment of meat processing plant and its requirements.Under this programme, topics of practical significance include basic tools and equipment of meat processing pilot plants and their handling, processing of meat for emulsion, enrobed, restructured, cured, smoked, shelf stable, convenient and traditional meat products, establishment of effluent treatment plant and by-product utilization plant, detailed project report for establishing meat quality laboratory, packaging and marketing of meat and meat products, business plan and project report preparation, how to start your own business, organic animal husbandry for quality meat, production of quality meat, cutting, processing and value addition, importance of personal hygiene in meat production and processing etc.

Agri-preneurship Incubation and Orientation programme through RKVY-RAFTAAR ABI scheme

To further promote and transform the entrepreneurial activity into startups GOI, DAC launched a programme RKVY-RAFTAAR to

Pig enterprise development: Success Story of an Entrepreneur

Er Pradeep Kumar, basically a mechanical engineer, started his business in January 2017 and initially undergone huge loss due to lack of proper scientific knowledge in pig farming and management practices. But he never gave up his hope. While searching for the apt solution, he came across one of the EDPs on Pig Production organized at ICAR-IVRI. He enrolled himself in this course organized under ABI scheme of IVRI. In that training programme he learnt about various technical aspects of pig farming along with creation of entire value chain which boosted his confidence to undertake the activity with rejuvenated vigor. He was in touch with various activities conducted at ICAR-IVRI under ABI like interactive session which helped in capacity building of manpower associated with his enterprise. He also admits that "YouTube videos and information on other social media platforms are not always much scientific to gather holistic knowledge to lead a successful business".

After getting trained from ICAR-IVRI, he started his own successful enterprise VDMR Agrotech Pvt Ltd Shilkohabad main-UP which is having more than 400 pigs at present. Encouraged by the success of previous enterprise, he started other farm SSGT-kanthari, at Shikhobad-UP with more than 350 pigs. Recently he has started one more new farm at Mathura with 80 animals. He has employed more than 10 staff members.

Not only that, he has started working towards innovative solutions for the alarming problems of this industry. The escalating price of pig feed is making this industry less remunerative. For that he has innovated a low cost pig feed and has registered his company VDMR Agrotech and applied for seed funding from RKVY RAFTTAR Agribuisness Scheme. For all his efforts, Er Pradeep was recently felicitated bt Hon'ble Union Minister of Fisheries and Animal Husbandary.

support the existing ABIs as well as some new Incubators. Thus, IVRI *पशु विज्ञान* Incubator, also known as Agri Business Incubation Centre came into existence with the goal to create and enhance the startup ecosystem in the animal science domain. The ABIC acts as a facilitator for small and large scale entrepreneurs by providing them research knowledge on the technical front as well as at business level. The centre is committed to give its hundred per cent by being proactive in the domain and take and pass on the opportunities from all the sources possible. The ABI centre organizes a year long full-fledged entrepreneurship programme under the RKVY-RAFTAAR scheme, Government of India. The centre is proactively working and designing courses as per the need of the entrepreneurs and startups in the animal science sector. To attain the perfection the centre runs on a continuous feedback mechanism which is collected after every session. The centre aims to transform every worthy startup in the domain into a successful venture while understanding this is one big audacious goal but that's the vision and the centre hopes one day to achieve the same through continuous Planning, Actions and Improvement.

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Entrepreneurship Opportunity

in Dairy Sector

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Livelihood security in rural sector of India primarily depends on agriculture including livestock sector. The milk alone accounts for 67% of the value of output from livestock sector and with increasing widespread demand it will continue to be among the major contributors to rural economy. About 70 million small and marginal farmers with an average of 2-3 animals produce more than 50% of the milk in the country. Milk and milk products constitute the major share in Indian food basket, next only to rice and wheat. India contributes to about 18.4% of global milk production with over 187.74 MT in 2018-19 with an annual growth rate of nearly 6.0%. The projected demand of milk offers new opportunities for marginal and small dairy farmers.

Key words: Dairy farming, Food processing, Mechanization, Stand-up India

GROWTH of Indian dairy sector would definitely coincide with the enhanced milk productivity, consistent supply of good quality raw milk directly from the milk producer or alternatively by promotion of value addition at the producer's level itself. Dairying would remain a major contributor to nation's GDP and lucrative source for livelihood options. There has been a growing interest among entrepreneurs towards establishment of dairy farms, milk or food processing units on commercial scale which is evident from the increasing number of organized dairy farms and milk processing units. Besides several opportunities exist in dairy sector for entrepreneurs, which are discussed here.

Strategic interventions required for promotion of entrepreneurs

The Indian dairy sector is largely under the domain of unorganized sector and its transformation is urgently required to meet the aspiration of domestic consumers and make a sizeable presence in international market. Probably the major reason that is driving entrepreneurs towards dairy sector is an element of certainty and huge market opportunities existing across the nation. Experiences with current set-up of technology management indicate several issues listed below, which hamper the entrepreneurship development in dairy sector:

- Lack of awareness among the stakeholders regarding the scientific/technological developments in R & D institutions and organizations.
- Large reservoir of technologies are available in R & D Institutions, but most of the technologies have not been validated for up-scaling, consumer acceptance and marketing potential under field conditions.
- Majority of skill development programmes currently operational lack qualitative improvement among the trainee and conceived without clear goals.
- Lack of institutional support to farmers, entrepreneurs and other stakeholders.
- Absence of effective marketing, technology transfer and entrepreneurship strategies for promotion and adoption of products manufactured in "unorganized sector" for successful commercialization.

Based on the above-mentioned issues, strategic plans need to be formulated to resolve the problem faced at different stages. Government initiatives through various schemes and programme have been conceptualized with well-defined set of goals and objectives, however, there is limitation in their effective implementation at different levels. It at times creates disenchantment among the startups. Since setting up of any business venture requires substantial investment, hence information on promotional schemes in terms of financing for plant and machinery and support system for marketing is required.

Prospective area for entrepreneurship in dairy sector

As 80% sector operates under the unorganized sector domain with numerous problems, it is of paramount importance that how changes can be brought in place. It would only be possible by developing the skills of stakeholders, creating awareness regarding the scientific or technological developments, transfer

of technologies to end-users and by providing assistance in validation of developed technologies through developing linkages among institutions, industry, entrepreneurs and farmers. Entrepreneurship development in dairy sector appears to be one of the best approaches in meeting the goal of sustainable development of Indian dairy sector based on technological developments. Agriculture, Dairy and Veterinary graduates may also opt for entrepreneurship in any of the following areas listed below:-

Dairy farming: Adoption of scientific dairy farming practices in peri-urban dairy sector has not only improved the productivity but also ensured the availability of quality milk to the consumers. Increasing knowledge and information of improved dairy farm management practices starting with selection and multiplication of superior germplasms, balancing of ration, disease prevention and treatment, minimizing the calving intervals and reducing the age of puberty, has assisted them in developing profitable ventures. The major requirement for the entrepreneur is how best they can deliver raw milk to the customers by using raw milk chilling-cum-transportation and Dispensing systems. Dairy farming could be more lucrative and satisfying through self-help-groups (SHGs) and milk producer's union (MPU) where forward and backward linkages may play crucial role. Dairy farms could also be partly converted into breeding farms as it may enhance the income of the farms manifold and assist in maintaining the herd size optimum. In states like Punjab and Haryana farmers earn huge revenue only through selling of animals. Government has also initiated e-Pashuhaat for facilitating the breeders, sellers and buyers for the trade of disease-free and quality animals.

Feed and fodder seed production: Good quality feed and fodder availability is important pre-requisite for quality milk production. As feed and fodder cost almost 60% of milk production, it has received due attention in commercial dairy farming system. However, considering the large bovine population and growing trend towards addition of mineral mixers, feed supplements, feed additives, composite feed block and emphasis on optimizing the dairy animal ration there is ample opportunity to start feed and fodder seed production business. To meet the demand of green fodder a number of crops and varieties are being evaluated and approaches including silage making and hay are gaining popularity. It is opportune time to capture the promising market and initiate innovative business.

Processing of milk/foods: Dairy based foods always have been an integral part of our rich cultural heritage and the nutritional advantages associated with consumption of these products are unparallel. The pace and the level of value addition in dairy industry are better, if compared with other food processing sector. Technological advancements in processing of milk offer an opportunity for improving the value addition scenario in the country. With the introduction of Food Safety & Standards Act, the trade scenario is destined to improve with major emphasis on quality, safety and human health. Continuous basic and strategic research activities pertaining to dairy products are on paramount importance in our goal to deliver the "wholesome" foods to consumer. Value addition at producer's level could be attractive alternative for strengthening the milk value chain to deliver quality assured products to consumers and provide remunerative prices to producers. Optimizing product mix for better return and process line for indigenous dairy products, as it appears to be the best option for new enterprise considering the demand and low investment required.

Product testing and diagnostics: Under the gambit of FSSAI there is growing demand for food testing laboratories and there is a scheme for establishment of Food testing lab through financial support of Ministry of Food Processing Industries (MOFPI). Persons having expertise in food quality, safety and management system may undertake accreditation job for NABL, HACCP, ISO and other safety management systems. However, that requires experience of field conditions. Another area for entrepreneurship development is manufacturing of rapid diagnostic kits and equipments to test adulterants, antibiotic residues, pathogens, mycotoxins, heavy metals and other pollutants.

Ingredient production and marketing: Food ingredients play an important role in quality enhancement of food products. Nowadays, excellent range of ingredients are available that can be marketed. The marketing of ingredients would be more remunerative, if technical and application services are provided. Likewise, to cater the need of growing fermented food market, there is rapidly growing demand of appropriate microbial cultures with novel techno-functional characteristics. Milk nutraceuticals have a great demand and occupy a pivotal position in market.

Converting waste into value added products: Community based approach for converting farm waste into value added products/service including vermin-compost, electricity, fuel and liquid fertilizer, may also be taken up as enterprise. There are successful business models that reflect the economic potential of farm waste in dairy value chain.

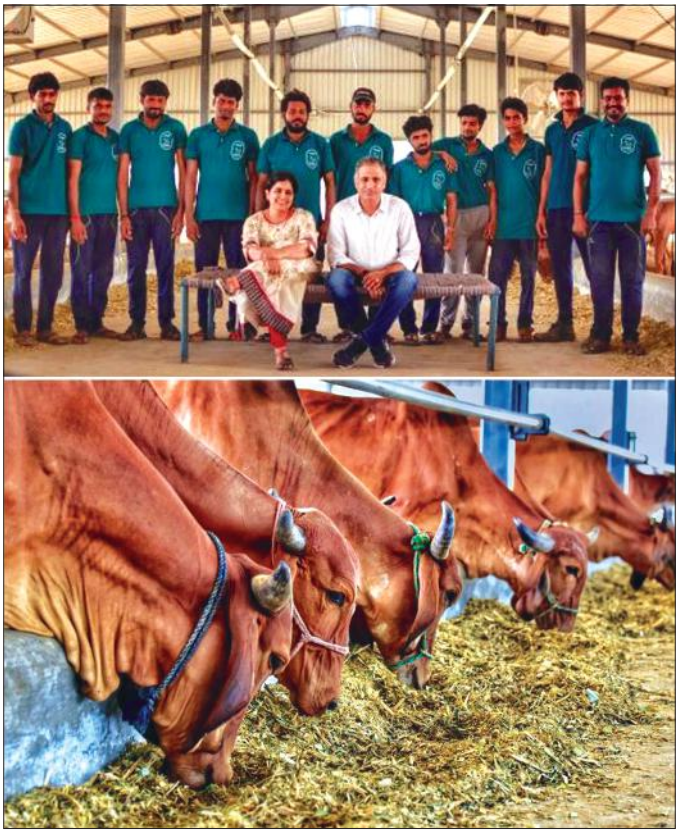
Farm and dairy processing equipment: Mechanization both at dairy farm and milk processing unit in SME (Small and Medium Enterprise) offer emerging opportunity to fabricators and engineers to start manufacturing such equipment. Mechanization is essential for enhancing the product quality and there is requirement of fabricators for small scale processing equipment. Moreover, there is also need for energy efficient service/utility systems to support small scale production. As packaging could be an effective tool for shelf-life and marketing that necessitate efficient packaging system and lines. Under Make-in-India mission it can be taken up and supported technically by ICAR institutes. Market statistics also suggest a growing demand of

equipments in export market as well.

Government schemes for promotion of dairying and food processing

Government has launched and modified various schemes for the promotion of entrepreneurship in dairy and food processing sectors. One of the important step in the direction is establishment of Business Incubation Centers for nurturing the budding entrepreneurs. Government has recently launched Dairy Processing and Infrastructure Development Fund (DIDF) with a total outlay of ₹ 10,881 crore, where cooperatives will be provided loans at 6.5% annual interest to be repaid within a period of 10 years. The centre will provide the interest subsidy. This scheme targets to benefit 95 lakh milk producers through coverage of 50,000 villages. Many skilled, semi-skilled and unskilled workers would get direct or indirect employment opportunity. Under this scheme, additional milk processing capacity of 126 lakh litres per day with milk drying capacity 210 tonnes/day and 140 lakh litres of milk chilling capacity per day will be created. The programme has also provision for Rapid milk testing machines and promotion of value added dairy products. Some of the major initiatives are discussed hereunder:

- **Dairy Entrepreneurship Development Scheme (DEDS):** Department of Animal Husbandry, Dairying and Fisheries, under the Ministry of Animal Husbandry and Farmers has launched the scheme under 12th plan, which continued in current financial years. The National Bank for Agriculture and Rural Development (NABARD) is appointed as nodal agency or the implementation of DEDS scheme. There is budget provision of ₹ 144 Crore with ₹ 110 Crore for General Component, ₹ 17 Crore for SC component and ₹ 13 crore for North-eastern. The scheme is for promotion of dairy sector including animal and milk processing.
- **Startup India:** Recent initiative of central government with the aim of fostering entrepreneurship and promoting innovation by creating an ecosystem that is conducive for the growth of start-ups. The scheme could be game changer for entrepreneurs and hopefully proves to be a milestone. (www.startupindia.gov.in)
- **Stand-up India:** Stand-up India scheme provide bank loans between ₹ 10 lakh to ₹ 1 crore mainly for socially deprived and women entrepreneurs. The enterprise may be in manufacturing, services or the trading sector. (www.standupmitra.in).



Success Stories in Dairy Sector

Olitia Foods Pvt. Ltd., Jaipur

The sectors of operations are indigenous breed based dairy farming, value added dairy products, olive tea, traditional beverages and primary processed products. It is a complete "Make in India" venture. The milk from indigenous cows is processed and packed in biodegradable cartons and marketed. Company is located in Jaipur and has units in various districts of Rajasthan and having an annual turnover of ₹ 25 crore. The company provides employment to around 150 persons. Agribusiness Incubation (ABI) of ICAR-National Dairy Research Institute, Karnal has guided and mentored them in establishing state-of-art dairy farm, milk processing unit and also in formulation of new products.

Aadvik Foods & Products Pvt. Ltd, Bikaner

Aadvik Foods, is India's first company to process, market camel milk and its products in the country and abroad. In a short span of 2.5 years, it has acquired over 250,000 customers who consume camel milk on a daily basis. One of the prime objectives of company is to dispel the gap between the camel milk and its consumers. In a pursuit to diversify their product portfolio, company has joined as Incubatee Company ABI, NDRI, Karnal in 2018 to carry out the core Research and Development in Camel milk and goat milk products.

Mishti Farmers Producer Co. Ltd., Karnal

A milk producer company consisting of about 250 farmers has started commercial of *bajra lassi*, whey drinks, sweets, ghee, butter, *lassi* and curd under the Business Incubation Programme of ABI. The milk collected from 270 resource poor farmers is processed and at present the company has 14 outlets in five district of Haryana. ABI has supported them through mentorship and skill development in commercial production of dairy products. It has also extended its support to continuously educate them with series of interactions with experts and developing business acumen in order

to compete with intangible market forces. One of the best examples of rural entrepre-neurship where poor farmers can be linked in the form of a Producer's company to provide better price of milk and higher return through manufacturing of innovative value added dairy products. The company is providing direct employment to about 15 persons and indirectly to about 150 persons. The company will expand its business through increasing manufacturing capacity and by launching new products.

Conclusion

India has made a remarkable growth in milk production, but still there are several issues that need urgent redressal to keep the momentum. Large population of non-descript cattle and buffaloes, very low productivity of milch animals, lack of feed and fodder, longer calving interval, reproductive problems and non-availability of good quality semen & animals. Likewise, milk processing industry is facing the problem of adulterants & contaminants, lack of standardized manufacturing technologies, absence of mechanization, poor emphasis on quality & safety and product innovations. The scenario is more of less similar across the country and it offers newer opportunity for rural youths and farmers. Present environment and government efforts have also created a positive atmosphere for the startups and it is an opportune time for entrepreneurs.

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Entrepreneurship in Meat Processing

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Meat sector is an integral and important component of agro-food industry in India, which contributes immensely for nutritional security, employment generation and earning much required foreign exchange. India produces about 8.1 million tonnes of meat annually (DADF, 2019). Around 72% of Indians are now on non-vegetarian dietary habit and regular meat consumption has rigorously increased over the years. Holding 11.6% of world livestock population and 17.71% of the world human population, India has tremendous potential in meat production, processing and marketing. The Indian meat market was valued close to USD 30 billion and is one of the fastest growing industry at a CAGR of 22% (Mintel Industry Research Report, 2017). Rapid consolidation in meat processing, more vertical integration and large number of smaller processing units will be the key trends in future.

Key words: Meat product processing, Value added meat, Wholesome meat production

AGRI-BUSINESS Incubation centre at National Research Centre on Meat, Hyderabad, a pioneering initiative in the domain of meat processing technology, was set up in 2016 with support of Indian Council of Agricultural Research, New Delhi to foster the growth of meat processing ventures in our country. The ABI, in addition to the requisite in-house expertise in the relevant focal areas of meat processing and technologies for comercialisation, has state of art primary and secondary meat processing facilities with FSSAI and FSMS certification. This centre envisages facilitating incubation of new startups/entrepreneurs and enterprises for innovative technologies by providing need based physical, technical, business and networking support, facilities and services to test and validate their innovation before successful establishment of enterprises. Presently, the ICAR-NRCM-ABI centre is promoting entrepreneurs in fields of meat animal and poultry production, wholesome meat production, value added meat products processing, value addition of animal byproducts, enhancement of meat quality and safety.

Meat business: Not only a man's world anymore: Triusha Foods

Dr. (Mrs.) K. Martina Rani is a Mother and a teacher , who paved her way in the male driven meat business world. She didn't spend tons of money to set up a unit, and she didn't have a major plan, except to share with others about her everyday life as a homemaker, as a pioneer woman. She knew who her target audience would be, and what she is going to deal with and believed in it.

Dr. Martina, aged 41 years, along with her husband Mr. Donbosco,

M/s. Triusha Foods signed MoU with ICAR-NRC Meat for incubation support.

approached ICAR- NRC on Meat and shared her vision to start a meat based venture. NRC provided basic guidance about the meat business and hinged them in the 5 days' entrepreneurship development training programme on value added meat and meat products processing. Soon after the training programme she conducted the market study and found her niche. Dr. Martina says "I worked ten years in Academics and learnt about business management and wrote many articles about women empowerment programmes. Nevertheless, I wanted to start my business in meat and meat products.

