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# Science & Technology based Entrepreneurship Development

Peter Carberry, Director General  
Kiran Sharma, Deputy Director General  
Jonathan Philroy, Manager, Agri-Business Incubator  
Amit Chakravarty, Chief of Staff ICRISAT

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)<sup>1</sup>

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## Introduction

The transformational role of entrepreneurship for socio-economic development is well documented: entrepreneurs apply innovative solutions to address local issues leading to creative destruction of the *status quo*, that has a multiplier effect on enhancing employment and income generation, supporting local economic growth, creating knowledge clusters and enhancing national competitiveness.

The Indian agricultural sector is a complex entity that is dominated by small and marginal farmers who make up 85% farming community but have very little control over the value chain to which they deliver. The chain itself is very long with numerous intermediaries involved from the farm-gate to end-consumer, managed by informal connections with obscure price discovery and demand-supply models that are often disadvantageous to the farmer-producer. Besides market challenges, the sector is also facing the risk of climate change.

Agricultural Innovation Systems (AIS) present an attractive paradigm shift in addressing these concerns and in shifting agriculture from a supply side push to a more market-oriented (and thus demand-driven) focus. AIS not only offers a holistic explanation of how knowledge (at local/regional/national level) is produced, diffused and used, but also emphasizes on the need to have continuous and interactive learning amongst different stakeholders, such as farmers, researchers, extension agents, policymakers, private and public sector companies and civil society organizations. AIS moves away from the linear research-to-market model and adopts a demand-driven approach that supports innovative and unique partnerships amongst different stakeholders. It stresses on the need to offer holistic support systems to farmers and to bring all the stakeholders on a common platform. However, for the system to be fully operational, it needs a facilitator, an innovation broker, an incubator providing incubation support, to enable linkages and interactions.

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<sup>1</sup> In book: Venkatesan et al. (Eds). Souvenir: 89th Annual Session of NASI & Symposium on Science and Technology based Entrepreneurship Development. Publisher: National Academy of Sciences India (NASI) & ICAR- National Academy of Agricultural Research Management (NAARM). Hyderabad.

Another interesting aspect is the recent emergence of agriculture technology (agtech) start-ups which are disrupting the sector using technology-enabled innovative solutions and business models. The National Association of Software and Service Companies (NASSCOM) estimates that India has over 450 agtech start-ups (every 9<sup>th</sup> agtech start-up is from India) and that this specific segment is growing at 25% year-on-year (NASSCOM, 2019). The report also highlights that the agtech stakeholder ecosystem is maturing and that the public and private sector entities are keen on partnering with these actors.

In these contexts, it is clear that agricultural research organizations have to move towards a more demand-driven innovation model that can address the challenges faced by the sector and engage as a facilitator for the diverse set of stakeholders with the ultimate objective of developing applied research outcomes that can help farming become a sustainable and profitable venture.

### **ICRISAT Model**

In early 2000s, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) started exploring a public-private partnership approach as one of the pathways to improve its technology outreach through entrepreneurship, nurture and validate innovations developed at lab and grassroots level, facilitate feedback mechanism for its R&D community, and develop engagement strategies and networks for value-chain intervention activities.

The Agri-Business Incubator of ICRISAT (ABI-ICRISAT) was the early mover when ICRISAT partnered with the Department of Science & Technology, Government of India, to set up the first agribusiness-focused technology business incubator in the country. Over the years, other ICRISAT initiatives such as Innovation & Partnership (INP), NutriPlus Knowledge (NPK), Intellectual Property Facilitation Cell (IPFC) and iHub (Innovation Hub) were initiated to complement the research activities of ICRISAT by translating research outcomes into actionable agribusiness models and value-chain development interventions in the drylands.

