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Soft Landing Agritech Startup Innovations across Farms

"Agriculture can trigger job-led economic growth, provided it becomes intellectually satisfying and economically rewarding." – **Dr. M. S. Swaminathan**

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AgHub Foundation, PJTSAU
and
Research & Innovation Circle of Hyderabad,
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Contents

Acronyms

AgHub	-	AgHub at Professor Jayashankar Telangana State Agricultural University
AI	-	Artificial Intelligence
AIP	-	Agritech Innovation Pilot
ARS	-	Agricultural Research Station
AVC	-	Agricultural Value Chain
BIRAC	-	Biotechnology Industry Research Assistance Council
DAATTC	-	District Agricultural Advisory and Transfer of Technology Centers
DGCA	-	Directorate General of Civil Aviation
ESG	-	Environmental, Social, & Governance
ET Wing	-	Emerging Technologies Wing, Government of Telangana
FGC	-	Focused Group Consultation
FPO	-	Farmer Producer Organization
GDP	-	Gross Domestic Product
IoT	-	Internet of Things
KVK	-	Krishi Vignan Kendras
NAREES	-	National and State Agricultural Research, Education and Extension Systems
PJTSAU	-	Professor Jayashankar Telangana State Agricultural University
RICH	-	Research and Innovation Circle of Hyderabad
SaaS	-	Software as a service
TRL	-	Technology Readiness Level
TSIC	-	Telangana State Innovation Cell

Executive Summary

Over the years, strategic technological interventions have propelled the agricultural sector's growth, leading to India achieving self-sufficiency in grain production and becoming a major producer of milk, fruits and vegetables, cotton, and sugarcane to name a few. However, the sector faces a range of challenges, including rising input costs, climate change, fragmented landholdings, and inefficient value chains. An ever bigger challenge is to ensure that the benefits of higher production and lower costs benefit the small and marginal farmers.

To tackle these challenges and promote sustainable agricultural practices, the integration of cutting-edge agricultural technologies (agri-tech) and innovative agribusiness models is poised as a promising approach. The growth of the agri-food tech start-up sector has been phenomenal in the past few years: from a mere 43 start-ups in 2013, the ecosystem now has over 3000 start-ups in 2023. These start-ups offer a wide range of services, from AI-backed crop advisory services to market aggregation and discovery across the agricultural vale chains. While the growth of the agri-tech sector is commendable, challenges including low technology adoption rates among farmers and limited access to reliable data remain as major bottlenecks for the technology developers.

Recognising the potential such technologies can have if harnessed in an equitable manner and through well segmented outreach, AgHub, an innovation hub hosted by the Professor Jayashankar Telangana State Agricultural University (PJTSAU) designed a unique program titled Agri-tech Innovation Pilot (AIP) in 2020. Collaborating with key innovation enablers in Telangana - Research and Innovation Circle of Hyderabad (RICH), Emerging Technologies (ET) Wing, and Department of Agriculture, Government of Telangana – the AgHub team focussed on bridging the gap in technological innovations and validating the technology, along with ground assessment of the strategies for market penetration. AIP was launched in December 2020 and has so far supported

This report highlights how collaborative efforts of initiatives like AIP not only accelerate technological advancements but also contribute to the transformation of Indian agriculture into a sustainable and prosperous sector, benefiting farmers, the economy, and society.

25 agri-tech start-ups in five phases/cohorts in conducting scientific trials backed by PJTSAU and assisted with market expansion.

This report focuses on the impact and outcome from AIP phase 1 (December 2020-November 2021). Ten agtech start-ups were selected for this phase; three of them later dropped out due to operational issues. These start-ups represented a range of technology-enabled innovative platforms – agri-robotics, drones, rapid soil nutrient assessment, supply chain traceability and market linkages. During the two-year pilots, seven start-ups were provided with guided field trials, scientists connect, and business mentoring support. In terms of outcome, during (and post) AIP: four start-ups from Cohort I have raised funds worth INR 11 cr in 2022-23; agri-drone start-ups received Directorate General of Civil Aviation certification for their drone models, and developed protocols for autonomous drone-based spraying of agro-chemicals; and could get business opportunities under Government led Schemes or industry based offers. In terms of market access, all the start-ups got connected with more than 100 farmer producer organizations (about 13 lakh farmers) for technology demonstration and adoption.

Telangana's proactive approach to fostering an innovation ecosystem, in conjunction with its rich agricultural research institutes and government support, emerges as a beacon for agri-tech start-up development and scaling-up in the country. The outcome from the AIP program exemplify its potential to expedite the growth of start-ups, facilitate market expansion, and build meaningful connections between innovators and farmers.