On 18th August 2018, she signed MoU with NRC- meat. The centre for Agribusiness Incubation at NRC-meat has provided the hand-holding support and registered the firm under MSME as "M/s. Triusha Foods". The firm has opened their outlet at Suchitra layout, a developing area near to Secunderabad, which was inaugurated by former MLA, Medchal. The firm has also hired 3 women employees on pay rolls. Currently, the firm is processing value added products such as Nuggets, Sausages, Burgers, Meat Balls etc. They are planning to start the fresh meat supply soon.

Lazeez Eats

Mr. Waseem Akther, an entrepreneur from Hyderabad has launched an innovative mobile app "*Lazeez Eats*" that allows customers to order chicken, mutton, seafood, exotic food, eggs and ready to eat items online. *Lazeez Eats* is a feature-rich and user-friendly application which allows the customers to schedule their delivery date and time.

Selling meat online is not new to Hyderabad, but what's peculiar about *Lazeez Eats* is that the company completely source it products directly from the farmers, which is fresh and hygienically processed at their unit with technical guidance and support from ICAR-NRC on Meat. Furthermore, the company has complete control over the end to end supply chain and long term aim to change the meat buying experience for the consumer through a technology integrated platform and solve the issue of finding safe meat.

Lazeez Eats was idea of Mr. Wasem Akther, a trainee of September 2018 batch of EDP conducted by NRCM on Value added meat and meat product processing. *Lazeez Eats* is the brand registered under Hyderabad based company Annum Agro Tech Pvt. Ltd which works in the field of agriculture and livestock production. The start-up delivers to selected locations at Hyderabad as of now on B2C and B2B revenue model.

Mr. Waseem got inspired, while he was purchasing the meat from a local store by seeing the unhygienic way of handling and cutting the meat. He thought to start an enterprise that sells directly soured meat from their farmer network. Talking about the app at the launch event, Mr. Waseem said that, *Lazeez eats* value proposition is Halal meat delivered to home. The meat is hygienic, hormone-free, antibiotic-residue-free and chemical-free, which is completely processed at company owned unit and they do not source from any third party processors.

From the operation itself the company sales started picking up slowly and now the company have delivery over selected pockets of Hyderabad. In addition to fresh meat it is now selling Sea foods, RTE, RTC products also.

Bloom Foods

After working for more than 10 years in several software companies in Middle East countries, Mr. Sidharth Nallu, returned to India for setting up his own business. He launched *Bloom Foods* in 2016 with the hand holding support of ICAR-NRCM and ICAR-NAARM. Being from Hyderabad, Mr. Nallu has created an iconic position for Bloom Foods in Non-Veg Pickle Market. Bloom Foods is currently one of the leading Manufacturer and Marketer of

Chicken, Mutton, Prawns and Fish Pickles.

The idea of Non-Veg pickles was inspired by seeing most of the pickle brands in the market which are pumped with chemicals, stabilizers and other preservatives to increase shelf life. Thus, he decided to make use of the opportunity and create a space in the pickle segment for non-chemical and less preservative non veg pickles.

During the initial days, the shelf life of the products was a problem. Thus, he decided to work with ICAR NRCM for enhancing the shelf life of pickles and with the support of ICAR NAARM he has created a B2B and B2C platform to sell pickles online. At present bloom foods is selling around 1,000 kg Pickles monthly. In addition to this bloom foods are also marketing through all social media platforms. Mr. Nallu says that they get an average of 5-10 posts a day just on Facebook and Instagram of people tagging @bloomfoods in stories, pictures and videos of themselves posing with our pickles.

Journey from an ordinary meat shop owner's wife to owner of Meat Pickle Manufacturer. Smt. Sarika Gokarni at present is a successful food processing entrepreneur based in Boduppal, Hyderabad. Being married to meat shop owner and mother of two kids, she found that her husband's income is good enough to run the family. But she had an unquenched thirst in food processing. With treasured recipes in hand, Sarika began pickling as a hobby and used to make pickles for her friends and relatives, which always got her great appreciations. One of her friends asked her to sell the pickles from which she can have a good income. But she was afraid because she did not know anything about business.

She came to know about Agribusiness incubation Centre of ICAR-NRCM through newspaper and contacted the same. The NRCM -ABI Centre, gave her some idea about entrepreneurship and asked to attend the EDP training programme. Without any idea and with lot of confusion, she attended the programme conducted in February, 2018. At the end of completion of the programme, she was very clear about meat business and got much hope to face the problems. With that intent, she joined in NRCM ABI Centre for hand holding support and established her venture in Hyderabad. Currently, she is manufacturing chicken, mutton and prawn pickle and also selling value added meat products. The raw materials are sourced from her husband's meat shop. This seems a good example for integrating the backward supply chain, as the cut-up parts and left over after deboning are utilised for manufacturing pickles.

Being a home-grown brand comes with its share of challenges. For her, competition is both with the local pickle seller who offer low price points and the multinational brands who are able to dominate shelf space across cities. She has recruited two marketing boys who look after the distribution and marketing. Sarika admits that her "biggest USP– quality and marketing has been through word".

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Jai Kisan, Jai Vigyan

- A total of ₹ 788.33 crores have been sanctioned for opening six new agricultural colleges for eastern India under Central Agricultural University, Imphal, and a new Central Agricultural University in Meghalaya.
- For the establishment of two new agricultural research institutes in Asom and Jharkhand, a sum ₹ 100 crores is allocated.
- First academic session of the Rani Lakshmibai Central Agricultural University has been allocated for four new agricultural colleges in Datiya and Jhansi.
- An Memorandum of Understanding was signed for transforming the Rajendra Central Agricultural University, Pusa, Samstipur, Bihar. A proposal of ₹ 400 crores is submitted in EFC.
- Post-Graduate Institute of Horticulture is being established in Amritsar, Punjab.
- Foundation stone of the Indian Institute of Agricultural Biotechnology is laid at Ranchi for promoting agricultural biotechnology.

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Creation of Entrepreneurship through Public Private Partnerships

– A success story from North Eastern India

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Public-private sector partnership (PPP) is an institutional innovation to bring in synergy, mobilize resources, generate, validate and transfer technologies. In every PPP programme, skills and assets of each sector (public and private) are shared in delivering a service or a facility for the use of the general public through a mutual agreement. In addition to sharing of the resources, each party also shares risks and rewards potential in the delivery of the service and/or the facility. Across the world, lot of innovations of technologies/techniques are happening in the R&D institutions, including that of agriculture and allied sectors, but their outreach to the end user is very much limited. In order to achieve efficient transfer of technologies from research institution to the industry, partnerships at various levels with different objectives were developed amongst various stakeholders, which shall bring prosperity to the nation through the prosperity of the main stakeholder, the farmer. For the success of the partnership with Public Institutions and Private Organizations, identifying the strengths of the partner and the areas of complementarities are very important. With partnership between public and private sectors, the strengths of both the sectors are leveraged. On one hand, public sector has highly skilled and efficient manpower in agriculture and on the other hand, private sector has excellent managerial resources. Private extension would improve commercialization of technology and make it available at the global level. The decentralized decision-making in private sector helps in reducing time for commercialization.

Key words: Piggery, Pork Processing, Zero cost farming

THE SUCCESS story of a start-up entrepreneur who collaborated with ICAR-National Research Centre on Pig, Guwahati through PPP mode has been described here. Technology commercialization in the context of piggery and pork processing would encompass whole range of issues and activities, from stage of need identification, development of appropriate technology, demonstration, creating demand and rolling out package for wider adoption on commercial terms. The technologies may either be low cost or high cost, simple or complex, but they should be suitable for adoption on a wider scale. With rapid changes in the food habits of the people after globalization and developments in pork processing technologies and evolving export standards for pork and pork products, investments in commercial piggery and pork processing sector are bound to increase. This increase would mean different areas where public participation would be needed; some of them are as follows: new pig breed development, development of value added pork products, pork product safety, residue studies, product composition etc.

Rationale and implementation strategy

The North East of India is synonymous with beautiful landscapes and exotic food habits. The region and its indigenous tribes cherish their livestock for celebrations and family events. Although having the largest population of pigs in the country as a region, the pi g and pork trades are completely unorganized. Large size pig farms are non-existent, medium farms are rare, value addition and scientific meat processing was unheard of. Consumers mostly buy fresh pork and value added pork products are not yet popular in the region. Over

two million pigs were annually consumed and the only value addition happening across the region is in the form of smoking and pickling done in rudimentary conditions. The R&D Pork Processing Plant at ICAR-National Research Centre on Pig, with state-of the-art facilities, is equipped with all essential machineries required for hygienic pig slaughter and processing of value added pork products. The unit has refined and standardized an array of viable technologies for processing value added pork products which are specifically suited to the taste of local consumers.

The beginning of an enterprise

In the year 2012, M/s Arohan Foods Pvt Ltd, a start up from Guwahati, approached ICAR-National Research Centre on Pig for a training program on value addition of pork. The founders were all professionally educated and had held managerial positions in reputed companies. The team comprised of Anabil Goswami (BE, MBA), Arindom Hazarika (BSc, MBA) and Rana Pratap Brahma (B.Tech, MBA) and they made the required commitments in terms of time and business planning to convince the institute that there was potential in the team and they could commercialise the technologies developed by the institute. The technologies under consideration were for processing different types of value added pork products. It was very rare in 2012 to find educated youth, who wanted to get into pig related economic activity. Even though piggery was widely accepted in the North East, there was still some apprehension attached to pig related commercial activities on an organised scale. The agreement to commercialise the technologies was signed between ICAR-National Research Centre on Pig and M/s Arohan Foods Pvt Ltd on 19th June 2012 initially for a period 3 years and was later renewed in the year 2015 for an another three year term.

The journey

With the technology support from ICAR-National Research Centre on Pig, Arohan Foods came up with smart branding and packaging solutions for the products and decided to call the brand – Choice Pork Natural. While they initially retailed across the North East Region, the quality of the products and the team, eventually attracted equity investments from Omnivore Partners, Mumbai, one of India's leading agriculture technology investors in the country. Arohan Foods Pvt Ltd became the first agri-sector start up in North East India to attract venture capital funds from a mainstream equity investor. Post the equity infusion, the company diversified into 20 states of India, retailing the Choice Pork Natural brand in Delhi, Mumbai, Bengaluru, Chennai, Kolkata etc. across stores like Godrej Nature's Basket, Spencer's, Big Bazaar, Big Basket and Hypercity. They also built a standalone slaughterhouse and processing centre under the guidance of the Institute which was HACCP and ISO certified. Every packet sold by Arohan Foods carried the following declaration – 'Technology developed by Indian Council of Agricultural Research'. The products developed by the institute and commercialised by Arohan Foods have been served by top hotels in the country.

The company has gone on to be recognised by DPIIT (earlier DIPP) as an innovative start-up in the field of agri and allied products. The company has now also started working amongst local farmer populations to ensure a steady supply of quality livestock for their processing activities. Most farmers in the region practice zero cost farming with herd sizes of 1-2 animals kept around their kitchen gardens. The market linkage was uncertain and dependant on a series of middlemen. Arohan Foods with the technical support of ICAR-NRC on Pig, introduced a system of guaranteed pricing where farmers were assured of revenues for healthy pigs any day of the year. Arohan Foods has now formally started working with farmer groups to ensure hygiene, productivity and commercialisation of pig rearing. Many of the farmers visit the institute to observe the high standards of farming and meet the scientists to understand the benefits of organised piggery compared to zero cost piggery. They have also attracted foreign direct investment from C4D partners, a Holland based foundation for their work in the backward integration of piggery. The company and their products have been covered by a multitude of magazines and newspapers, with CNBC Awaz visiting the ICAR NRCP campus to conduct a live interview of the team in action.

Anabil Goswami one of the founders and person who leads the production and technical aspects of the enterprise says "When we approached ICAR NRCP, we had no idea of how it would progress with none of us ever having engaged formally with a research organisation. We were only interested in the technology and commercial aspects of the same. Initially our focus was only sausages and salami, now we see piggery as a means to help 1000s of farmers. We came for the technology, stayed for the mentorship. The guidance we got has helped us in establishing a commercially viable enterprise and today our customers are very happy with the quality and taste of our products. We are currently developing new products in association with ICAR-NRC on Pig and this will enable us to scale new heights. The whole team at NRC on Pig has helped us throughout this exciting journey."

Way forward

Arohan Foods has come a long way from 2012, when they had come to learn the basics of pork processing, till today where they are working with multiple agencies to create sustainable value chains for pig farmers across North East India. Arindom Hazarika one of the founders who looks at marketing and liaison says "We were a group of engineers and bankers. If someone had told us we would be working with 3,000 pig farmers we would not have believed them. Part of the reason for change is the bond and passion we share with ICAR NRCP

and the Scientists who have guided us over the last 7 years. What started as a purely manufacturing endeavour has now developed into a fully fledged mission for working across the piggery value chain. We have received timely guidance on technologies; research and exposure from the institute that has helped us non veterinarians embrace a line of business that is tangential to our education. On the marketing front, although India is still a marketplace dominated by price sensitive consumers, chefs and institutions who know what ICAR stands for show an immediate acceptance for our premium products."

The company has recently launched a line of shelf stable retort line of pork curries representing the 8 states of the North East region. The new brand called "Just Oink" was launched by the Hon'ble Chief Minister of Meghalaya at the first North East Food Show with SIAL Paris. The company has also constructed the first community focused rural slaughterhouse. Both these were possible with technology standards developed by ICAR-NRC on Pig. It is noteworthy to mention here that ICAR-National Research Centre on Pig has recently signed an agreement with Arohan Foods to transfer the rural pig slaughterhouse technology in presence of Dr. Trilochan Mohapatra, Hon'ble Secretary, DARE and Director General, ICAR on 24th November, 2019. The company has also gone ahead and built community led brand stores to retail the hygienic meat produced from the brand stores. While the rural slaughterhouse and brand store format has just started, the company reports that farmers are getting up to 30% more realisation from this channel as compared to selling to traditional middlemen.

The founders of the company have also pursued complimentary developmental avenues and have now established the brand as a leading solutions provider for all livestock and natural farming related activities. They have already developed an in house traceability solution with M&E capabilities. Arohan Foods has gone on to become an associate member of the Agriculture Skill Council of India. They are also founder members of the NEEA, North East Entrepreneur Alliance, with a reach across the North East and neighbouring regions. Arohan Foods Pvt Ltd is currently associated with the livelihood missions in North Eastern states towards sustainable piggery development and value chains projects.

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Agri-Business Incubation

for Small-holder Plantation Crops

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Coconut, arecanut and cocoa are the important small-holder plantation crops of India which exert profound influence on the rural economy by supporting the livelihoods of 25 million people in the country. They also support the national agrarian economy, with annual contribution to the tune of ₹ 14,200 crores to the national GDP and foreign exchange earnings of about ₹ 2,440 crore, besides supporting subsidiary industrial development. Owing to traditional methods of processing and product utilization, the sector is alien to modernization which hampers sector's vertical growth. This leads to greater price instability and lesser input use efficiency, which is felt more after global integration in the post World Trade Agreement (WTA) and ASEAN treaty era. To ensure the livelihood security of those dependent on the small-holder plantation crops, it is of paramount importance to strengthen the commodity value chains through appropriate forward and backward integration. Keeping abreast of the race in productivity alone cannot guarantee success or even survival in an activity exposed to unmediated global competition. It is, thus, imperative to think beyond the periphery of production and productivity and there lies the importance of technology driven agri-business initiatives.

Key words: Arecanut, Coconut, Coconut chips, Samrudhi

'ONE tree – several products' goes the byline in the wrapper of coconut products developed at ICAR-Central Plantation Crops Research Institute (CPCRI). But the coconut products in Indian market are only copra, oil, desiccated coconut and tender coconut. Of the total production of 20 billion coconuts in the country, 85% are harvested as mature coconuts (10-12 months old) and the remaining as tender coconuts (7-8 months old). More than half the quantity of mature nuts produced (54%) are utilized for domestic and religious purposes; 40% for making copra and only a meager 6% is absorbed by the industry for converting into value added products, chiefly the desiccated coconut. The coconut industry had developed in the country without much institutional/academic support except for few gadgets such as manually operated coconut dehusker, copra dryers and copra moisture meter. In other words, the market alone influenced the quality standards, type of packaging, and disposal/utilization of byproducts. Since the focus was on domestic market, coconut products from India failed to make an entry into the world trade.

As a result, the commodity has a very unfavourable market in India characterized by frequent price-crashes and declining productivity in the traditionally cultivated regions. To make a turn-around in the sector, value addition and product diversification were suggested from many quarters. Responding to this requirement, ICAR-CPCRI had initiated research on coconut value addition and product diversification since 2000. The Institute had developed processing protocol for coconut chips in 2004 and conducted 23 training programmes for imparting skill and knowledge on its preparation to 200 beneficiaries during the period 2004 to 2009. However, few chips making units were only established despite the fact no fee is being charged for technology transfer. The reasons for not using the chips-technology include non-awareness on industrial source for procuring gadgets and machinery, non-availability of appropriate packaging material, lack of technology backstopping while scaling up the production, and marketing issues. These issues are common to any new entrepreneur. Making a decision on product portfolio and input capacity of the unit to be started, sourcing technology, procurement of machinery, preparation of detailed project report and avail credit, seeking government incentives, and complying with policy and legal framework are the other common

challenges a new entrepreneur would face. It can be observed that a number of new entrepreneurs in coconut and other sectors had failed and eventually closed in the initial years itself for one or the other aforesaid reasons. To equip the new entrepreneurs to reduce their learning curve and risks associated with availing credit and marketing, the Indian Council of Agricultural Research (ICAR) established a number of Agri-Business Incubation (ABI) Centres under National Agricultural Innovation Project (NAIP) during the period 2009-2013 and subsequently strengthened further. The ABI Centre at ICAR-CPCRI started during June 2013. The primary objective of CPCRI-ABI is to promote entrepreneurship with selected business models using proven and potential technologies developed at the Institute.

Interface programe on science, innovation and entrepreneurship at CPCRI.