Science and technology-based entrepreneurship promotion initiative from ICRISAT got a further boost in 2010 with the adoption of the Inclusive Market-Oriented Development (IMOD) research framework that focused on a wider range of innovations to harness the market opportunities to improve farmer incomes and achieve a state of prosperity. IMOD was built on the innovation systems perspective that allowed the scientific community to identify the various links in the crop value chain, constraints, and challenges faced in the adoption of new technologies, and gain a better understanding of the institutions and other actors who influence those chains. The IMOD framework thus allowed ICRISAT to embed the entrepreneurship promotion model at an institutional level and led to the creation of the Agribusiness and Innovation Platform (AIP) of ICRISAT in 2011. AIP-ICRISAT now houses all the

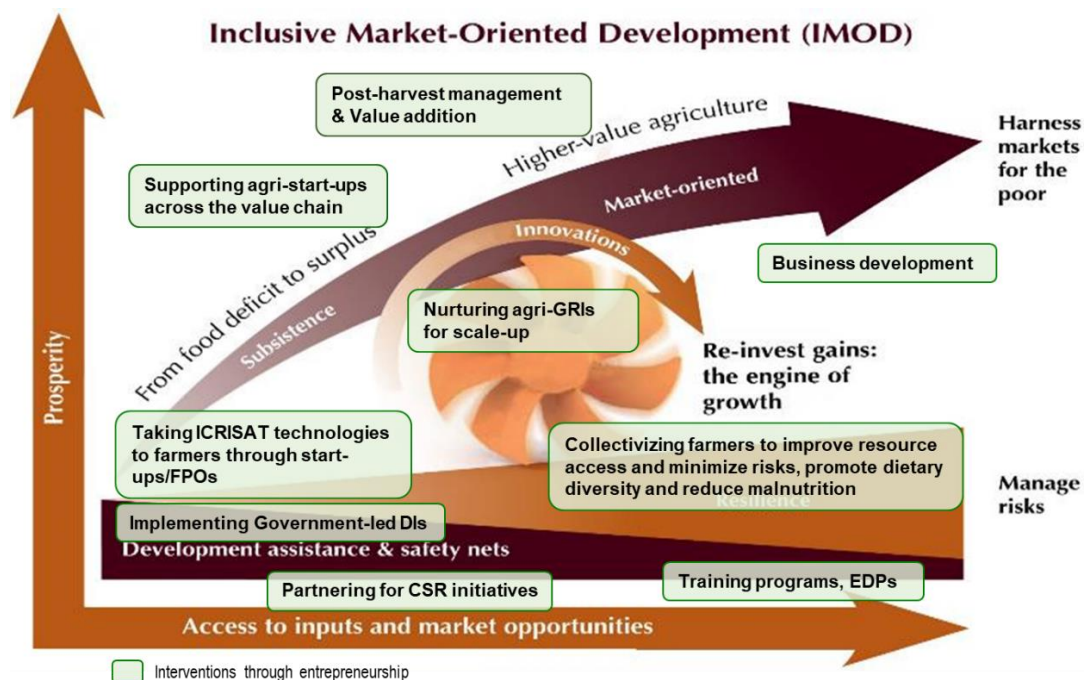
entrepreneurship and partnership outreach program (box 1) and complements the IMOD research framework with activities and initiatives as outlined in Figure 1. The Platform works towards upscaling technology and research outputs from ICRISAT using agtech start-ups/agribusiness enterprises, and advocating sustainable interventions with sector partners to foster the growth of rural agribusiness ventures and grassroots innovations, and sharing of knowledge and information that will help in improving the livelihood of smallholder farmers, youth and women of the rural community and enhancing the contribution of the non-farm sector to local economic development. The iHub works with

### Box 1. AIP-ICRISAT Programs

- **ABI** works towards improving livelihood of smallholder farmers by promoting innovative technology backed agtech start-ups through its business incubation services
- **INP Program** focuses in developing collaborative research-cum-development partnerships with public and private sector stakeholders in the agricultural value-chain
- **NPK Program** deals with post harvest management, nutritional and food safety awareness in agri-food sector related to ICRISAT mandate crops
- **IPFC** supports start-ups, small and medium enterprises and innovators in protecting their intellectual property and provides other legal advisory services to help strengthen its competitiveness.