Background

"Science and technology coupled with improved human capital have been powerful drivers of positive change in the performance and evolution of smallholder systems."
- Food & Agriculture Organization of The United Nations

Agriculture and allied sectors play a pivotal role in the socio-economic development of India. With over 65 percent of Indians residing in rural areas[1], agriculture serves as a primary livelihood source for millions of farming households and contributes around 18 percent to the Gross Domestic Product (GDP) of the country. It is also a critical source of employment, directly employing more than 47 percent of the rural workforce.

The agriculture sector grew manifold following targeted technological interventions from the late 1960s, enabling India to become food secure in grain production and achieve top producer status in milk, vegetables, cotton, sugarcane etc. In recent years, India has also rapidly emerged as the net exporter of agricultural products. Besides directly impacting farmer livelihood, the contribution to other economic sectors makes agriculture critical for economic growth, poverty alleviation, and rural transformation initiatives.

However, the sector continues to grapple with various challenges. Rising input costs, climate change, fragmented landholdings, depletion of natural resources, and persistent sectoral inefficiencies such as multi-layered and informal value chains, market imbalances, and lack of transparent pricing mechanisms, remain significant hurdles to building a resilient and sustainable farming sector. Addressing such multi-dimensional issues require holistic solutions at the farm and off-farm level. One promising approach lies in the adoption of cutting-edge agricultural technologies (agri-tech) with innovative agribusiness models that

[1] https://www.indiabudget.gov.in/economicsurvey/doc/eschapter/echap06.pdf accessed on 02 August 2023.

seamlessly integrate various facets of value chain management and rural livelihood enhancement.

The agri-food tech start-up sector in India has grown substantially in the past decade, expanding from 43 start-ups in 2013[2] to over 3000 in 2023[3]. It now encompasses start-ups offering a wide array of services and products such as real-time crop advisory and Artificial Intelligence (AI) supported farm management at the upstream segment of the value chain, to aggregation and market discovery (business-to-business/B2B or direct-to-consumer/D2C) and novel food products in the downstream segment. The sector is evolving towards building full-stack platforms and converging with other segments such as financing or partnering with traditional players that are actively seeking ways to optimize operational costs and improve scalability. Projections indicate that the Indian agri-tech industry could generate revenue of up to US Dollar 24 Billion by 2025[4].

While the agri-tech start-up growth story has been phenomenal, a major hurdle is the low technology adoption rate and market penetration

[2] https://start-uptalky.com/indian-agritech-start-ups-growth/ accessed on 02 August 2023.
[3] https://www.indianweb2.com/2023/02/india-has-more-than-3000-agri-start-ups.html accessed on 02 August 2023.
[4] https://assets.ey.com/content/dam/ey-sites/ey-com/en_in/topics/start-ups/2020/09/ey-agritech-towards-transforming-indian-agriculture.pdf accessed on 02 August 2023.

and reaching last-mile clients including farmers. Most agri-tech start-ups in the initial growth phase struggle with access to quality and reliable data to test their model, and access to farmer networks, infrastructure, funding and scientific mentors/domain experts. Other pain points are the diversity of crops grown, climatic and soil variations, various agricultural practices adopted by the farmer, and complex agriculture supply chain and sector regulatory frameworks.

A structured technology validation program that targets a particular crop or a region, backed by access to data and domain experts, could therefore be beneficial for agri-tech start-ups. Such start-up pilots could enable the ecosystem to fast-track promising ventures to the market while also safeguarding farmers from potential risks of using non-performing technology solutions.

It was on these lines that AgHub at Professor Jayashankar Telangana State Agricultural University (AgHub, PJTSAU) designed the concept of the program and initiated series of discussions with institutions like Research & Innovation Circle of Hyderabad (RICH) and Emerging Technologies Wing, Department of Information Technology, Electronics & Communications, Govt. of Telangana. RICH had prepared a compendium of technologies[5] potentially applicable across the agri-food value chain from 183 start-ups during 2020 and ET Wing contributed its opinion on Technology Readiness Level (TRL) with respect to each of the identified technology. AgHub team then did a ground level assessment of potential of the technologies to apply into the agri-food value chain and designing a testing program in agro-ecological regions across Telangana. These inputs from three organizations helped in designing and initiating 'Agritech Innovation Pilot (AIP)'. Launched by AgHub, PJTSAU in December 2020, AIP is the first-of-its-kind unique platform to pilot agritech start-up technologies at real farm level, leading to technology and user validation[6].

This brief features the key aspects of the AIP program, the immediate lessons learnt from the first cohort and the potential benefits for the ecosystem at large.

[5] Kumar, B. (Ed). 2020. Emerging Technologies for Agriculture. RICH. 232p.