Agri-Business Incubation

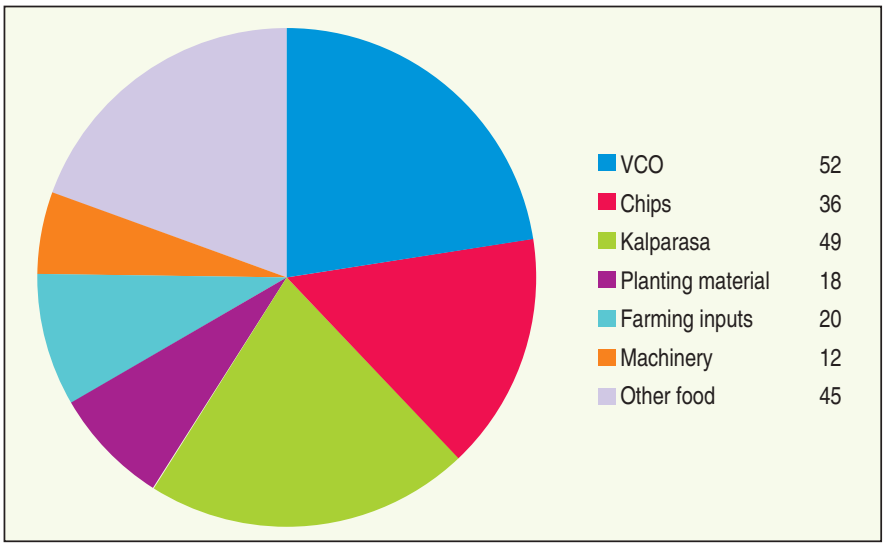
ICAR-CPCRI ABI provides both in-house and distant incubation. The in-house incubation facilities are available at ABI centre for the following products: (i) Virgin coconut oil; (ii) Coconut chips; (iii) Coconut palm sugar; (iv) Desiccated coconut; (v) Vegan coconut frozen delicacy; (vi) Bean to bite chocolate; and (vi) Activated coconut shell charcoal production unit. Terms and conditions for availing these facilities in the ABI centre can be seen from the Institute website (www.cpcri.gov.in) or the website of ABI (www.cpcriagribiz.in).

There are many entrepreneurs who wanted to test and validate their concepts with the Institute support. For instance a street vendor approached for perfecting the technology for coconut water jelly. Another young entrepreneur standardized packaging protocol for short-duration storage of fresh coconut gratings. Formulating unique combination of frozen coconut delicacy is another example in this regard. Institute also signed MoAs for joint development of air blast sprayer, Unmanned Aerial Vehicle applications for spraying and surveillance, mobile applications, and detection of pests using acoustic tools.

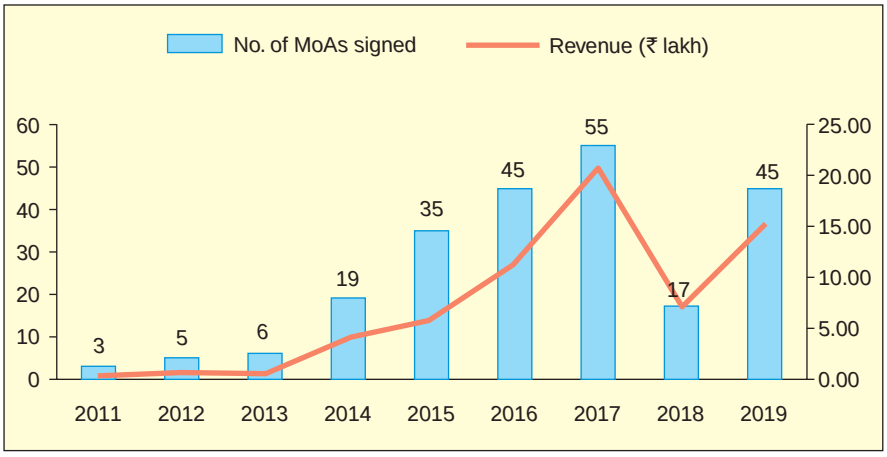
The distant-incubation is chiefly for technology support, which is the most valued strength of the ABI. In some cases, the period of incubation would be of short-duration, while in other cases (e.g. arecanut tissue culture), it is of two to three years. The ABI has recently signed an MoA for developing coconut nursery with duration of Agreement as 15 years.

Other than technology support, the ABI also provides marketing assistance. The service in this regard varies from incubatee to incubatee. Generally the newly initiated food processing entrepreneurs use the exhibitions in which the Institute participates at different locations in the country for marketing their product, on an average, in an year, the Institute participates in 30 exhibitions. Facilities are being created for online sale with the help of an exclusive incubatee for that purpose. In few cases the product launching is done in a big manner. The vegan coconut frozen delicacy was launched by then Union Minister for Agriculture and Farmers' Welfare Shri. Radha Mohan Singh and the Kalpa Soil Care with brand name 'Samrudhi' by Shri. Justice (Rtd.) P. Sathasivam.

The centre also provides services such as preparation of detailed project report, credit linkages, and licensing with local bodies etc. One



Pattern of technology utilization.



Number of MoAs and revenue generated (in lakh rupees).

of the noteworthy services provided in this regard is the export of packaged tender coconut water to Italy (brand name: Push).

Promotion of entrepreneurship

To popularize the technologies and opportunities with agri-business ventures, large number of seminars, interface programmes and awareness camps are being organized at different places every year. Some of the unique programmes conducted by CPCRI ABI are: (i) Dream-Big Kalpa, the Institute-Industry interface programme conducted every year (ii) Innovators meet (iii) Startup Green to promote agripreneurship (iv) Competition for innovative business models for coconut value addition (v) Interface programme on science, innovation and entrepreneurship. The incubatees are scouted from such forums.

The CPCRI ABI had signed MoU with Kerala Startup Mission to foster entrepreneurship in agricultural sector. One of the joint initiatives in this regard was 'Kalpa Green Chat' in which entrepreneurs will get an opportunity to interact with successful businessmen/faculty. One of the key personalities interacted with local entrepreneurs was Mr. Nagaraja Prakasam, renowned angel investor.

Technology Utilization

Among the technologies commercialized by CPCRI, largest number of MoAs was signed in the area of coconut value addition, 182 out of 232. VCO, coconut chips and Kalparasa® are the most popular technologies. The efforts of the Institute in coordination with other agencies to bring changes in Excise Act also helped to expand business with 'kalparasa'. Over the years, number of entrepreneurs approaching for buying Institute technologies increased.

Bottom line

The Agri-Business Incubation Centre at ICAR-CPCRI attracts on an average two entrepreneurs every working day and play a mentor's role in choosing business ventures, sourcing technologies and providing marketing guidance. From infancy, it has now got established to serve the cause for it is created. As of now, we are certain that the gap between technology generation and utilization has blurred; we envisage seamless technology scale-up and entrepreneurial capacity building.

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Bioencapsulation for Smart Delivery

of Agriculturally Important Microorganisms

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Beneficial microbes are available in different formulations, the common types being liquid, peat, granules, and freeze-dried powders. Nevertheless, a promising advancement would be to develop techniques that allow encapsulating the microbial strain in a nutritive shell or capsule and deliver them to the targeted site. This would ensure precision delivery, lower application, easy handling and cost-effectiveness. Hence, a major area of focus was development of novel delivery systems of bacteria and fungi for growth promotion, soil nutrient solubilisation and biocontrol.

Key words: Bioencapsulation, Microbes, Soil nutrient

FORMULATIONS of microbes like bacteria and fungi can be used to enhance soil nutrition, plant growth and biocontrol.

Socio-economic relevance of this work

- Precision delivery of biocontrol strains with higher microbial counts by encapsulation and therefore greater residence time in the rhizosphere ensures quick resolution of diseases infecting plants, faster mobilization of nutrients and positive plant growth and yield.
- Easy handling, higher shelf life and higher microbial population due to encapsulation have made biofertilizer application more efficient, feasible and sustainable to the farmers.
- The encapsulation technology is not restricted to spice crops alone, but can be used to encapsulate any microbial strain across any crop.

Technological Relevance

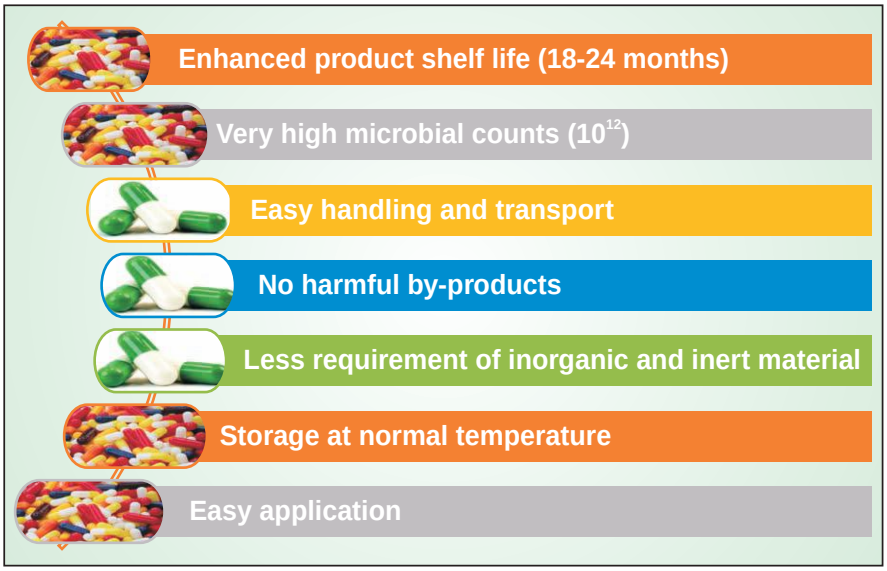
- The role played by beneficial micro-organisms is very critical in agriculture and they play a vital role in maintaining soil quality, besides enhancing environmental quality. The technical exactness required, time consuming and cumbersome procedures in their method of use are factors which has made the use of beneficial micro-organisms unattractive. There are also concerns about the quality of the commercial formulations available in the market.
- It was the realization that a more convenient method of delivering beneficial micro-organisms could positively influence the adoption rates, that prompted the search for an alternative delivery mechanism. A major advancement would be to encapsulate beneficial microbes and deliver to crops.
- The encapsulation technology while considered a breakthrough is also an easily perceptible and understandable technology and unlike the conventional talc, liquid and peat based formulations, the biocapsule technology permits easy handling and use with precision delivery to crops. It marks an acceleration of technological progress in the delivery of microorganisms to crops and at the same time enhancing soil biological quality.

Scientific relevance of the work

- A major spin off from the encapsulation technology and PGPR/fungal formulations is the

Novel method for smart delivery of agriculturally important microorganisms- a first in the world biofertilizer industry. Commercialized by non-exclusive licensing to two biofertilizer companies and the process patent was filed in 2013, with subsequent first examination reports on the patent filed in 2016.

Patent filed: A Novel Method of Storing and Delivering Pgpr/Microbes through Biocapsules Application No.3594/CHE/2013 dated 13/08/2013.



Novelty of biocapsule technology.

extent of reduction in harmful fungicides/chemical contaminants being added to crops and ultimately the soil. This will ensure clean crop production with fewer chances of the produce being rejected by the consumers/exporters/importing countries.

- The bio-capsules containing beneficial micro-organisms are generally used for promoting plant growth, providing protection against biotic stresses and enhancing availability of nutrients. By supplementing fertilizer application with bio-capsules, it is possible to reduce the use of traditional fertilizers by 20-30%.

Potential value of the research results in increasing production, productivity, profitability and sustainability of agricultural enterprises

- This is the first time in the worlds biofertilizer industry that a robust encapsulation technology for smart delivery of agriculturally important microorganisms was developed and non-exclusively licensed to private industries for mass production and distribution.
- The technology provides a much easier and cost effective (cost benefit ratio 1: 3) compared to talc based formulations, which are currently in vogue.
- The encapsulation technology appears to be significant game changer because it can be used to deliver all kinds agriculturally important microorganisms like nitrogen fixers, nutrient solubilizers, PGPR, Trichoderma, etc.
- The technology has captured the imagination of a wide range of end users and stake holders and is being touted as one of the most innovative agricultural technologies in the country.
- The biocapsule technology has definitely given a fillip to the efforts in promoting green agriculture in the country and is catching up fast in different states. There is absolutely no doubt that the technology will revolutionize the world biofertilizer industry in the years ahead.
- No wonder that the first licensee M/s Codagu Agritech was one of the 17 start-ups in agricultural sector from the country invited for presentation before the Hon'ble President of India Shri Ram Nath Kovind during the Festival of Innovation and Entrepreneurship (FINE), a unique initiative of the Office of the President of India to recognize, respect and reward grassroots innovation, on 19 March 2018 held at The President House of India New Delhi.

Crops covered by the biocapsule technology

Spices: Black pepper, ginger, turmeric, cardamom

Leguminous crops: Pea, Pigeon pea, Black gram, Green gram, Chick pea, Cow pea, Soybean, Peanut, Lentil, Berseem etc

Vegetables: Lettuce, Cabbage, Cauliflower, Brinjal, Capsicum, Gourds and other cucurbits

Tree crops: Clove, Nut mug, Cinammon, Mango, Apple etc.

Beverages: Tea, Coffee, Cocoa, etc

Fruit crops: Grapes, pineapple, Banana, Strawberry etc.

Spread of biocapsule technology in India

The technology has now spread to majority of the spice cultivating states like Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Maharashtra, Madhya Pradesh, Gujarat, Uttar Pradesh, Himachal Pradesh and even NE states like, Nagaland, Sikkim, Tripura etc. (Table 1) covering approximately 15% of the area and we expect it to double by the next 5 years.

Impact of encapsulated delivery of agriculturally important microorganisms

- The benefits from the technology can be visualized at three levels. The gains to the technology developing institute, the gains accruing to private firms involved in the manufacturing and distribution of the technology and the benefits to the end users (farmers) of the technology.
- The gains from the technology across the three levels were estimated to be 21.82 crores for the year 2018-19 in spices crops alone. The benefits in other crops (vegetables, fruits, ornamentals etc) will be multi-fold.
- The cost involved in production of the capsules and the cost of technology adoption have been deducted from the gross value generated by the technology. Conservative estimates are used for evaluating user benefits and the real impact could be of higher magnitude.
- Apart from these monetary gains, use of bio-capsule technology has also promoted organic input use in agriculture reducing the need for chemical inputs.
- By using bio-capsules, the avoided quantity of plant protection chemicals is estimated to be 75.6

Table 1. Details of biocapsules developed by our licensees presently available in the market

	Commercial name	Beneficial Microorganism and origin of the strain	Recommended crops
	M/s Codagu Agritech Pvt. Ltd, Kushalnagar, Karnataka		
1	Tricho Cap	*Trichoderma harzianum* (ICAR-IISR, CLT)	Cereals, vegetables, spices, fruits crops, ornamentals
2	Power Cap	*Micrococcus luteus (ICAR-IISR, CLT) Micrococcus sp* (ICAR-IISR, CLT) *Enterobacter aerogenes* (ICAR-IISR, CLT)	Black pepper, Vegetables
	M/s SRT Agro Science Pvt Ltd., Patan, Durg, Chhattisgarh		
1	Azoss Caps	*Azospirillium brasilense* (NCIM 5135)	Cereals, vegetables, spices, trees, beverages, fruits crops, ornamentals
2	Aceto Caps	*Gluconacetobacter diazotrophicus (*NCIM 5348)	Sugar cane, Sweet potato, sweet sorghum
3	Rhizo Caps	*Mesorhizobium mediterraneum* (MCC 2495)	Leguminous crops
4	Zinc Grow Caps	*Bacillus spp* (IARI, New Delhi)	Cereals, vegetables, spices, trees, beverages, fruits crops, ornamentals
5	P.S.B plus Caps	*Bacillus megaterium* (NCIM 5472)	Cereals, vegetables, spices, trees, beverages, fruits crops, ornamentals
6	Potash Grow Caps	*Bacillus decolorationis* (ICAR-IARI, New Delhi)	Cereals, vegetables, spices, trees, beverages, fruits crops, ornamentals
7	Azoto Caps	*Azotobacter chroococcum* (MCC 2351)	Cereals, vegetables, spices, trees, beverages, fruits crops, ornamentals
8	NPK Grow caps	*Azotobacter chroococcum* (MCC 2351) *Bacillus megaterium* (NCIM 5472) *Bacillus decolorationis* (ICAR-IARI, New Delhi)	Cereals, vegetables, spices, trees, beverages, fruits crops, ornamentals

tonnes (Metalaxyl mancozeb formulation) in spice crops alone. The technology also reduced need for consumption of chemical fertilizers to the tune of 3169 tonnes of inorganic NPK nutrients in spices. The avoided environmental cost from avoided use of fungicide and chemical fertilizers is not explicitly considered herein.

- The novel encapsulation technology has been non-exclusively licensed to firms for production of encapsulated microorganisms (biocapsules) or use in crop production.

Licensing of encapsulation technology for commercial production

The technology has been licensed to two companies:

- M/s Codagu Agritech Pvt. Ltd. Kushalnagar, Karnataka
- M/s SRT Agro Science Pvt. Ltd, Patan, Durg, Chhattisgarh.

Revenue generated by the licensees (₹/ year)

- M/s Codagu Agritech Pvt. Ltd. Kushalnagar, Karnataka: ₹ 3.0 crores/year
- M/s SRT Agro Science Pvt. Ltd, Patan, Durg, Chhattisgarh: ₹ 10.2 crores/year

Amendment to the Fertilizer control and inclusion of encapsulated microorganisms (biocapsules) in the Gazette of India

(Extraordinary, Part 2-Section 3-Sub section (ii) dated 01 December 2018)

- Following the success of this breakthrough technology, a significant development has been the amendment of the Fertiliser (Inorganic, Organic or Mixed) (Control) Order (FCO), 1985, namely Fertiliser (Inorganic, Organic or Mixed) (Control) (Fifth) Amendment Order, 2018, which came into force on the date of its publication in the Official Gazette (01 December 2018) and inclusion of encapsulation technology in the revised order.

Biocapsule value chain development for external marketing

- Another major watershed has been the development of value chain based on encapsulation technology wherein our licencee SRT Agro Science has signed MOUs with:
- **NAFED** (National Agricultural Co-operative Marketing Federation of India Ltd, New Delhi) for sale of Biocapsules through their marketing channel to various states of India.
- **MAIDC** (Maharashtra Agro industries Development Corporation Limited, Mumbai) for marketing biocapsules in Maharashtra.
- **Paramparagat Krishi Vikas Yojna (PKVY) and ATMA schemes** for large scale distribution through this Govt. Scheme by SRT Agro Science Pvt. Ltd.

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Know *Krishi Unnati Yojana*

The *Krishi Unnati Yojana,* a central sector scheme, is envisaged as umbrella programme for focusing on food security, by merging schemes on Soil-health Card, Integrated Scheme on Agricultural Co-operation and Agricultural Marketing, National Mission on Agriculture Extension, Horticulture Development, Price Stabilization Fund, National Mission on Sustainable Agriculture and other programmes.

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Agri and Food Startup Ecosystem in India

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Government of India through different policies and schemes like National Intellectual Property Rights (IPR) policy, Make in India, Skill India, Start Up India, Smart Cities, Digital India policies trying to build a strong ecosystem for nurturing innovations and Start-ups/ entrepreneurship in the country. The country predominantly is agrarian as its majority workforce is engaged in it. This sector has a huge potential for promoting innovations as it has rich resources of traditional indigenous knowledge, biodiversity and human capital. The country has gradually started shifting form 'a producer-driven to demand driven and market-led' agricultural research and development (R&D) system. ICAR had established 24 Agri-business Incubation (ABI) Centers to nurture early stage innovative startups and entrepreneurs. Ministry of Agriculture's Rural ABI programme is also gaining momentum. In 2018 agri-tech startups raised around $65.6 million, and food sector startups around $516. The experience of two cases, indicates that the food and agriculture sector has been thronged by the streams of educated youth, fired by the ideas, passion and innovations. These entrepreneurs and start-ups are providing missing links in the agri-value chain and delivering efficient products, technologies and services to the farmers on one hand and the consumers on the other hand. Through two cases it can be inferred that there are better opportunities for nurturing and building innovative enabling platforms for agri-business and agri-entrepreneurship in the country.