Information Technology (IT) start-ups to leverage IT technologies such as AI, Machine Learning, Blockchain, advanced sensors and other emerging technologies to improve value chain efficiencies, information symmetry, reduce transaction costs and time to market, improve forecasting and price discovery thus ensuring a larger share of the value is captured by the farmers. Another ICRISAT initiative – BioNcube – is for supporting start-ups in the agri-biotechnology space.

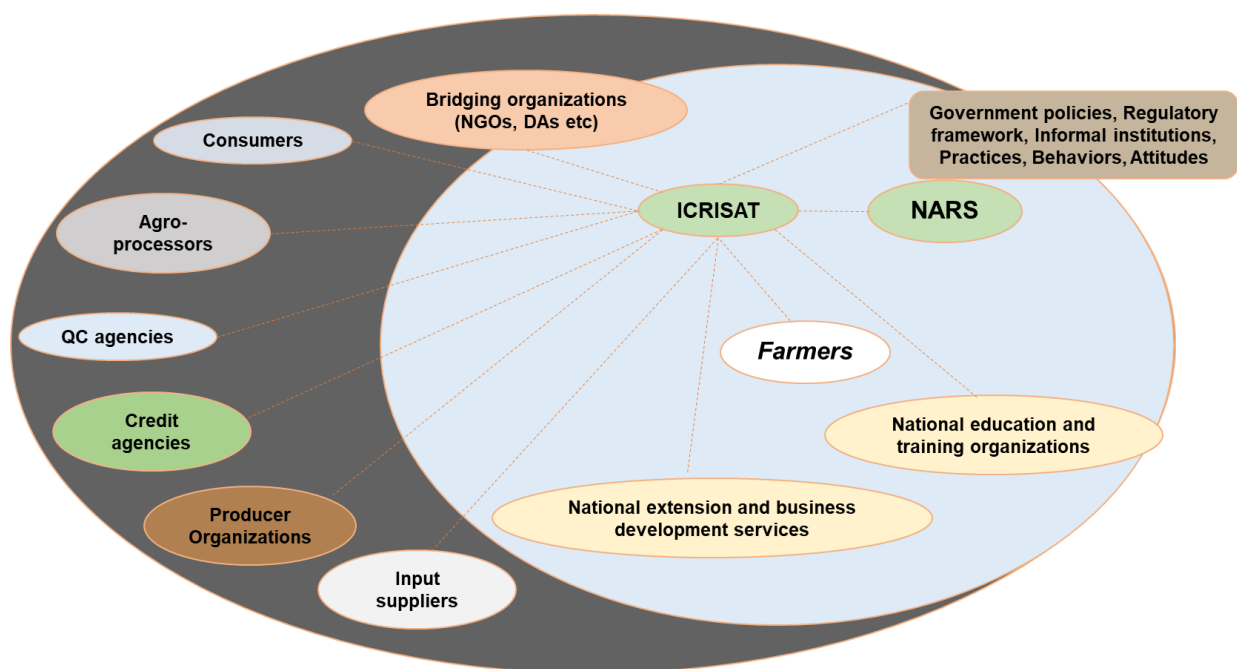
Figure 1. Achieving IMOD through Entrepreneurship



Source: ICRISAT

Through its programs, ICRISAT works with a diverse set of stakeholders in the dryland agrifood system (AFS) and has been successful in linking them to ICRISAT research programs thereby supporting efforts made by ICRISAT in addressing some of the challenges in the value chain. These ongoing efforts involving farmers and downstream actors such as entrepreneurs, small and medium food enterprises, public and private sector agencies, Government departments and policy bodies have so far provided increased outreach and dissemination of ICRISAT research outcomes, immense opportunities for cross-learning, assimilation and developing new, inclusive solutions that benefit the smallholder farmer (Ffigure 2).