Key words: Entrepreneurs, Skill India, Startups

THE "National Intellectual Property Rights (IPR) policy in 2016, is to promote a holistic and conducive ecosystem for catalysing the economic, socio-cultural development. The policy aimed at strengthening the national initiatives such as Make in India, Skill India, Start Up India, Smart Cities, Digital India. The flagship programme of the Government like Start Up India aims at building a strong ecosystem for nurturing innovations and Start-ups/ entrepreneurship in the country. Under this, Atal Innovation Mission (AIM) is the action plan envisaged with the focus on promotion of entrepreneurship and innovation in sectors such as manufacturing, agriculture, health and education.

India has a huge potential for promoting innovations in food and agriculture. This is due to the fact that has rich resources of traditional indigenous knowledge, biodiversity and human capital. Besides the country has progressed in terms of agriculture, India has become self-sufficient in production of many commodities. Still the major part of workforce depend on agriculture, farmers' incomes are still low, output markets and input markets are operating in sub effective ways, Many asymmetrical development in production and consumption systems are there. Recognizing this, the NARES has gradually started shifting form 'a producer-driven to demand driven and market-led' agricultural research and development (R&D) system. In this transition, issues of technology transfers through commercialisation from public research, gaps of knowledge in new product development (NPD) processes for the markets and attracting entrepreneurs to this sector have emerged.

This led to development of Incubators, who are nurturing early stage startups and entrepreneurs, besides big corporates getting involved in these new product development more specifically in agri-technology and food technology. The agri-technology startups in India are trying hard to get to a scale for sustenance and growth. The majority of these startups are under three years of age and have made their model in such a way that they wanted to be the unicorn in the stiff competition. Off late innovations in new product development has been seen in private sector also, this is more in food sector. Lot of processing industries with national and international licenses have been set up in India.

Many companies are innovating on their own and lot of entrepreneurship is emerging in this sector. The face of the Indian food processing industry is redefined by the startups. We want to now clearly participate in this market, Sanjay Sharma, CEO of MTR Foods told PTI. According to RedSeer's Foodtech Market Updates, the foodtech industry has seen an overall GMV growth of close to 140% in 2018, with order volumes increasing by a whopping 176%.

The ecosystem needed to enable the growth of startups started with incubation support. Incubators are the technology-led and knowledge-driven entity to help in commercialization of innovations and research outputs. Technology business incubators not only help in growth of technology based new enterprises but also improve their survival rate from 30-70% (NSTEDB, 2016a). These also help in mustering support services for start-ups, finding funding such as venture capitalists, angel investors and better networking opportunities for locating good markets.

National Science and Technology Entrepreneurship Development Board (NSTEDB) of Department of Science and Technology, Government of India was promoting technology transfer in India through Science and Technology Entrepreneur Parks (STEPs) programme since 1982. Since 2000, NSTEDB initiated Technology Business Incubators (TBI) programme for nurturing technology and knowledge based start-ups. These incubators provide services such as developing business plan, market research, technical assistance, other support assistance such as obtaining approvals, arranging legal and IPR services, using facilities of host institute at minimal charges and proving workspace for initial period.

IIM-A CIIE, ICAR NAARM: aIDEA, Villgro and AIP- ICRISAT have done a creditable job in building the much-needed initial incubation support (mentoring as well as seed capital) in this sector. ICAR had taken the stewardship of promulgation of IP and technology commercialization process, by institutionalization of the policy through development of operational guidelines and establishment of a governance mechanism in a three tier mode across all the institutes of ICAR. Further, support is being provided for technology incubation activity and nurturing the techno-entrepreneurs in Agri-business Incubation (ABI) Centers established in 24 ICAR institutes, keeping in view the spectrum of technologies, available

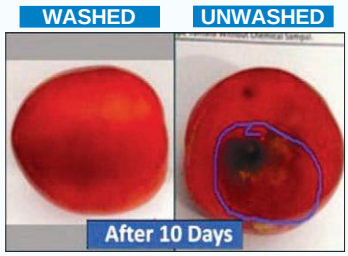
Case 1: Tazaa Agro: Ensuring fresh fruit and vegetable on your plate

Bikram Mehra, Managing Partner of Tazaa Agro after completion of his management studies joined in National Centre for Cold-chain Development, Autonomous body of Ministry of Agriculture & Farmer Welfare, Government. of India. After seeing the issues in post harvest losses, especially those of farmers he thought to do something and came up with the idea of Tazaa Agro. Post harvest quality and quantity loss is a very established fact in Indian Agri scenario. Normally 30-40% loss has been estimated in perishables like fruits and vegetables (F&V). Preventing the loss to cope up with increasing demand for these commodities would increase F&V farmers income contributing to the national goal of doubling the farmers income and preventing the national loss to the tune of 30% of GDP.

The F&V loss can be reduced significantly by using TAZAA AGRO Bio-degradable emulsion one can 1) extend the shelf life of fruits and vegetables for about 3 times in ambient temperature while preserving the quality (Table 1); and 2) Blocks the pores of F&V partially which slow down the metabolic activities of fruits and vegetables to reduces the physiological weight loss and loss of moisture. Features of TAAZA AGRO are: 1) It keeps intact the Appearance/Texture and brings shine to F&V which reduces the expenditure of edible wax.; 2) Maintain crispness, chewiness and aroma (Taste) in F&V for long period of time and preserves the original quality of juice content and flavour; 3) It can effectively resists the contaminants of micro-organisms (bacteria, fungi, viruses) when used with a combination of Ozone technology; 4) Treated F&V can be consumed directly without water wash (Easy Operation); 5) Tazaa Agro keeps F&V hydrated and prevents from drying; 5) Low cost technology and can be used by small land holder farmers, traders, retailers or cooperatives to extend the shelf life of fruit and vegetable at ambient temperature; 6) Tazaa Agro is mobile in nature and capable of being transported from one place to another.

Table 1. Difference between untreated and treated F&V at ambient temperature as follow:

F&V	Normal shelf live (days)	After treatment (days)	Increase in duration (times)
Apple	10-12	25-30	2-3
Grapes	2-3	6-8	2-3
Plum	2-3	6-8	2-3
Mango (Alphonso)	3-4	10-12	3-4
Mango	2-3	6-8	2-3
Capsicum	3-5	10-12	3-4
Tomato	5-7	14-15	2-3



infrastructure and the core competency of the institutes. Incubators of ICAR and other organizations provide an effective platform for fostering the growth of sustainable business endeavour and provide a wide range of services such as research support; business planning; office space; access to information and communication technologies; and advice on management, marketing, technical, legal, and financial issues. Realizing that novel approaches of developing new entrepreneurs and startups are a prerequisite to accelerate the process of access to new technologies by farmers.

In the recent past, we saw acceleration programmes of NAARM-aIDEA and CII joint programme of India's first accelerator in Food and Agri accelerator in 2015 and Agri Udaan in 2016, Yes Bank, Gastrotope, etc. gaining momentum. Grand challenge and awards from Ministry of Agriculture, Ministry of HRD, Marico Innovation Foundation, Rabobank, ID Capital, etc. have also opened doors for many new entrepreneurs. Now Ministry of Agriculture's RABI programme is also gaining momentum.

Since 2016 has been more promising for the agricultural sector in terms of entrepreneurship development and startups - which has traditionally been less or misunderstood sector by different stakeholders, viz. including majority of investors, on account of lack of visibility of scale and higher perceived risk on account of government policies, climate risks, high degree of fragmentation at the farming end, and lack of data and transparency in the supply chain. However, it seems to be changing now. According to YourStory Research(w2), at least 13 agritech startups raised total funding of around $65.6 million in 2018, up over 21% from total investments of around $54 million in 18 agritech startups in 2017. Clearly, the increase in number of deals and larger size of investments in Indian agtech marks an inflection point for the sector. Investment in food sector is $516 million across 70 deals in 2018 (W3).The entrepreneurial activity in

Case 2: BharatRohan: Precsion farming with Indian farmers.

A company by two young Aeronautical Engineers Mr Amandeep Panwar and Mr Rishabh Choudhary, helps farmers attain their greatest potential using hyperspectral remote sensing- based Decision Support System (DSS). The BharatRohan CropAssure™ is a subscription-based service package that provides support to the farmers from sowing to post-harvest, with periodic alerts on early diagnosis of pests infestation, disease outbreaks and supports in cultivation through IPM practices. This service also helps food companies procure pesticide residue free or IPM agriculture-produce for which they pay good incentives to the farmers. BharatRohan also provides seed companies with valuable aerial intelligence data for their Hybrid Evaluation Trials, besides serving agri-chemical companies for their product testing experiments toxicity studies, evaluation trials and data compilation for approvals, geography and bio-efficacy studies.

Their technology and proprietary algorithms are capable of gathering miniscule colour changes occurring in the plants due to different biochemical changes occurring in different phenological conditions. The company is serving more than 2,000 farmers directly across Uttar Pradesh, Andhra Pradesh, Telangana, Karnataka and Maharashtra. Also, serving one of the biggest agrichemical companies, seed companies and food companies in India.

Project 1: Peppermint Cropping System in Barabanki: BharatRohan is working on Mentha cropping system which is a very significant revenue source. The cropping system involves Mentha, paddy and potato crop. Bharat Rohan built spectral libraries in association with CSIR-Central Institute of Medicinal and Aromatic Plants, Lucknow. These libraries are correlated with and applied on Drone/UAV based Hyperspectral Data acquired from farmers field using various proprietary unmixing models. CSIR- CIMAP, also provides their phenomenal support in creating precision agriculture advisories for the local farmers for Aromatic Crops. BharatRohan's Crop Assure™ services help peppermint farmers save INR. 3,620 per acre by precisely applying the agriculture inputs where they were required. Moreover, the productivity of Peppermint oil increased from 50 kg per acre to 70 kg per acre. The company provides unprecedented advisory services through a proprietary ICT Platform, diagnose pest attacks, disease outbreaks in the crops of interest and suggest control methods, promote use of sustainable precision agriculture practices, and acquire, process and analyse farm level precision agriculture data and support farmers in implementation of precision agriculture advisory from the stage of sowing to the harvesting.

Project 2: Serving seed companies with aerial intelligence for Hybrid Evaluation Trials (HETs) and High-throughput Phenotyping Experiments. Seed companies carry out (HETs) and High-throughput Phenotyping to understand various genetic traits of the newly developed varieties. These experiments also help them in selecting the best variety to be released for farmer use. Companies spend a lot of manpower in collecting Crop Height Information which is often imprecise and bound to be biased.

Indian agtech in 2017 reached a new peak with more than 600 start-ups working for solving problems of Indian agriculture (AgriUdaan Experience of ICAR_NAARM). This number was less than 50 about five years back. Most of these entrepreneurs/startups are not formally studied agriculture but have family roots in agriculture, which makes them ideal candidates to spot the opportunity and develop solutions. Many of these startups have emerged independently, they have been mentored by industry itself. The experience, indicates that the food and agriculture sector has been thronged by the streams of educated youth, fired by the ideas, passion and innovations to launch newer kinds of technology and business models to lift the face of agriculture from primitive to hi-tech one. These entrepreneurs and start-ups are providing missing links in the agri-value chain and delivering efficient products, technologies and services to the farmers on one hand and the consumers on the other. From apps to farm automation; from protected cultivation to innovative food processing and packaging (Case 1); and from smart poultry and dairy ventures; From conventional farming to precision and smart agriculture (case 2). The proliferation of all innovations and technology driven powerful startups is set to revolutionize the food and agriculture sector. This not only speaks about millions of hopes associated with agriculture but also points out to the huge scope for agritech startups in the country to make those hopes of Indian farmers come true.

Sustainability of business models: The scale of agtech start-ups (unlike consumer internet/ ecommerce) is not driven by discounts, GMV and eyeballs. For example, the value proposition in case of direct-to-farm models is around right quality of agri-inputs at right price and right time. Likewise, for tractor rental models – it is around optimisation of assets, efficiency and timeliness of farm operations in labour-starved market. The sustainability is integral to agtech business models and that is the reason most of them have survived without external funding. The sustainability on the back of margin improvement opportunity through dis-intermediation and efficiency is unique to this sector.

Despite the progress, there is still lot of scope to improve the ecosystem and attracting the capital in the area. The low level of seed funding, incubation centers, less number of mentors coupled with lack of access to supply chains for prototyping innovations is responsible for sub-optimal growth and premature death of worthy startups.

Both public and private ecosystem necessary for agtech scale is showing green shoots. The government realizes that target of doubling farmer income can not be achieved without making innovations accessible to farmers, so they want farmers to adopt innovations. There are several other government programmes, which can also give startups enough room to innovate.

Many state governments in India have also taken giant steps to provide agtech start-ups a public platform to scale. Andhra Pradesh government clearly stands out among all state governments who have demonstrated commitment to agtech through their AP Smart Village programme (in collaboration with University of California, Berkeley) as well as organising the agtech event of the year – AP Agtech Summit, (organised in partnership with Bill & Melinda Gates Foundation), which gave many start-ups an opportunity to work closely with the government to scale innovations in the state for the benefit of farmers.

Then there are initiatives from other states, viz. Rajasthan, Madhya Pradesh, and Karnataka governments to build Custom Hiring Centres in partnership with agtech community to provide farming as a service. Karnataka government's focus on promoting millets as superfoods to get it back on consumer plate is also unique and praiseworthy.

Private sector participation is also on the rise with an intent to collaborate with agtech community to learn more about the sector and how it can impact their tried and tested businesses. Companies like Mahindra, Mahyco as well as some forward-looking SMEs are deeply engaged with agtech startups. Many insurance companies are working with ag-data startups for determination of risk profile of farmers and farms for determination of risk premium and claim settlement. Likewise, banks including Yes Bank, Rabobank have also started to work closely with many agtech startups, which can enable banks to lend efficiently to the sector.

The country paper through two cases clearly indicates enhanced opportunities for nurturing and building new enabling platforms for agri-business and agri-entrepreneurship in the country. Considering the large diversity of players in the entire agricultural production-consumption systems, there are focused areas for improving the system through R&D. The technologies and products need to be transferred through systematized approach and by forging more business partnership between technology developers and the seekers. The journey of NARES into technology transfer process has started only in 2006 as compared to initiatives in other sector. However, it may be pointed out that ICAR initiatives are in synchronization with recently announced national IPR policy of Government of India. Forging formal links and developing partnership with schemes and projects operating under other agencies of GoI (DST, DBT), successful NGOs, professional bodies and associations is one way to take forward the early initiatives and success gained. Entrepreneurs bring a new vision to the forefront of economic growth. Policy makers may consider improving conditions for entry of resource poor farmers into these modern markets, which might become much more dominant in the years to come as has happened in other developing countries.

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Agri-Business Incubation

for Rice-Based Ecosystems

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Rice is the staple food for more than 50% of the global population and for about 800 million population of India. Worldwide the crop is grown in an area of 166 million ha with a production of 500 million tonnes of milled rice. India ranks first in terms of area (42 million ha) and second in terms of production (114 million tonnes) in the World. It plays a major role in diet, economy, employment, culture and history. It is the staple food for more than 65% of Indian population contributing approximately 40% to the total food grain production, thereby, occupying a pivotal role in the food and livelihood security of people.

Key words: Agribusiness, FPOs, Rice

ICAR-National Rice Research Institute (NRRI) is a premier research and development institute in the country. Management of rice germplasm, development of varieties and technologies, quality rice seed production and reaching the farmers are the major activities of NRRI. The institute primarily follows traditional breeding methods such as pedigree and backcross to develop new varieties. Besides, molecular markers assisted selection is now integrated with conventional breeding. The doubled haploid technology has also been standardized and applied to develop varieties from popular commercial hybrids. Transgenic rice lines are being developed for validating gene function and efficacy of some known genes for tolerance to stem borer, sheath blight and drought. In addition to variety development, the institute designs farm implements, equipments and appliances for use in farm and post-harvest operations. Several crop management technologies have been standardized and are provided to the end-users. NRRI varieties occupy 18% of rice area of the country producing 28 million tons with ₹ 48,643 crores gross return annually.

Agriculture can be made remunerative if it can be taken up in business mode given there is demand for the production in the market. Twenty-seven Agribusiness Incubation (ABI) Centres have been established in different ICAR-Institutes for technology commercialisation and also to train the youth in their respective fields of interest. Entrepreneurship development remains the major objective of the ABIs to support the youth for their agribusiness start-ups.

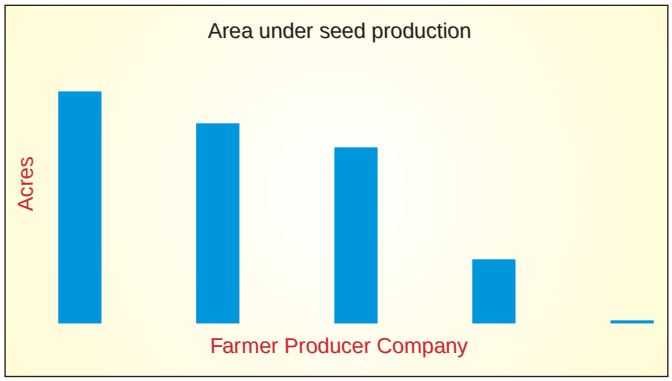
Genesis: Although NRRI–ABI started in 2016, Business Planning and Development (BPD) unit under National Agricultural Innovation Project (NAIP) had started in 2014. The foundation for ABI activities was laid since 2014 in form of identifying the suitable technologies for entrepreneurship development, procuring machineries, developing infrastructure and hiring manpower. Sensitisation meetings were held in villages for taking up farming as a business.

Promoting Agri-enterprise through Farmer Producer Organizations (FPOs)

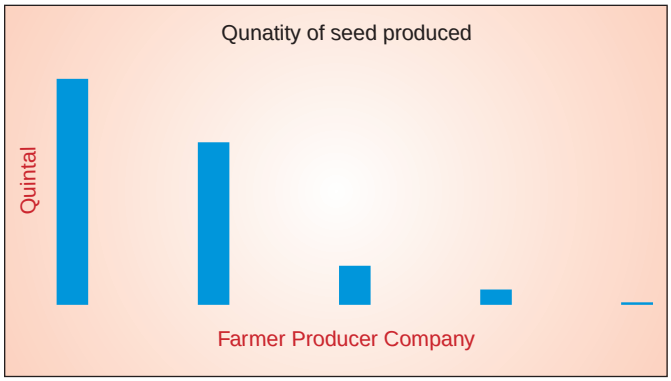
The Ministry of Agriculture, Department of Agriculture and Farmers Welfare, Govt. of India brought out a Policy and Process Guidelines for Farmer Producer Organisations in 2013 (Anonymous, 2013). At first, Strengths, Weaknesses, Opportunities and

Table 1. Farmers Producer Company formed

Company Name	CIN Number
Cuttack 4S4R Seed Farmer Producer Company Limited	U01404OR2018PTC028528 Date of Incorporation - 17 Mar 2018
Athagarh 4S4R Farmer Producer Company Limited	U01110OR2018PTC028457 Date of Incorporation - 09 Mar 2018
Niali 4S4R Farmer Producer Company Limited	U01100OR2018PTC028785 Date of Incorporation - 27 Apr 2018
Badamba 4S4R Farmer Producer Company Limited	U01100OR2018PTC029954Date of Incorporation – 29 Nov 2018
Banki 4S4R Farmer Producer Company Limited	U01100OR2019PTC030574Date of Incorporation – 22 Feb 2019



Area under paddy seed production by FPCs.



Quantity of paddy seed produced by FPCs.

Threats (SWOT) were identified for seed production, seed processing and seed marketing in Cuttack. Mahanga Block in Cuttack district of Odisha was selected as the study village for participatory seed production as it was already there in place. The data was analysed for seed production, seed processing and seed marketing using Strength, Weakness, Opportunities and Threat (SWOT) analysis and Analytical Hierarchy Process (AHP) method. Firstly, strength, weakness, opportunities and threat regarding seed production, seed processing and seed marketing were enlisted by farmers. Then the statements were prioritised using AHP method. Top three factors for seed production, seed processing and seed marketing were identified. Based on these factors 'IT enabled Self-sufficient Seed System for Rice (4S4R)' model had been developed. FPC is central to this local seed system model.

In case of seed production, it was found that Strengths: Availability of suitable irrigated and fertile land for seed production (0.219) and Farmers had basic knowledge about seed production (0.117) and Weakness: Labour problem during peak hour (0.134) were top three factors affecting seed production.

Whereas in case of seed processing, it was observed that Strengths: Technical know-how for purification (0.398) and facility for initial processing like threshing and winnowing (0.168) and Weakness: Lack of proper covered threshing floor (0.128) were top three factors affecting seed processing.

While in case of seed marketing, the Strengths: Production of quality seed and suitable appropriate variety as per requirement of the locality (0.324) and can provide seed at a cheaper rate than the market price (0.114) and Weakness: Lack of storage facility (0.143) were top three factors affecting seed marketing.

As explained earlier, a model for local seed system was developed by NRRI-ABI Centre and five Farmer Producer Companies (FPCs) were registered under Company Act, 2013. The Centre supported off-campus incubation of these five FPCs in five different blocks of Cuttack. Assessing the demand for quality rice seed of the farmers in the market, ABI centre focussed on supporting self-sufficient sustainable seed system for rice (4S4R) through FPCs. It provided all the technical supports by organizing awareness and training programs throughout the year starting from FPC formation to marketing techniques for successful sale of their products to fetch profits. Details of the FPCs are given in Table 1.

Promoting Agri-enterprise through Skill-based Agripreneurship (SBA)

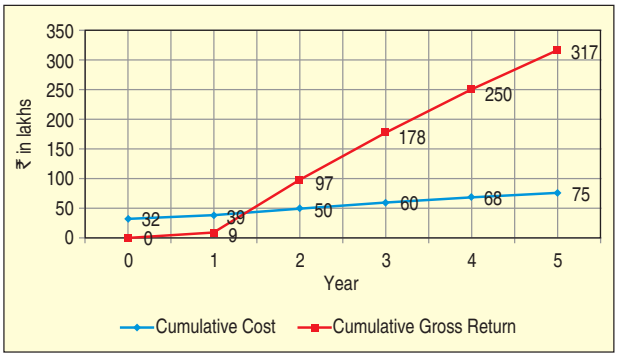
Agribusiness Incubation Centre conducts various skill-based agripreneurship training programmes to develop the potential farmers, entrepreneurs, ex-servicemen, educated and unemployed rural and urban youths as agripreneurs. Three different programmes were designed to suit the need of the clientele. These trainings are oriented to inculcate managerial and entrepreneur skills to the aspiring candidates.

1. Comprehensive Agribusiness Incubation Program (CAIP) - 3 weeks
2. Technology based Entrepreneurship Development Program (TEDP) - 1 week
3. Skill based Entrepreneurship Development Program (SEDP) - 1 week

CAIP is a three-week program oriented to provide comprehensive understanding on agriprenurship comprising of 1st week: Entrepreneur motivation; 2nd week: Agri-technologies (as per candidate's area of interest) and 3rd week: Enterprise management. This programme is designed for those who have no exposure to either entrepreneurship or business.

TEDP is a one-week program comprising of the thrust areas as per the choice of the participants. This is designed for those who have been exposed to nuances of business but want to know only about technologies.

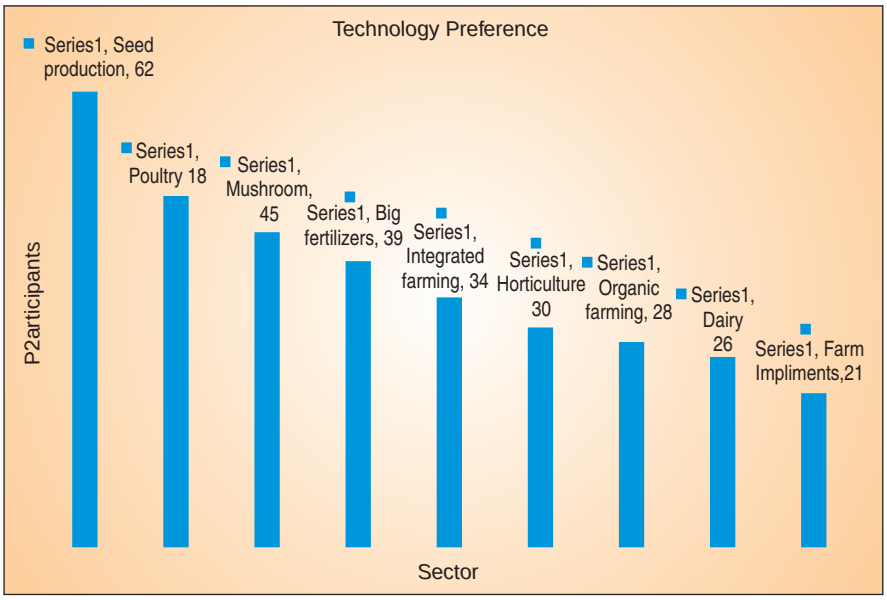
The SEDP is also a one-week programme oriented to provide hands on experience for manufacturing small agriculture farm implements.



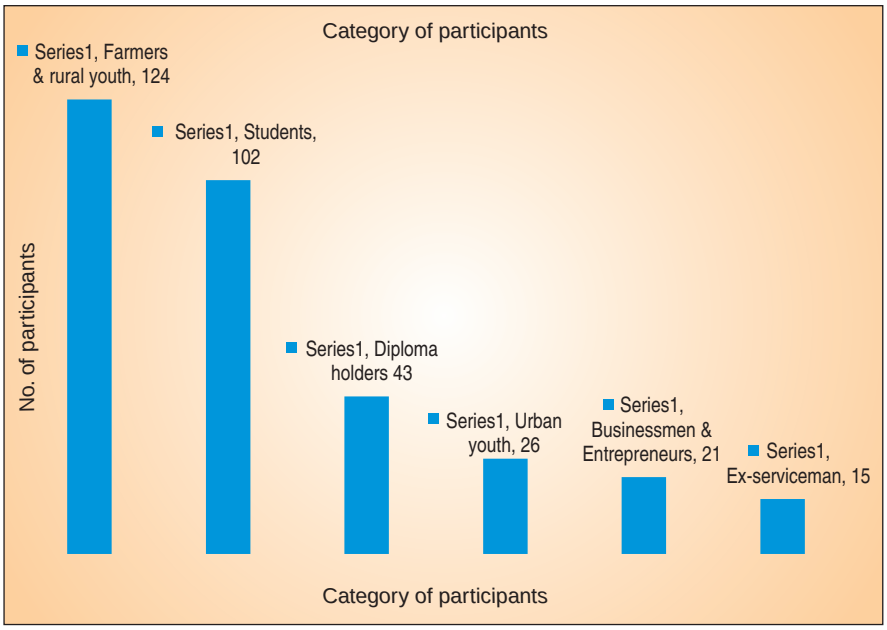
Sale realisation by FPCs and Break-Even Point (BEP).

Categories of Participants

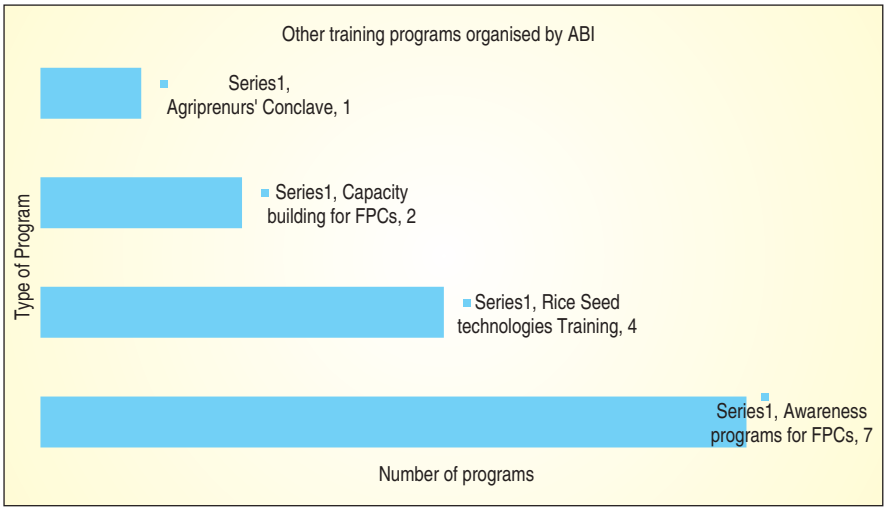
Di fferent types of participants have participated



Technology preference of the participants.



Different sectors of people participated in training programs.



Details of other programmes organised by ABI Centre.

in the Entrepreneurship Development Programs. It included farmers/farmwomen, students, entrepreneurs, ex-servicemen, youth and others.

The ABI Centre has also organised various awareness programmes and capacity building programmes for farmers on organisation and management of farmer producer companies. An agriprenuer's conclave was organised to know the status of the progress of the budding agriprenuers graduated from ABI Centre. Nine incubatees are incubating in this Centre, out of which one has started an innovative process of utilizing rice husk for making incense sticks. Other off-campus incubatees have started their agribusiness in different sectors. At ABI Centre, 63 candidates have so far graduated through Comprehensive Agribusiness Incubation Program while 257 candidates graduated through Technology based Entrepreneurship Development Program and 11 candidates graduated through Skill based Entrepreneurship Development Program.

Future plans for NRRI-ABI

The NRRI-ABI is being upgraded from incubation centre to Start-up Park which would have modern workshop, production facility for microbial fertilizer, bio-agent production unit and quality lab besides incubation offices. The start-ups will be able to use these facilities on payment basis at nominal rate.

CONCLUSION

In situations where rice cultivation is less remunerative, it can be made profitable through innovative agribusiness approaches. The role of Agribusiness Incubation Centre at NRRI is to make available the scalable and commercial technologies in rice based ecosystem to the budding agripreneurs to make their farming remunerative. With the above mentioned technologies and also with the upcoming technologies, ABI Centre would reach more number of aspirants and train them to develop agribusiness ventures through incubation process.

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Agri-Business Opportunities

through Innovative Technologies, Prospects and the Way Forward

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Innovative technical knowledge, often termed as 'improved technology' plays an important role in yield and income enhancement in agriculture and allied sectors. Research institutions, especially the publicly funded ones, often tend to be the primary sources of such technical knowledge in the form of improved varieties, hybrids and other technology-based products. Dissemination of the same for large scale adoption by the end users has often been a limiting factor, given the inadequate infrastructure and/or resources at the disposal of these research and development-based institutions. Hence, as a means of spearheading large-scale dissemination of these innovative processes and products, a novel system of 'developing and nurturing technology-based businesses' has been gaining momentum world over, which also formed a part of the UNs millennial sustainable development agenda.

Key words: Agrinnovation, Agricultural Technologies, Technology commercialization

SIMULATING the model of innovation lead entrepreneurial development through commercial licensing and incubation, has widely been practiced in a number of research universities abroad, the ICAR, the apex body for all agriculture and allied sector based research organizations in India has adopted its own policy of Intellectual Property Rights and Technology Management policy(IP&TM) in 2006. This further helped ICAR to institutionalize a robust system of technology commercialization through licensing and incubation across the R&D institutions under its purview.

In a bid to double the farmers' income within this decade, the GoI has made a number of regulatory reforms to support startups, launched Startup India with 19 Point Action Plan and hosted an Agricultural Grand Challenge to provide the startups with an ecosystem to flourish. As a part of this endeavor, 27 states and 3 UT have made tremendous policy reforms to uplift the startup ecosystem and improve the entrepreneurial efforts since the last three years.

Huge investments in order of thousands of crores seems to have been ploughed into the Science and technology based entrepreneurial development modules. Besides the Government sponsored programmes like DST, DBT, Attal Incubation, NITI Aayog etc., several industry partners like CII, FICCI, and private entities are also floating investment support for S&T based entrepreneurial ventures. Though the basic tenant of these programmes appears to be encouraging science and technology based smart solutions for the problems and constraints faced by stakeholders along the agricultural value chain, their approach differs widely across the different programmes. Innovative, smart and quick solutions based on AI and IoT have wide ranging applications across the length and breadth of the problem situations. It is reported that an estimated 3000 and more entrepreneurial ventures have been launched in the last five years trying to make an impact on the S&T based entrepreneurial development across different fields, with specific interest being on AI, IoT, smart farming solutions, market linkages.

However, in cases relating to the science and technology based solutions that also require to pass through stringent regulatory compliances like bioefficacy studies, generation of toxicological data and other specific ecological, social or other forms of compliances, it is seen that often several entrepreneurial ventures that get initiated with high competitive edge lose out soon. In this context, instead of reinventing the wheel, the startups could benefit from obtaining a license from the pool of technologies that have been developed over years of research and experimentation by the publicly funded R&D institutions taking into account the various specific requirements into consideration. The S&T based entrepreneurial options often need to pass through different

TRL levels and need to be de risked prior to being scaled up.

Initiatives by ICAR- Status and progress

After adopting its own IP policy in 2006, ICAR has institutionalized technology transfer office through its three tier system of technology commercialization process effective since 2007 with Intellectual Property & Technology Management (IP&TM) Unit at the HQ as the top tier, Zonal technology Management Centres (ZTMCs) as the middle tier and Institute Technology Management Units (ITMUs) for effective technology transfer at 72 of the research institutions under its purview. The system has been effective in commercializing over 1600 technologies to potential entrepreneurs and help set up several successful agriculture-based enterprises across the country.

In realization of the fact that some of these technology transfers often require scaling up and the licensees require handholding support both for scale up and to reach the market, ICAR initiated the Incubation activities through financial support from the World Bank funded National Agriculture Innovation Project (NAIP) since 2009. A total of around 22 incubation facilities have been initiated for effectively supporting the licensees through incubation process for a period of 18-24 months.

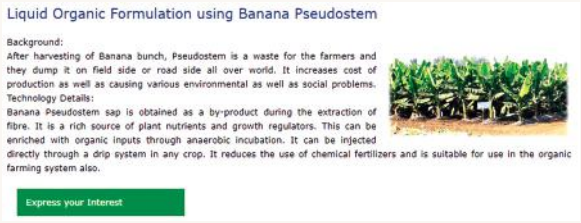
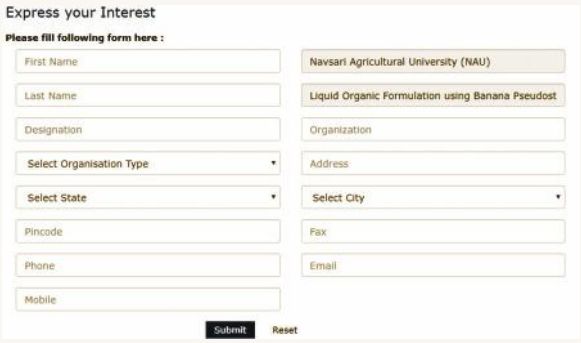
Subsequent to the NAIP, ICAR has initiated and continued the financial support for incubation facilities through the National Agricultural Innovation Fund (NAIF) since 2016 onwards. A total of 25 institutions under the ICAR have been successfully operating incubation facilities promoting individual entrepreneurs and MSME enterprises license and scale up technologies. Besides, some of these incubation facilities are also encouraging new ideas and help early stage innovations through R&D support for scale up.

The fact that the technology-based incubation facility of ICAR promotes market ready technologies that fulfill statutory compliances and regulatory frameworks, makes it easy for budding entrepreneurs to head start their businesses with immediate effect. A total of over 200 incubatees (virtual and real) have benefited from these incubation support activities, few have already broken even and have also obtained national and international recognition and funding support.

Genesis of Agrinnovate

Further, ICAR with an objective of enhancing its visibility and to cater a number of growing needs of different institutions and following the models adopted across the globe, has established a 'corporate face' that could promote technology transfers in a centralized manner- *Agrinnovate India Limited (AgIn*), a Government of India Enterprise which was incorporated under the Companies Act, 1956 (No.1 of 1956) since October, 2011, under

Table 1. User Journey on the website (www.agrinnovate.co.in) to submit the Expression of Interest

Steps	Screenshots of related section
1: Go to available technology section to see the list of research institutions and technologies available	
2: Understand the technology details by going through the solution description and related pictures.	
3: Express your interest to take up the technology by submitting your contact details	

the direct administrative control of DARE, Ministry of Agriculture & Farmers' Welfare.

AgIn within the capacity of one of its kind public sector institution, besides its primary function of promoting technology commercialization, is envisaged to facilitate the process of large scale sourcing and supply of unique bio based products for mass production with appropriate legal and statutory compliances; facilitate professional service functions of National Agriculture Research and Education System (NARS) and to enhance the pace of commercialization through capacity building for national and international clientele.

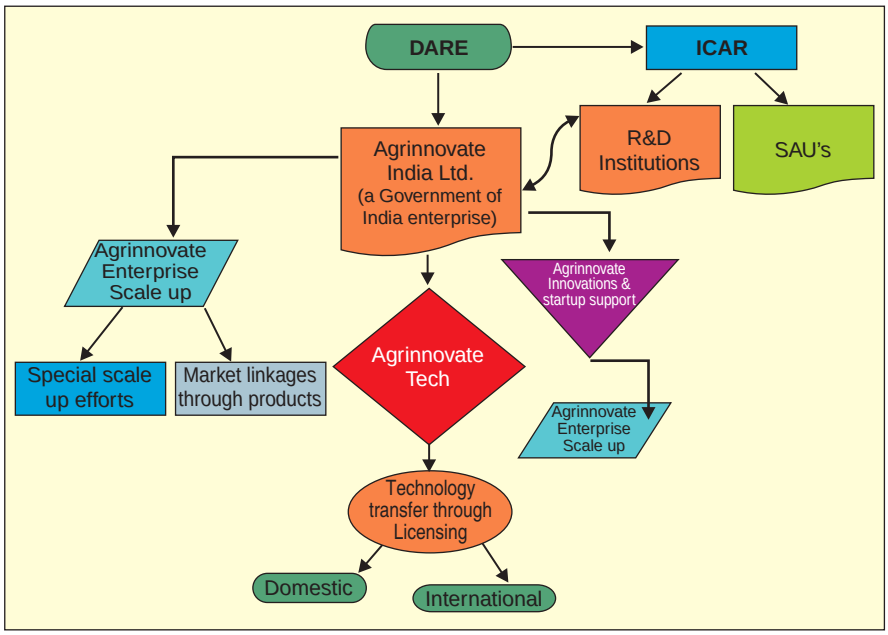
The concept of technology-based entrepreneurship development through effective technology transfer as a one stop shop for various agri based sectors through Agrinnovate has proved to be an efficient one in terms of saving both monetary and physical efforts of reinventing the wheel.