Figure 2. Strategic Fit: Agricultural Innovation Systems (AIS) & Entrepreneurs



Source: Adapted from World Bank (2012)

With regard to entrepreneurship promotion, the business incubation model at ICRISAT primarily focuses on assisting the start-up team in developing the right perspective for building their product and service model. The incubation package broadly covers: idea validation to prototyping support; scientific & technical advisory; business development, networking/mentoring opportunities with farmers, industry, research and domain experts; capacity building/skill development workshops for start-up team, entrepreneurs/farmers/innovators; fund facilitation through investor network; legal and IP services; access to office spaces, wet labs, research fields and food processing plant; complimentary business credits through service partners; and soft-landing services.

## Journey so far

- Incubated 103 ag-tech start-ups in domains such as agriculture biotechnology, digital agriculture, food processing, ag-machinery, and farm business, and also promoted farmer-led seed business ventures; 74 ventures have graduated/exited the incubator. Box 2 below profiles a few start-ups.

## Current Portfolio



- It is estimated that ICRISAT incubated ventures had generated more than 2500 direct jobs and over 3 million farmers have used their product/service across the country in 2018-19.
- Commercialized 10 agro-technologies developed by ICRISAT and partners, and introduced over 90 agro-products developed by the incubatees into the market. Training on entrepreneurship aspects has been imparted to over 4000 individuals.
- Start-ups have mobilized US\$25mn in funding through investment partners.
- An ecosystem of over 40 partners has been created by the Platform for supporting agribusiness ventures/ag-tech start-ups to assist the start-ups in its scaling-up journey.

- ABI-ICRISAT was the handholding and mentoring partner for 22 agribusiness incubators for the Indian Council of Agricultural Research (ICAR) research institutions. More than 1200 start-ups were supported and 331 agro-technologies were commercialized during 2010-14. The ongoing agribusiness incubator projects such as the NAIF scheme of ICAR and the RKVY-RAFTAAR scheme of the Department of Agriculture & Farmer Welfare, Government of India are the outcome of this partnership with ICAR. This will be useful in technology transfer and agri-based entrepreneurship activities in the country.
- Facilitated patent filing for three start-ups, and nine trademarks were filed and granted for start-ups. Worked with the University of Agricultural Sciences, Raichur towards securing Geographical Indication status for Kalaburgi pigeonpea.
- Set up 16 Farmer Producer Organizations (FPOs) in Telangana, Andhra Pradesh, and Tamil Nadu with support of the National Bank for Agriculture and Rural Development (NABARD). This collectivization model has gained traction in the country and ICRISAT has been working on developing sustainable business approaches that can be scaled-up.
- Undertaken value-chain studies and agribusiness promotion projects for agencies such as the Walmart Foundation, FAO, SFAC, CIDA-McGill, and for corporates like Emami, CF Biotech, etc.
- ICRISAT is an outreach partner to various entrepreneurship promotion initiatives led by the Ministry of Micro, Small & Medium Enterprises, Ministry of Science & Technology, and Ministry of External Affairs, Government of India.