Agrinnovate India limited is promoted as:

- One stop shop for market ready agri technologies with suitable regulatory compliance,
- Facilitate strategic collaborations and turnkey projects (domestic and foreign) as per the client requirement
- Capacity building on IP and technology management and specific technology related programmes (both domestic and international)
- Technology valuation and pricing and Impact assessment for all agriculture and allied sectors including field crops, horticulture, fisheries, animal husbandry, dairy and agricultural engineering.

The technological solutions that could be obtained on a license from Agrinnovate include:

- Seed and Planting material (Field crops, horticulture)
- Bio based agri inputs (bio pesticides, bio fertilizers, Nano inputs with regulatory compliance)
- Animal husbandry, dairy and fisheries (diagnostics, vaccines, feed and nutritional products)



Proposed Integrated Technology Based Entrepreneurial Ecosystem for NARS.

- Post –harvest value added products (horticulture, meat, dairy & fisheries)
- Small and marginal Farmer friendly agricultural tools, implements and machinery
- Biotechnological products (protocols, GMO detection, molecular markers etc

Based on a sound Intellectual property rights guideline, the company has adopted its own standard operation processes that ensure stringent compliance of processes and formats such as:

- Submission of Technology Disclosure Form along with a Costing Sheet
- Techno-Commercial Assessment Committee Meeting for approval of the Standard Terms of reference between Agrinnovate and the institution in the presence of a technical expert,
- Uploading of Standard Terms
- Advertisement and Business Development
- Expression of Interest received from clients on the web or otherwise,
- Due Diligence of the Client
- Mutual Agreement of the Terms of Trade between the company and the client
- Draft Legal Agreement and Vetting followed by
- Signing of Agreement, once the license fee is received from the client.

With a revamped web site indicating/listing institute wise technologies that are ready for commercial licenses cutting across different disciplines, (www.agrinnovate.co.in) any interested individual or a company can access the technologies and submit his/her expression of interest to Agrinnovate.

Despite its slow start since 2011 to 2018, Agrinnovate India limited today has commercialized more than 30 technologies and has earned more than a crore as license fee. Technology commercialization through Agrinnovate has helped the research and development institutions under NARS in streamlining the processes by having a uniform MoU across institutions, legal vetting of individual MoUs. Further, Agrinnovate has been able to provide a 'platform for technologies available in the system' at one place and has been able to facilitate 'multiple technology transfers' in one MoU. Clients can choose different technologies from different research institutions and have one MoU for the licensing. Agrinnovate is also being able to undertake international transfers and collaborate with organizations like CII, FICCI and several others. Having initiated the process and successfully completed several tech transfers assisting ICAR institutes as well as Stat agricultural universities, Agrinnovate is getting

pepped up to take additional responsibilities of initiating national and international level capacity building programmes and facilitate financial support for innovations and incubation in the future through an integrated system proposed here with.

Proposed integrated system for efficient management

Keeping in view the diversity of technology needs, a centralized model that encompasses an integrated approach to be promoted as a unique Government of India enterprise that integrates existing mechanism of technology transfer, incubation and start up support and at the same time indemnifies the organization at large.

Under this proposed model, effort is being made to bring the existing approaches under a single platform so that multiple duplicating mechanisms would get integrated.

Agrinnovate Tech: The primary function of technology transfer through licensing will be dealt under this programme through a centralized portal where all the potential technologies from within the NARS (ICAR institutions and SAUs) will be listed and marketed through other digital platforms for large scale domestic and foreign licensing. Such a centralization would also help make the system leaner and more effective by reducing the number of 'active technology transfer offices' in the system.

In addition to the existing 'non-exclusive' licensing process, this would also include new initiatives such as 'limited exclusivity' based on geographic location and time.

Agrinnovate Enterprise Scale up: This arm of the integrated system would identify potential enterprises involving technology back up for specialized scaling up process. Agrinnovate would provide the much-needed financial support and help scale up the commercial production process, thereby, paving way for enhanced income for the organization. This could also include large scale production or sourcing of IP enabled technology products for supply. Such an initiative would help the licensees get validation of their products and also assured market of quality products, at the same time an assured income for the organization.

Agrinnovation and start up support: This arm of the integrated system would help promote startups through technology or business incubation models. The system would involve a specialized selection process ad according financial support and also equity-based participation. Other components on need based capacity building, entrepreneurial development support and technology enabling facilities for both domestic and foreign could effortlessly get added to this arm.

Such models are already in existence across the world and have proven to be successful. Converting such a set up into a status of 'federation' would be the way forward for delinking the commercial wing from the existing system and making it a truly corporate arm.

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Skill and Entrepreneurship Development

in Post-harvest Technology and Value Addition through Agribusiness Incubation

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Indian agriculture is a way of life and it supports about 60% of population for their livelihood. Engineering inputs are vital for modernization of agriculture, agro-processing and rural living. It is needed for development and optimal utilization of natural resources, appropriate mechanism of unit operations of agriculture for increasing production, productivity with reduced unit cost of production for greater profitability, economic competitiveness and sustainability. Mechanism also imparts capacity to the farmers to carry out farm operation with dignity, with ease and freedom from drudgery, making the farming agreeable vocation for educated youth as well. It helps the farmers to achieve timeliness and precisely mater and apply costly input for better efficacy and efficiency, achieving higher productivity with reduced application of inputs. Agricultural produce and by-products are perishable in nature in varying degree and their perishability gets exploited on the market floor compelling distress sales orchestrated by factors of demand and supply, intervention of the faces of marketing in the absence of matching post-harvest technology and agro-processing infrastructure. Agricultural Engineering inputs are also needed to assure remunerative prices to the growers and a share in the value addition to the growers through on-farm post-harvest technology and value addition to their produce and by-products in order to strengthen their livelihood-base landholdings which are decreasing for their socio-economic sustenance and assure minimum standards of living. This article depicts the experience of Institute Technology Management Unit and Agribusiness Incubation Centre operational at ICAR-Central Institute of Post-Harvest Engineering and Technology as an innovative developmental instrument for supporting the growth of competitive enterprises in post-harvest technology and value addition by advancing innovation in product development, process optimization technology dissemination.

Key words: Agribusiness, Agri-processing

IN ORDER to boost the trade and agro industry of the Country, the Indian Council of Agricultural Research (ICAR) established the concept of entrepreneurship and skill development through NAIP and NAIF schemes. During the current scenario number of innovative agricultural ventures are created and supported through proper intrusions and hoards. The Agri-Business incubation centres of ICAR provide support to the farmers and entrepreneurs and young unemployed youth by spawning new technologies and machineries and creating path to access latest agricultural technologies, by providing suitable need based services. Presently ICAR's incubation centres are known for their technology interventions and prompt commercialization of research outputs.

India's food ecosystem offers huge opportunities for investments with stimulating growth in the food retail sector, favourable economic policies and attractive fiscal incentives. The Government of India through ICAR is also taking all necessary steps to boost investments in the agro processing industry. Food processing has an important role to play in linking Indian farmers to consumers in the domestic and international markets. India is an agro based economy, around 65% of its population depends on agriculture to make a livelihood. In such a scenario, Agriculture has to be seen as Agribusiness and not merely a way of

life. Unless technology is blended with agri entrepreneurship, the productivity would continue to remain low as in the traditional methods of farming and agribusiness. Accordingly it is necessary to increase productivity with increasing population. A large number of technologies capable of changing the face of Indian agriculture are being churned out. Many of these new and highly useful techniques, agronomic processes, equipment and products tend to remain unused or underutilised at the farmers end for want of commercial interventions to convert them into conveniently usable forms and make them available to farmers through marketing channels.

To address the issue pertaining to income and employment generation through agro processing ICAR have set up an innovation based Agribusiness Incubation Centre at ICAR-Central Institute of Post-Harvest Engineering & Technology (ICAR-CIPHET), Ludhiana, Punjab. ITMU/ABI Centre offers their services to farmers/entrepreneurs/ unemployed youth/women entrepreneurs along with small and medium scale industries to get benefit from CIPHET developed agro based technologies for income and employment generation. Through this Centre, the Institute has transferred 47 technologies to 125 licensees and provided hand on training to more than 200 participants and has helped to create good number of jobs.

Role of icar-ciphet for development of overall business environment throgh ABI

Post-harvest processing sector has huge potential to employment and income opportunities in the rural catchment. However this opportunity is lying untapped for want of technological breakthroughs to suit requirements of rural entrepreneurs and adoption of food/ agro- processing as industry. The development of the country largely depends on its agricultural productivity and uplifting the farmers' livelihood. Lack of awareness on the values of food processing, lack of technical know-how and hands-on skill development training experiences are some of the reasons for poor interests and fewer ventures in food/agro processing. Farmers can be easily made as food processing business entrepreneurs by properly skill development training and encouraging them. Providing incubation facilities to the market test their produce will also help new ventures coming in the sector. ICAR-CIPHET has developed many technologies and processes for the benefit of small and medium entrepreneurs of India in general and Punjab in particular. At present the developed technologies are demonstrated through farmers and trade fairs, exhibitions, trainings and demonstrations. However few days exposure to the technologies developed is inadequate to create entrepreneurial abilities among the trainees, who are often farmers or small entrepreneurs. Food/Agro processing have tremendous scope and potential to emerge into biggest industry, provided processing sector reached to the production catchment. ABI-CIPHET centres at CIPHET, Ludhiana/Abohar is constantly imparting hands on skill development training on selected commodities and provide incubation facilities, technical, financial and marketing know-how to interested entrepreneurs which is supporting the entrepreneurs to tackle challenges even after successful operation of the venture. CIPHET, Ludhiana is projecting adoption of food/agro processing as rural industry to reduce post-harvest losses, transportation cost and drudgery, along with increased shelf life of agricultural produce. ABI centre at ICAR-CIPHET, Ludhiana is showcasing the working with modern food processing industries and technologies developed by CIPHET on Pilot scale to facilitate Entrepreneurship Development Programme, enthuse new entrepreneurs towards profitability of food processing units, and extend support even after adoption of technologies.

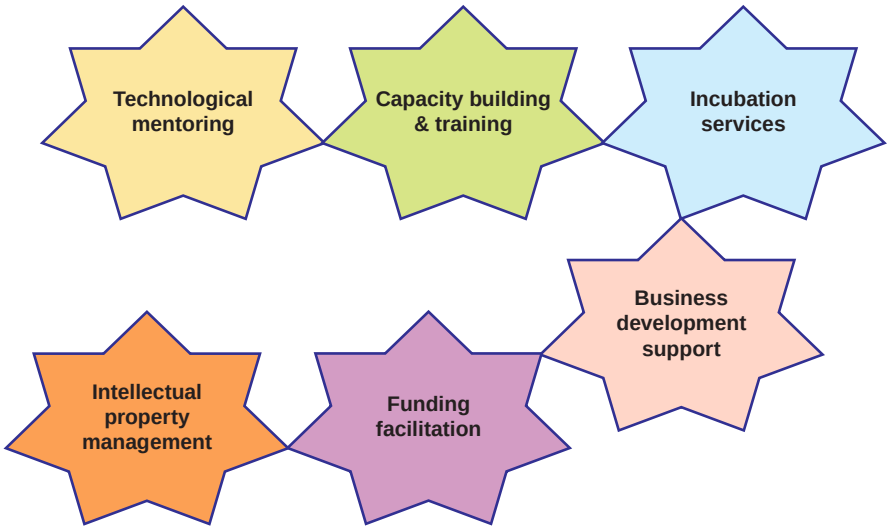
Working model of ABI

CIPHET-ABI Centre helps the clienteles in decision making through a questionnaire consisting of technology development stages, project viability, maturity cycle and resource requirements.

For successful implementation of the project, the centre provides support for project reports consisting of all necessary aspects such as technical, financial, commercial and operational strategies.

Clients and their team members are provided training to obtain, improve, and retain the skills, knowledge, tools, equipment, and other resources needed to adopt the particular technology and do their jobs competently.

Logistics support in terms of providing well furnished, air-conditioned office spaces for the Clients to set up their office, ICAR-CIPHET also provides access to its commercial pilot plant facilities such as tomato processing plant, chilli



processing plant, kinnow processing plant etc. Thus, incubatees can take up commercial production using the machineries and instruments set up in the Pilot plant, without setting up a facility of their own, until successful test marketing phase. In addition with this, the Centre provides assistance and guidance to incubates in obtaining statutory approvals, registration, licenses, certifications etc at the time of start of business enterprise. The centre also provides assistance in the development and formulation of a product brand and provides support regarding intellectual property rights through Patent Attorney. The Centre promotes the incubatee products through the Institute's social media, websites, publications and showcase them in national and state level exhibitions, industry meets etc.

SUCCESS STORY

Following start-ups have been started after taking incubation facility under the guidance of ABI, ICAR-CIPHET Ludhiana

Mr Japinder Wadhawan, young and budding mechanical engineer approached CIPHET Ludhiana for training and incubation on design and manufacturing of agro processing machines. He was admitted for incubation during 2019-20. After getting incubation from ABI CIPHET the incubate started his own start up in the brand name of M/S Raftaar Start up with the financial assistance of MSME for manufacturing of agro processing machineries. He is manufacturing post-harvest equipments/implements for various institutions, universities firms etc.

Mr. Ashwani Garg, entrepreneur from HP approached CIPHET Ludhiana for training and incubation on Makhana Popping Machine. He was admitted for incubation during 2019-20. After getting incubation from CIPHET the incubatee started his own start up in the name of M/S Unitech Technocrats Start up for manufacturing of makhana popping machine and supplying to makhana processors.

Mr. Harjit Singh, entrepreneur from Khanna, Punjab approached CIPHET Ludhiana for training and incubation on groundnut/soy processing. He was admitted for incubation during 2019-20. After getting incubation from CIPHET the incubatee started his own start up in the brand name of M/S Suraj Udai Agro-foods Start up for manufacturing of ground-nut/soy products under the brand name of Udai Shakti and making products such as soy milk, tofu, grounsnut milk, paneer etc and supplies to local market, Jalandhar, Chandigarh.

Mrs. Karamjit Kaur, entrepreneur from Abohar, Punjab approached CIPHET Ludhiana for training and incubation on aonla processing. She was admitted for incubation during 2016-17. After

getting incubation from CIPHET the incubatee started her own start up in the brand name of M/S KK Foods Start up for manufacturing of aonla prodcuts such as preserve, candy, pickle ladoo etc. and supplies in local market, Ludhiana, Faridkot, Ferozpour etc.

SUMMARY

India is endowed with varied agro-climate, which facilitates production of temperate, sub-tropical and tropical agricultural commodities which lead to main generator of employment and income to millions of people. Entrepreneurship in post-harvest technology and value addition is not only an opportunity but also a necessity for improving the production and profitability. These incubators can take the form of comprehensive occupational schools, offering rural producers and workers sufficient knowledge, experience, infrastructure, and means to become agribusiness entrepreneurs. This endogenous movement can have far-reaching effects, promoting the overall modernization of primary production, industrialization, and marketing and development of rural areas. The ABI CIPHET Ludhiana take care of technologies, advise/ guide the farmers and entrepreneurs and young unemployed youth for exploring new business opportunities and therefore help to enhance and improve economic development through post-harvest processing and value addition of agriculture produce.

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Agri-business Incubation System in India:

An Overview of ICAR

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The approach of developing a culture of agribusiness incubation and agri-entrepreneurs is a prerequisite to accelerate the process to new technologies by the farmers' for realizing the goal of doubling the farmers' income by 2022. ICAR had taken the initiative to promote the IP and technology commercialization process, by institutionalization of the policy through development of guidelines and establishment of a suitable mechanism in three-tier mode in the ICAR institutes. Further, support is being given to the activities related to agri-business incubation which nurtures the technology entrepreneurs and starups in 50 ICAR Agri-business Incubation (ABI) centres network all over the country. These centres provide the effective platform for fostering the growth of sustainable business endeavour and provide the service support like research support, business planning, advice on management, marketing, technical and financial matters.

Key words: Incubation Fund, Start-up India Action Plan, Tax Exemptions

Initiative on Agribusiness Incubation system in Indian Council of Agricultural Research (ICAR)

In the Indian National Agricultural Research System (NARS), ICAR had taken the stewardship of promulgation of IP and technology commercialization process in 2006 and as an effort to adapt to the new IP regimes, took initiative of bringing in a new policy direction through its rules and guidelines on intellectual property and technology management. At the same time, to emphasize more on innovation management and creation of agri-business environment, establishment of business incubators in NARS initiated with the National Agricultural Innovation Project (NAIP) under World Bank funding. In this project 10 Business Planning and Development (BPD) units were established (5 in ICAR institutes and 5 in State Agriculture Universities). Later, up-scaling the initial efforts, 12 more such BPD units were established in the phase 2 (2013-14). These Units were provided the physical infrastructure necessary for technology incubation and to launch new business; including offices and lab space, and shared resources such as specialized equipment's and technical support services. Appropriate capacity building in terms of human resource was also undertaken by engaging/contracting professional help and providing required trainings to the existing inter-disciplinary professionals in the

Agribusiness Incubation Activities under National Agricultural Innovation Project (NAIP)*(from 2006 to 2014)*

ICAR-Institute	Entrepreneurs Trained/ Supported (Nos)	Incubators Enrolled/ Incubated (Nos)	Entrepreneurs Graduated (Nos)	Local employment generated (direct) through incubates (Nos)
CIAE, Bhopal	327	9	0	0
CIFA, Bhubaneshwar	29	8	0	35
CIFT, Cochin	490	71	6	31820
CIPHET, Ludhiana	0	10	10	0
CIRCOT, Mumbai	47	129	15	116
CPCRI, Kasargod	0	20	10	0
CPRI, Shimla	82	31	1	10
IARI, New Delhi	307	366	7	35
IIHR, Bengaluru	383	76	0	0
IISR, Indore	12	1	0	0
IIVR, Varanasi	1	0	0	0
IVRI, Izatnagar	50	15	5	100
NAARM, Hyderabad	128	0	0	100
NDRI, Karnal	331	6	0	10
NIRJAFT, Kolkata	54	118	1	100
NRRI, Cuttack	46	16	0	0
Total	2287	876	55	32326

(*Source:* NAIP Final Reports, 2014-15)

area of technology management and enterprise creation. The BPD units successfully nurtured and developed the skills of entrepreneurs and helped in commercialization of technologies. The salient progress of these BPDs are summarized as follows:

In order to institutionalize the policy and operational guidelines, ICAR launched a scheme titled Intellectual property management and transfer/commercialization of Agricultural Technology Scheme in XI Plan. This, consequently, led to establishment of an IP governance mechanism in a three tier mode across all the institutes of ICAR. The Institute Technology Management Units (ITMUs) have been established in all ICAR institutes to pursue matters related to IP management with the purpose of accelerating transfer/commercialization of technologies in the institutes. The ten Zonal Technology Management Centers (ZTMCs) have been established to facilitate the ITMUs in their subject domain. The Intellectual Property and Technology Management (IP&TM) Unit at ICAR Hqrs does the overall facilitation; and has led by developing policy guidelines, undertaking training programs and helping the units on difficult issues beyond the capacity of ITMUs or ZTMCs.

The success achieved laid the basis for providing a continuum in the ICAR for technology commercialization, incubation and entrepreneurship development. The Scheme 'National Agriculture Innovation Fund' (NAIF) is operating at ICAR with the following major objectives:

i. Nurture the national agriculture innovation system for accelerated intellectual property (IP) generation and better protection of IP through well-established formal institutional mechanisms, that are in tune with the need of the time; and incorporate suitable instruments for incentives, awards, and other innovation-recognition mechanisms that encourage greater and rapid innovativeness in system.
ii. Undertake inter-institutional networking to link individuals and institutions with specific core competencies in diverse areas of agriculture, for demand-driven, market-oriented R&D to generate commercially viable know-how and technologies for mass impact.
iii. Create conducive agribusiness environment and required capacity building for skill and entrepreneurship development in scientific fraternity, young research scholars, entrepreneurs, grass root innovators, and start-up organizations in agribusiness dimensions using IPR-enabled and open source agricultural technologies.

The idea of Incubation Fund under NAIF was conceptualized from the report of the Prime Minister's Task Force on Micro, Small and Medium Enterprises (pg. 90/January 2010). The report states that despite the efforts, institutional linkages for research & development institutions and industry has not developed. Also, in spite of India having the advantage of a large pool of human resources, the industry continues to face deficit in manpower possessing the right skills for manufacturing, service, marketing, etc. It recommends setting up of Business Incubators that would assist entrepreneurs in further development of their new/innovative ideas.

Incubation centres will also play a significant role in lending credibility to start-up enterprises and effecting the enabling environment for agribusiness entrepreneurs; which would operate profitably, leading to a catalytic effect in the growth of the overall agriculture sector. The implementation, governance and management of this component is vested with the IP&TM Unit (as the National Coordination Unit for Incubation Fund) at ICAR Headquarters. The Steering Committee for monitoring of this component has formed in XIIth plan at ICAR Hqrs level with Secretary (DARE) & DG, ICAR as the Chairman and IP&TM Unit as its Member Secretariat. One Clearing House and Facilitation Centre is established at ICAR's National Academy of Agricultural Research Management (NAARM), Hyderabad to facilitate the IP&TM Unit/ National Coordination Unit in implementation of the project. One Program Implementation Committee (PIC) had constituted in each of the nine ZTMCs and one general PIC at NAARM will be constituted in the Chairmanship of the Directors of these respective institutes.

Agri-business Incubation

Agri-business Incubation (ABI) Centres in ICAR were established in 2016 in 25 institutes. These incubators provide an effective platform for fostering the growth of sustainable business endeavour and provide a wide range of services such as research support; business planning; office space; access to information and communication technologies; and advice on management, marketing, technical and financial issues. This initiative addresses the much-needed requirements of business incubation for converting agriculture technologies into an attractive commercial proposition. Accordingly, a network of established 25 ABI centres in various institutes; and further expanded by establishing another 25 new ABIs at different ICAR institutes in October 2019. Thus, the total strength of ABI network in ICAR is 50.

Objectives of the Incubation Fund

- To establish/transform agri-business Incubator centres as leaders in NARS that would provide technology and skill upgradation, inputs supply and market support leading to promotion of viable enterprises and sustainable employment to entrepreneurs;
- To undertake last mile scale-up from pilot level of value chain in collaboration with stakeholders;
- To explore and support appropriate technologies including grassroots' innovations that are vital in future for an accelerated growth and competitive technological

leadership;
- To impart training and capacity building to prospective entrepreneurs; generate value added manpower to compete effectively.

Salient Features of Agri Business Incubation (ABI) Centers

- 2016-19: 25 Agri Business Incubation (ABI) Centers of ICAR had facilitated 662 incubates/ entrepreneurs/start-ups for their agri-business related technical as well as infrastructural needs in the last three years (2016-17 to 2018-19) and graduated/ trained 385 entrepreneurs/ start-ups for starting their business in agriculture and allied sectors.
- 2019-20: 25 ABI centres have been supported/established in various institutes; and issued a sanction for 25 new ABIs, at different ICAR institutes. Thus, the total strength of ABIs in ICAR is 50. These ABIs undertook different activities to facilitate the business environment in the ICAR institutes, which include, Agri-entrepreneurs/ Incubators admitted for incubation (207); Agri-entrepreneurs/ Incubators graduated (91); Entrepreneur Development Programme (EDPs) organized (86); and Agri-business Development/Awareness Programmes Organized (290).

Outside ICAR Support

National Initiative for Developing and Harnessing Innovations (NIDHI) is an umbrella programme conceived and developed by the Innovation and Entrepreneurship Division of National Science and Technology Entrepreneurship Development Board (NSTEDB) of Department of Science & Technology, Government of India, for nurturing ideas and innovations into successful start-ups.

Objectives of NIDBI-Technology Business Incubator

- To create jobs, wealth and business aligning with national priorities.
- To promote new technology/ knowledge/innovation based start-ups.
- To provide a platform for speedy commercialization of technologies developed by the host institution or by any academic/technical/R&D institution or by an individual.
- To build a vibrant startup ecosystem, by establishing a network between academia, financial institutions, industries and other institutions.
- To provide cost effective, value added services to startups like mentoring, legal, financial, technical, intellectual property related services.

Under this programme, five ICAR institutes got incubation facility support, viz. National Dairy Research Institute (NDRI), Karnal (2008); Indian Institute of Horticulture Research (IIHR), Bengaluru (2008); National Academy for Agriculture Research and Management (NAARM) (2014); Indian Institute of Millet Research (IIMR), Hyderabad (2017); and Indian Agricultural Research Institute (IARI), New Delhi (2018).

Rashtriya Krishi Vikas Yojana – Remunerative Approaches for Agriculture and Allied Sectors Rejuvenation (RKVY-RAFTAAR) is a unique scheme of Government of India, Ministry of Agriculture and Farmers' Welfare (MoA&FW). It is aimed at strengthening infrastructure in Agriculture and Allied sectors to promote Agripreneurship and Agribusiness by facilitating financial aid and nurturing a system of business incubation.

Objectives RKVY-RAFTAAR

- To achieve "Lab to land" by dissemination of new technology/ varieties to farmers through promoting a culture of Agri startups
- To promote innovation, entrepreneurship and business creation in agriculture and allied sector by skill development, capacity building and technology scale up;
- To create employment opportunities for youth in agriculture in the rural vicinity;
- To promote an integrated approach for technology acquisition, R&D, commercial technology transfers and knowledge dissemination;

Under this programme, 29 RABIs have been supported in agriculture research institutes, out for that five ICAR institutes got selected with above mentioned objectives, viz. Indian Agricultural Research Institute (IARI), New Delhi (Knowledge Partner for RABI); Indian Institute of Millet Research (IIMR), Hyderabad; National Rice Research Institute (NRRI), Cuttack; Central Institute for Research on Cotton Technology (CIRCOT), Mumbai; and National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI), Bengaluru.

Start-up Initiative in India

The Ministry of Rural Development (MoRD) has implemented the Start-up Village Entrepreneurship Programme (SVEP), as a sub-scheme under Deendayal Antyodaya Yojana National Rural Livelihoods Mission (DAY-NRLM). This scheme was approved on 6th May 2015. The objective of the scheme is to help the rural poor to set-up enterprises at the village level in non-agricultural sectors. Besides providing start-up capital, a cadre of Community Resource Persons-Enterprise Promotion (CRP-EP) is set up to provide business support services to enterprises. As on 31st October, 2019, AAPs have been approved for 153 blocks across 23 States. DPRs have been approved in 120 blocks in 21 States. As per the approved DPRs, 1.93 lakh enterprises are targeted for formation over a 4-year period. As on 31st October, 2019, a total of 69,991 enterprises has been set up.

Start-up India is a flagship initiative of the Government of India, intended to build a strong eco-system for nurturing innovation and Start-ups in the country that will drive

Subject Specific ABI Centres at ICAR

Animal Science: 7, Crop Science: 13, Agricultural Engineering: 5, Agricultural Education: 2, Horticulture: 12, Fisheries: 4, Natural Resource Management: 7

sustainable economic growth and generate large scale employment opportunities. The Government through this initiative aims to empower Start-ups to grow through innovation and design. Start-up India initiative launched on 16th January 2016, consists of 19 Action Points that act as a guiding document for the initiative. As on 26th November 2019, there are 25,115 recognized start-ups in India.

Under Start-up India initiative, an entity is considered a 'Start-up' if:

- it is incorporated as either Private Limited Company or Registered Partnership Firm or Limited Liability Partnership. A sole proprietorship or a public limited company is not eligible as start-up
- its turnover for any of the financial years has not exceeded INR 100 crore
- it is working towards innovation, development or improvement of products or processes or services, or if it is a scalable business model with a high potential of employment generation or wealth creation
- it has not been formed by splitting up or reconstruction of a business already in existence.
- it is up to 10 years from the date of its incorporation/ registration

Salient features of Start-up India action plan

Compliance Regime based on Self-Certification with an objective to reduce the regulatory burden on Start-ups thereby allowing them to focus on their core business and keep compliance cost low.

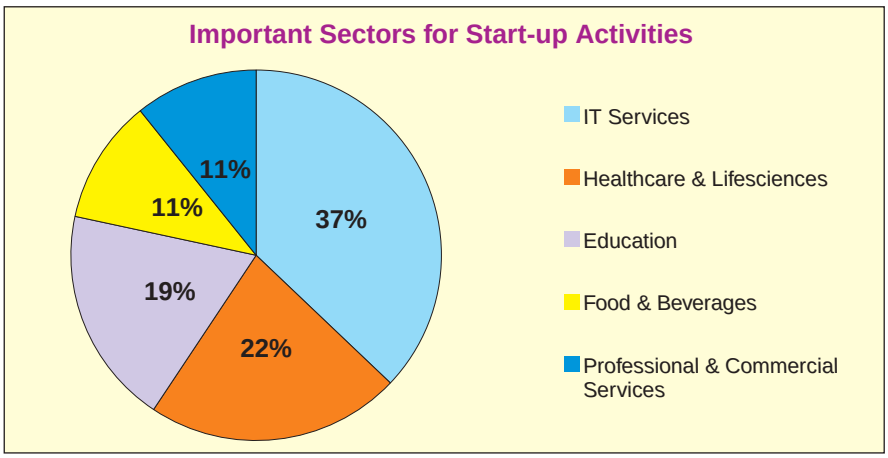
Start-up India Hub with an objective to create a single point of contact for the entire Start-up ecosystem and enable knowledge exchange and access to funding.

- Rolling out of Mobile App and Portal with an objective to serve as the single platform for Start-ups for interacting with Government and Regulatory Institutions for all business needs and information exchange among various stakeholders.
- Legal Support and Fast-tracking Patent Examination at Lower Costs with an objective to promote awareness and adoption of IPRs by Start-ups and facilitate them in protecting and commercializing the IPRs by providing access to high quality Intellectual Property services and resources, including FastTrack examination of patent applications and rebate in fees.
- Relaxed Norms of Public Procurement for Start-ups with an objective to provide an equal platform to Start-ups across sectors vis-à-vis the experienced entrepreneurs/ companies in public procurement.
- Faster Exit for Start-ups with an objective to make it easier for Start-ups to wind up operations.
- Providing Funding Support through Fund of Funds with a Corpus of ₹ 10,000 crores with an objective to provide funding support for development and growth of innovation driven enterprises.
- Credit Guarantee fund for Start-ups with objective to catalyse entrepreneurship by providing credit to innovators across all sections of society.
- Tax Exemptions on Capital Gains with an objective to promote investments into Start-ups by mobilizing the capital gains arising from sale of capital assets.
- Tax Exemptions to start-ups for 3 Years with an objective to promote the growth of Start-ups and address working capital requirements.
- Tax Exemption on Investments, above Fair Market Value with an objective to encourage seed-capital investment in Start-ups.
- Organizing Start-up Fests for Showcasing Innovation and Providing a Collaboration Platform with an objective to galvanize the Start-up ecosystem and to provide national and international visibility to the Start-up ecosystem in India.
- Launch of *Atal Innovation Mission* (AIM) with an objective to serve as a platform for promotion of world-class Innovation Hubs, Grand Challenges, Start-up businesses and other self-employment activities, particularly in technology driven areas.

Harnessing Private Sector Expertise for Incubator Setup with an objective to ensure professional management of Government sponsored/funded incubators, Government will create a policy and framework for setting-up of incubators across the country in public private partnership.

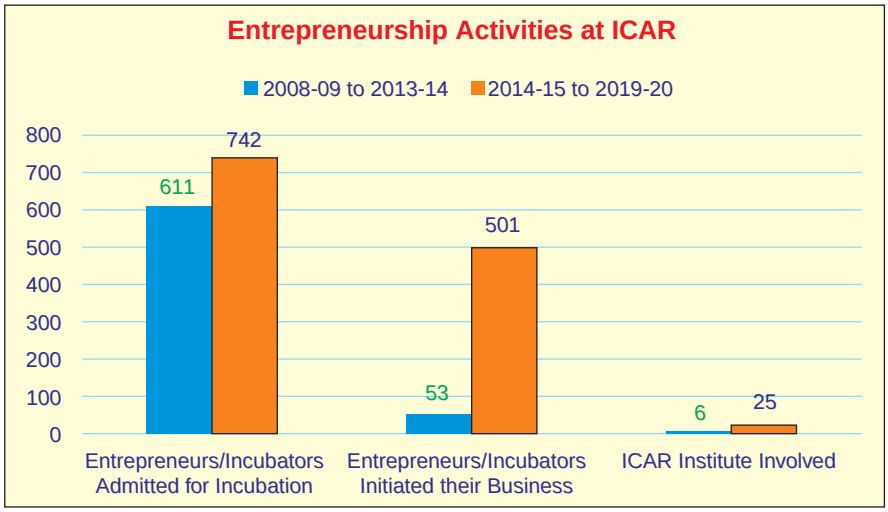
Building *Innovation Centres* at National Institutes with an objective to propel successful innovation through augmentation of incubation and R&D efforts.

- Setting up of 7 New Research Parks Modelled on the Research Park Setup at IIT Madras with an objective to propel successful innovation through incubation and joint R&D efforts between academia and Industry.
- Promoting Start-ups in the Biotechnology Sector with an objective to foster and facilitate bio-entrepreneurship.
- Launching of Innovation Focused Programs for Students with an objective to foster a culture of innovation in the field of Science and Technology amongst students.
- Annual Incubator Grand Challenge with an objective to support



creation of successful world class incubators in India. Sector Number of start-ups recognized by DPIIT in each sector as on 21st November 2019.

The top five sectors in which maximum number of start-ups have been recognized by DPIIT since launch of the initiative include IT Services (3443), Healthcare & Life-sciences (2063), Education (1766), Food & Beverages (1009), Professional & Commercial Services (998).



Start-up Entrepreneurial Activities at ICAR

Agri-Startup and Entrepreneurship Conclave: Council had organized a two days Agri-Startup and Entrepreneurship Conclave for *Unleashing potential in agriculture for young agripreneures* (UPAYA) on the World Food Day during 16-17 October, 2018 at NASC Complex, Pusa New Delhi. About 700 participants attended the Conclave which includes 104 ICAR (ABI-Network) nurtured agri-startups /entrepreneurs /licensees from different corners of the country. It had provided a unique platform for bringing together agri-professional, business experts, researchers and Farm Producers Organizations (FPO) in a face to face mode, same time country's finest mentors, angel investors, and venture capitalists were also interacted in different technical domains.

The platform was also equipped with an exhibition of agri-startups / entrepreneurs /licensees on farm machinery, fish gadgets, plant protection methods, post-harvest technologies, and seed and planting material, for sharing of success stories and explored business and marketing linkages, technology and financial tie-ups and partnership opportunities. It had been created the desired awareness and helped to build an entrepreneurial environment particularly in agriculture sector with participation of various stakeholders such as the government, corporate, educational institutions and other who were interested to join hands and together built a better ecosystem for entrepreneurship in agriculture sector.

In the line of Start-up India initiative, Hon'ble Union Minister of Agriculture and Farmers Welfare had released a book entitled as "AgRIM-Agri-Startups: Reflection of ICAR Technologies in Market". This book is a compilation of profile of 100 Agri-Startups of different domains of agriculture and allied areas. These start-ups have been supported by ICAR at various stage such technology license, incubation, training, IP filing etc.

Other than this Council is regularity emphasizing on entrepreneurial activities at different institutes.

Conclusion

The interaction between R&D institutions in agriculture and industry has significantly increased over the last few years the impact has been less than desired. There are several stages of development through which a new technology passes before reaching the farmers through commercial channels; and in the initial stages there is very limited consideration of business. The subsequent stages shall involve optimization and take into account business as well as marketing considerations. Experience has shown that the industry and the academic institutions have adopted an over-cautious, risk-averse and safety-first approach in partnerships, focusing on "sure projects", or "low hanging fruits". The primary reason being that in innovation based partnerships or collaborations the end result is not always certain and commercial success is not often assured right in the beginning. Therefore, it is not easy to motivate the industry to participate in the innovation-based technology development as the risk is large and financial returns are not easily foreseeable.

Internalize the IPR dimensions, nevertheless, is becoming more and more complex, because of the divided opinion among people who are passionate about the environmental and public good perspective of public sector research in agriculture and others with strong feelings towards much faster realization of the agro-economic value in natural resources. While the debate goes on, steps are being taken by GoI to strike a balance between affordable access and private interest. ICAR intends to closely work with other organizations/departments and as in the past shall adjust the policy frameworks, if need be, to provide the basis for equitable adjudication between the various interests involved in a manner consistent with the ICAR's primary commitment to public interest.