## Box 2. Translating technology into entrepreneurship initiatives

- **Ridgeland Industries Pvt Ltd:** was established by two first-generation women entrepreneurs who approached ABI-ICRISAT with plans to setup food-based start-up to make healthier snacks for children, and took up millet-based extruded snack food technology developed by NPK Program to begin their entrepreneurial journey. Over the past three years, the team worked with ICRISAT in technology and product refinement and has slowly grown its healthy snack-food market in Hyderabad, nearby cities in Andhra Pradesh, and is currently expanding its operations into Bengaluru, Karnataka. The start-up has about 20,000 paying customers, employs eight, and has an estimated annual turnover of INR 45 lakhs. Starting with extruded sorghum snacks (crispys), they are now manufacturing (out-sourced to vendor) and selling millet-based healthy ready-to-eat food products like jowar & ragi crispys in different flavors, chocolate-coated ragi balls, jowar/ragi/bajra cookies and jowar/ragi roasted flakes. The product range is sold in the brand name of Rigdam, and is available in modern retail stores and school canteens as well as e-commerce platforms such as BigBasket and Amazon.
- **PEAT GmbH:** developed Plantix an innovative, multi-lingual diagnostic mobile app that was field tested and validated by ICRISAT and the PJTSAU in Telangana and Andhra Pradesh. The app helps farmers identify pests and diseases on their crops by taking pictures of the affected crop and uploading them on the app. The photographs are analyzed using artificial intelligence algorithms and diagnostic results are returned to the farmer. Critical information on symptoms, triggers, as well as chemical and biological treatments are provided immediately. All pictures sent using the app are geo-tagged, thereby enabling real-time monitoring of pest and diseases. Furthermore, the app encompasses a weather information system specific to the farmers' location and a community feature that facilitates interaction with other actors interested in plant protection services. The start-up recently secured funding of USD 7mn and the application has over a million downloads in the Google Playstore.
- **LeanCrop Technology Solutions Pvt Ltd:** provides personalized farm advisory using algorithms based on soil, water, weather, and financial data. This optimization has resulted in 60% increase in productivity and 20% reduction in production costs for its 35,000 farmer users in Maharashtra, Andhra Pradesh and Karnataka. The start-up is working with ICRISAT scientists in developing stress-induced parameters that can be used in predicting plant health and potential to be affected by pest or diseases. Once validated, these parameters will become part of the algorithm in the digital platform that is being developed by the start-up. *BharatAgri* is backed by India Quotient Advisers LLP and had a turnover of INR 89 la (2018-19), and is an implementation partner for SMART project



of Government of Maharashtra. It is also a winner of the Women Entrepreneurship Quest Award, DST-Anita B Org, 2017.

- **PALS Agri eConnect Pvt Ltd:** developed Khethinext, a farmer service platform that partners with Farmer Producer Organizations (FPOs) and agri-entrepreneurs to extend its services for pre-aggregation of Inputs, facilitate crop advisory, facilitate access to market linkages for higher remuneration. It is currently working with 4.9 lakh farmers in Andhra Pradesh, Telangana and Haryana.
- **Thanos Technologies Pvt Ltd:** has designed and built drones that can be used for agricultural spraying purposes. The field validation trials were supported at FPOs linked to ICRISAT, and the drones are now available as a spraying-as-a-service model. Currently used by leading agri-chemical companies and over 50 farmers in Telangana and Andhra Pradesh.

## Conclusion

Science and technology-based entrepreneurship initiatives have the potential to drive innovation, sustainable economic growth and productive employment that can contribute towards the Sustainable Development Goals (SDGs). There is a growing interest among the youth to start agri-enterprises and with digital tools making knowledge and information more easily accessible. Agricultural research and education systems should be at the forefront to promote entrepreneurship in the sector.

This requires a change in the approach to the traditional technology transfer mode. Since agriculture-based entrepreneurship is a long and difficult journey, R&D organizations can focus on creating business engagement platforms that are client and market-responsive. The innovation systems framework offers an excellent starting point in this regard.

The support of the host organization is vital for the longevity of such platforms. Other key considerations that can help facilitate the entrepreneurship promotion process are: profiling of agrotechnologies for commercialization based on market feedback/response, developing an ecosystem of mentors, coaches and partners that can assist the entrepreneur, capacity building and skill development for improving human capital and accessibility for trained/skilled manpower, fostering an environment for stakeholder interactions and feedback mechanism, nurturing inter-dependent relationships driven by market, and facilitate access to funding avenues.

ICRISAT has adopted a more demand-driven innovation model and become an innovation broker that brings together a diverse set of stakeholders to deliver sustainable and profitable agricultural systems.

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