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Enabling New Generation Entrepreneurs

in Horticulture through Horti-Business Incubation

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ICAR-Indian Institute of Horticultural Research, Bengaluru, Karnataka 560 089

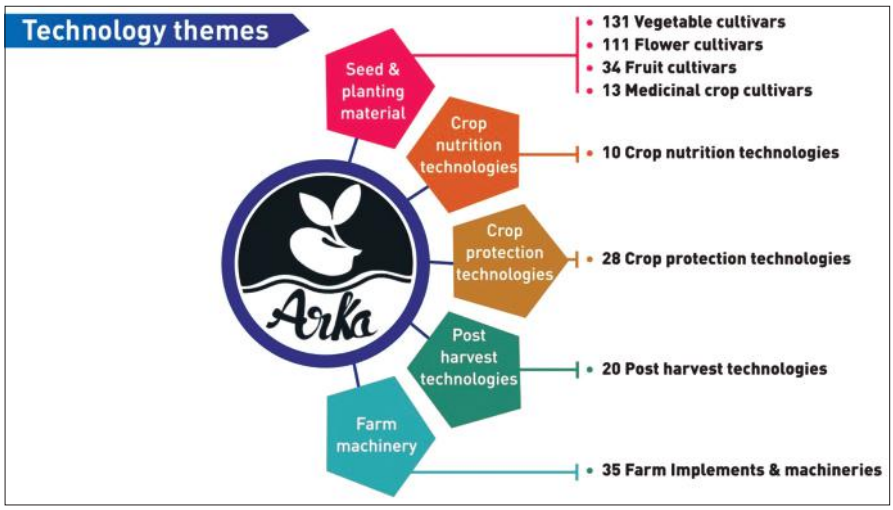
Institute Technology Management Unit & Agri-Business Incubation centre located at ICAR-Indian Institute of Horticultural Research, Bengaluru is a facility of Indian Council of Agricultural Research (ICAR) created through National Agriculture Innovation Fund (NAIF) to commercialize the technologies of ICAR-IIHR by non-exclusive licensing, nurture horticulture technology based start-ups/ventures and horti-business consultancy through incubation. Technology developed for the benefit of farmers and other stakeholders will be successful when it is adopted by large number of growers. This is possible only when the technology is made available in adequate quantity with quality. The technologies developed by the research institutes was made available for farming community through commercialization and incubation of start-ups. Main objective of ITMU & ABI unit is to impart appropriate IP protection to the innovations, showcase, transfer, commercialize innovations from the ICAR-IIHR. The ITMU and ABI a unit of ICAR-IIHR, Bengaluru strives to be a bridge that links the research community with all the stakeholders of horticulture and business community. It attempts to promote horti-business ventures through technology development, dissemination and commercialization for everyone from corporate to individual farmer.

Key words: Crop Nutrition Technology, Farm Machinery, Plant Health Management

FOCUS AREAS OF ITMU & ABI

Seed & Planting Material

The improved varieties, hybrids having multiple disease resistance and high yield in crops like vegetables, fruits, medicinal and ornamental crops have been developed by the institute. Lines with special traits like male sterility have also been made available. In the last ten years, institute has licensed these technologhies to more than 73 seed companies.



Plant Health Management

Safe and cost effective plant health management technologies like bio-pesticides, micronutrients, botanical formulations, pheromone traps and bio fertilizers *etc.*, are offered to promote sustainable plant health management.

Post-Harvest Technologies

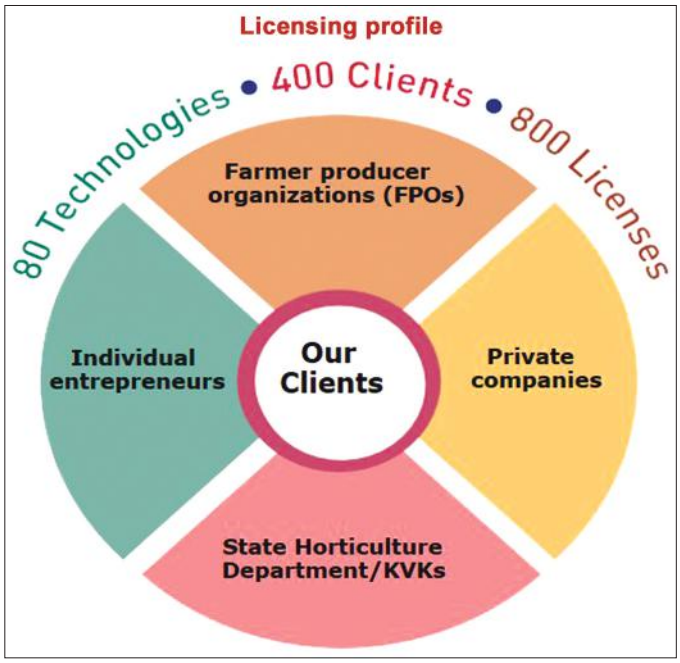
Processed products like fruit bar, osmotically dehydrated products, ready to serve (RTS) beverages, crushed tomato, squashes, wines, dry flower, mushroom products available are available for licensing.

Farm Machinery & Implements

The institute has developed various machineries and implements for facilitating farm mechanization, several designs for licensing viz.

- *Nursery Machinery:* Rooting Media

Mixing Cum Filling Machine - Automatic Dibbler Cum Vaccum Seeder
- *Sowing and transplanting*: Onion Drum Seeder - Broad Bed Former Cum Vegetable Seedling Transplanter
- *Fruit harvesters*: Mango, Sapota and Lime Harvester - Tractor Drawn Hydraulic Platform for Harvesting and Pruning
- *Mango processing*: Raw Mango Peeler, Slicer and Cube Cutter
- *Mushroom spawn production*: Motorized Grain Cleaner, Grain Boiler, Grain and Chalk Powder Mixer, Bag Filling Machine and Bulk Spawn Inoculators
- Fruit and Vegetable vending van
- Arka High Humidity Storage Box



Incubation model operation at ICAR-IIHR

Biotechnology

The division has developed technology for embryogenic cell suspensions for mass multiplication of banana (cv Elakki bale).

Incubation Models at ICAR-IIHR

The incubation facility provides handholding and capacity building support for entrepreneurs and start-ups in scaling up of technology based products from lab scale to commercial scale. ICAR-IIHR adopts a technology based incubation model of three pronged approaches of (i) On-site Incubation (ii) Off-site Incubation (iii) Specialized Incubation

On-site Incubation

Clients are provided technology up-scaling facilities inclusive of infrastructure, space and other technical inputs. This facility enables the start-ups for maximizing their profit. Under this mode of incubation, technology innovator works in close collaboration with the client for scaling up the business processes. The incubatee is also permitted to sell product through marketing network of the institute and assist the client to get better market access.

Off-site Incubation

In this mode of incubation, the client enters into MOU and obtains license for technology and take up production in own facility. If any technical guidance is required by the client during the production, the innovator will visit the client's site and provide the requisite advice and direction.

Specialised Incubation

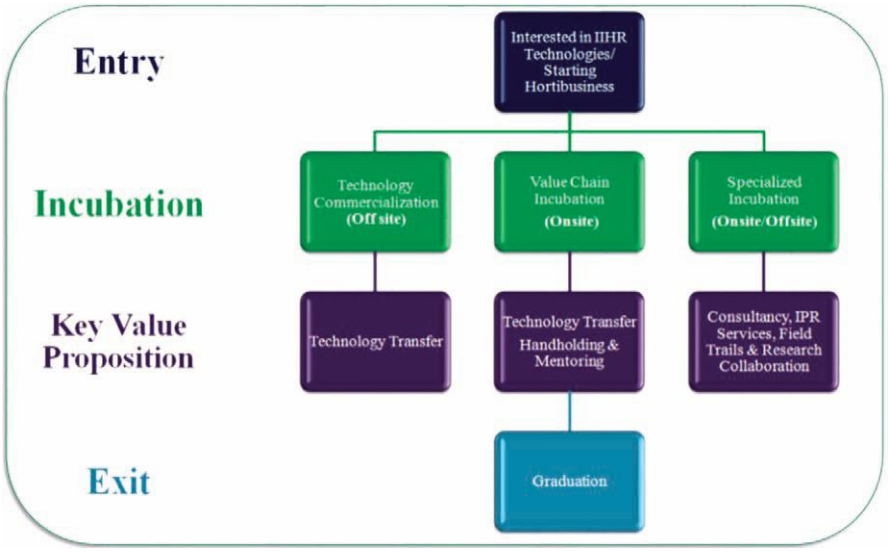
The institute also has facility for providing consultancy services in specialized areas as required by clients. Under the specialized incubation mode there is provision for research collaboration, concept testing, new product development, product enhancement, paid up trials.

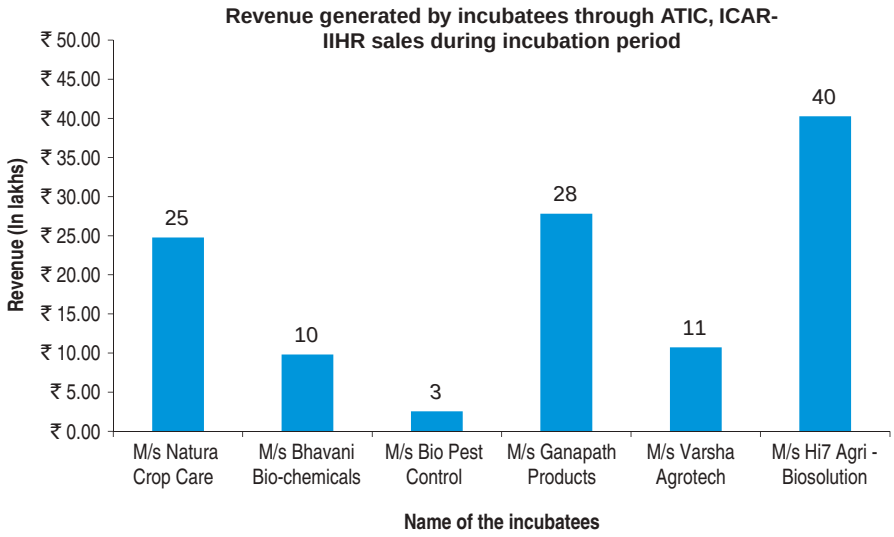
Success stories of incubatees graduated from ABI

M/s Natura Crop Care, Doddaballapur

Mr Manoj Kumar, M. Tech graduate while working at ICAR-Indian Institute of Horticultural Research, Bengaluru as research fellow, realized the potential of ICAR-IIHR developed technologies and the provision for thier commercialization. He started initially with licensing of Arka Microbial Consortium (solid and liquid formulations) during 2016 and gradually he obtained licenses for number of products over the years, at present he has licensed over seven ICAR-IIHR technologies i.e., Neem Soap, Pongamia Soap, Citrus Special, Actino-plus, Decomposer and Pheromone trap. He has created an employment opportunity for 20 people, with a turnover of around 4.5 crore per year and is serving over 40,000 farmers across six states.

The firm has been recognized at international, nation and state level by receiving award and recognitions. Best Innovation award in sustainable





crop protection from Global Forum for innovations in Agriculture from Ministry of Food and Agriculture, Abu Dhabi held in Abu Dhabi during April 2019. BIRAC BIG Award for innovative idea of organic formulation from Department of Biotechnology during 2019. Elevate Karnataka Award during 2019 from Karnataka Start-up Cell and depart of ITBT, Government of Karnataka. M/s Natura Crop Care has been selected as one of top 5 Indian Agritech Start-ups and appointed for delegation at Indo Brazil Agritech cross border program (Dec 2019).

M/s Hi7 Agri Bio Solutions, Bengaluru

Mr. Gavaskar, B. Tech graduate from Andhra Pradesh, while working at the institute developed intrest in commercialization and incubation. Intially he started the firm with licensing of banana special then went on to license mango special and vegetable special to his company. Now he has created employment opportunity to 10 employees and currently has production capacity of 30 tonnes per month with a turnover of around 1.5 crore per year.

M/s Krishi Biosys, Doddaballapur

Mr. Srinivas, being an entrepreneur came to know about the commercialization of our technologies through ICAR-IIHR website. He has licensed biopesticide technologies i.e., *Trichoderma viride*, *Trichoderma harzianum, Pseudomonas fluorescencs, Verticillium chlamydosporia and Paecilomyces lilacinus* during 2012. Presently, with the support of 10 people he is producing around 40

tonnes of biopesticides per month with a turnover of around 4.0 crore per year.

M/s Leaf Box, Bengaluru

An innovative entrepreneur came with a design of leaf box- a natural air purifier and ICAR-IIHR provided validation and technical support including specific list of plants that are suitable for indoor cultivation and purifying the air. This unique product improves aesthetic value and has completely automated water supply system.

Sidda Halasu

S.S. Paramesha of Chelur village in Tumakuru district of Karnataka had a jackfruit tree with a unique deep coppery red flakes that are not only tasty but also have high nutritive value. S.S. Paramesha observed huge demand for the fruits from this tree. He planned to multiply planting material and ICAR-Indian Institute

of Horticultural Research supported the farmer by signing a MoU to multiply Sidd halasu planting material through grafting. Under the MoU 75% of the proceeds goes to the farmer.

Conclusion

The Technology Management Unit & Agri-Business Incubation centre has made good progress in the last 5 years with regard to technology commercialization and had commercialized 80 technologies during this period. Number of technologies have been protected, patents filed and licensed for mass production under different theme areas. Agri-Business Incubation centre at ICAR-IIHR, started its operations since May 2013 and successfully initiated the processes of incubation and business process development. The ABI centre has a total enrolment of 10 onsite, 18 offsite and two specialised incubatees over the years. The ABI organized 15 Entrepreneurship Development Programmes (EDPs), business mentoring and awareness campaigns for enthusiastic horti-preneurs and research scientists, facilitated research collaborations, patent search facilitation, patent filing and has several success stories to highlight and share.

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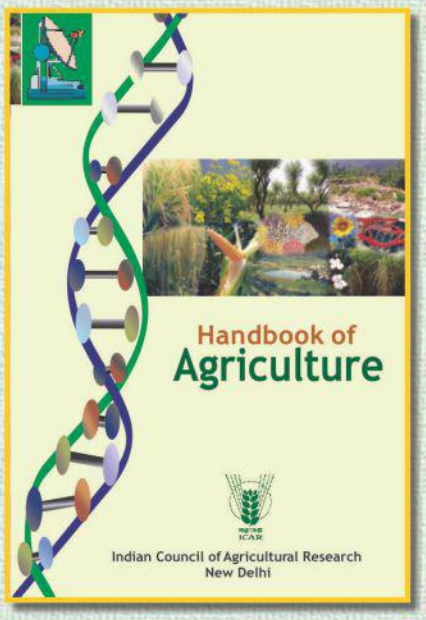
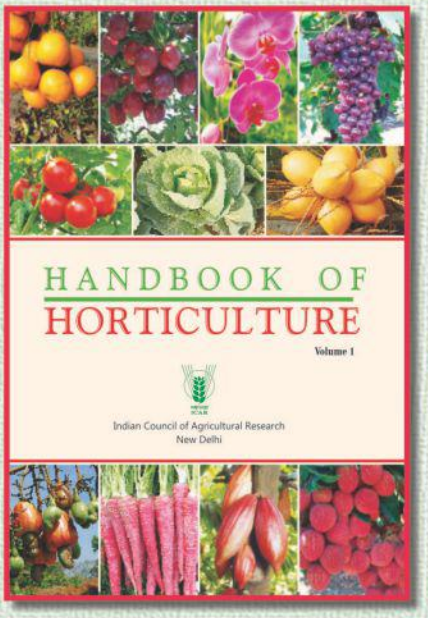
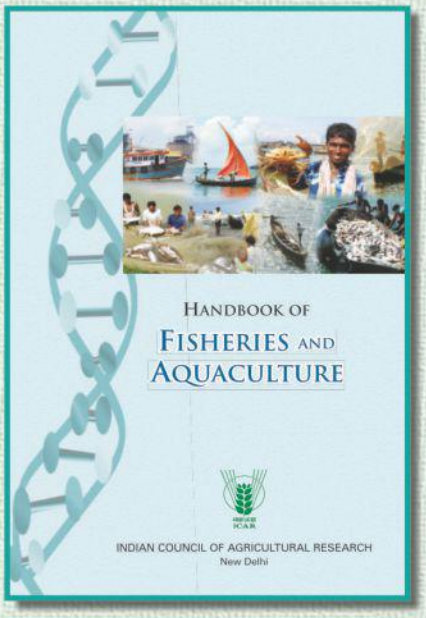
भाकृअनुप
ICAR

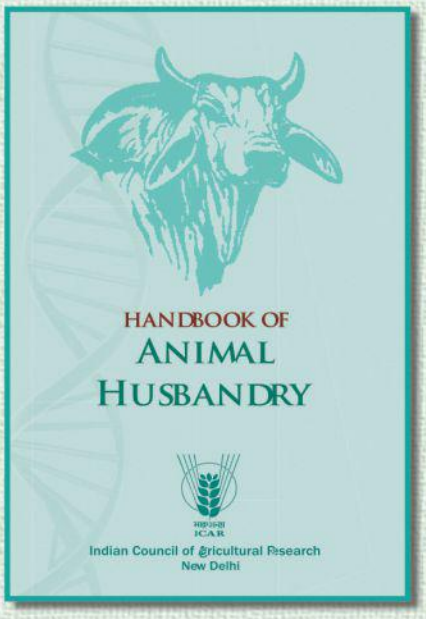
DIRECTORATE OF KNOWLEDGE MANAGEMENT IN AGRICULTURE

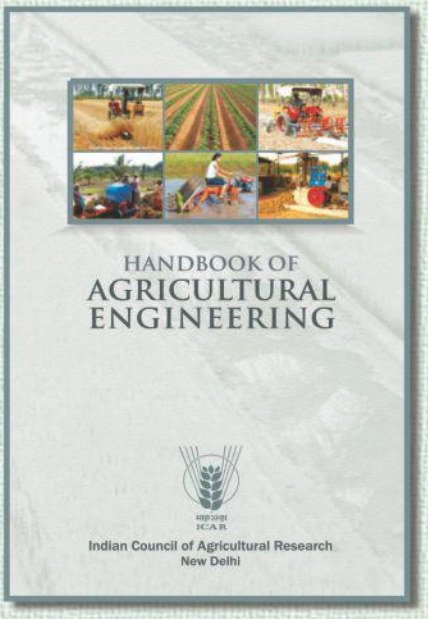
HANDBOOKS OF ICAR

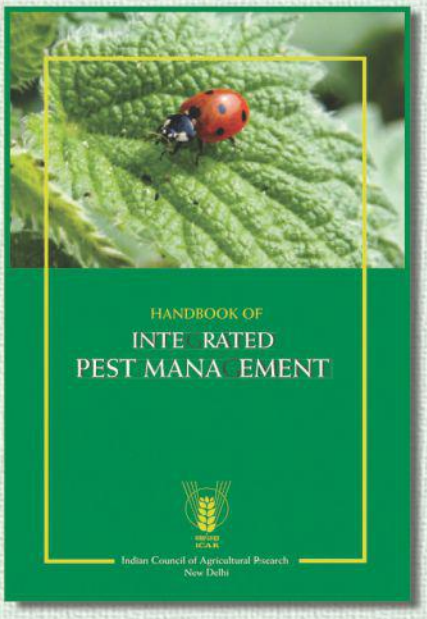












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Construction of water harvesting tank at source
by ICAR-IISWC & farmers of village Pawwala Soda under PPP mode

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