[6] AIP was officially launched on 05 December 2020 by AgHub, PJTSAU for 10 selected start-ups. The inaugural function was graced by Dr Jayesh Ranjan IAS, Principal Secretary (Industries & Commerce, Information Technology & Electronics and Communications Department), Government of Telangana; Mr Naga Prakasam (Adjunct faculty and Angel Investor); Dr V Praveen Rao, Vice Chancellor, PJTSAU.

AIP: Genesis and Framework

Since its formation in 2014, Telangana has actively pursued initiatives to become the top technology investment hub in India. The Government of Telangana has been keen to foster an entrepreneurial innovation ecosystem to boost the economic development of the state, as exemplified by the Telangana State Start-up Policy[7] and Government-established innovation enablers such as IIIT-H, RICH[8] , T-Hub[9], Telangana State Innovation Cell (TSIC)[10] , ET Wing[11] , etc. Together with an extensive network of business incubators and accelerators hosted by various research and academic organizations in tier I and II cities in Telangana, these enablers work to support innovators and entrepreneurs with their start-up journey. The collaborative approach of the community has made *Telangana a preferred start-up destination* in India and the ecosystem to be globally recognized.

Launched in 2017 by the Government of Telangana, RICH acts as a *strategic convenor* to promote greater collaboration between various entities in the research and innovation space. RICH also represents the Hyderabad Science & Technology (S&T) Cluster, a Mega-Cluster initiative of the Office of Principal Scientific Adviser (PSA) to Government of India. RICH operates in close coordination with the S&T Cluster Apex Committee and the Prime Minister's Science, Technology, and Innovation Advisory Council (PM-STIAC). RICH aims to catalyse an ecosystem that empowers innovators to transform scientific research into impactful solutions that generate wealth, employment, and create social good, and strives to foster innovation that advances society, through effective use of science and technology.

RICH
Research and Innovation Circle of Hyderabad

[7] https://startup.telangana.gov.in/state-startup-policy/. Accessed on 08 November 2023.
[8] https://rich.telangana.gov.in/. Accessed on 08 November 2023.
[9] https://it.telangana.gov.in/initiatives/t-hub/. Accessed on 08 November 2023.
[10] https://teamtsic.telangana.gov.in/. Accessed on 08 November 2023.
[11] https://it.telangana.gov.in/initiatives/emerging-technologies/. Accessed on 08 November 2023.

Telangana hosts many prominent agricultural research institutes of national and international repute and has the largest number of agribusiness incubators and accelerators in India thereby enabling collaborations for research to market translation. AgHub at PJTSAU[12] which began operations in August 2020, aims to create an inclusive agri-innovation and entrepreneurial ecosystem across Telangana.

AgHub, the first of its kind Innovation Hub structured in a *unique Hub & Spoke model* works towards building an Inclusive Innovation and Entrepreneurship Ecosystem among Agritech startup founders, student entrepreneurs, rural innovators and rural communities.

At the Innovation Hub, it nurtures early stage startups through Incubation, Agritech Innovation Pilots, Co-Innovation and Enterprise Acceleration Programs and promotes student entrepreneurship through Design Thinking, Ideation/ Idea Sprout and Student Incubation Programs. The Rural Innovation Spokes of AgHub across two and tier cities across, the State of Telangana promote rural entrepreneurship through customised Sensitization, Rural Incubation, Community Enterprise Building Programs. The novel "Agritech Market Access Program" connects the rural stakeholders including rural youth, women, SHGs, FPOs and grassroots Innovators with agritech startups and collectively develops stand-alone innovation bridges across the agri-food landscape.

Such unique collaborations extend to the Government level as well, with some of the start-ups working on use cases identified by the Department of Agriculture to demonstrate technology applications in solving critical gaps in the value chain.

Compendium to Pilots

In 2020, RICH compiled and curated a list of 86 agri-tech start-ups operating across the Agricultural Value Chain (AVC). The list was selected from a wider pool of 183 start-ups, and evaluated for its technology and business readiness. The need for validating technology-enabled models and performance improvement claims of agri-tech start-ups was a unique value proposition that was identified during the initial discussions for curating the list, which led to the development of the AIP framework.

[12] https://ag-hub.co/pjtsau/. Accessed on 08 November 2023.

Objectives of AIP

- To generate synergies between start-ups and researchers for piloting innovations, and assessing technology capabilities.
- To facilitate farmers/FPOs to access latest technologies developed by start-ups.
- To support start-ups in generating traction through Business-to-Government (B2G), Business-to-Business (B2B), Business-to-Customer (B2C), and Business-to-Farmer (B2F) interface.

Framework of AIP

AgHub at PJTSAU ran a series of discussions with the research community to ensure the AIP framework offered a balance between a science-based approach, social acceptance and building equitable businesses based on Environmental, Social & Governance (ESG) factors that could create sustainable models in the agri-food systems. The success of the pilots depended on the seamless engagement of the scientists, start-ups and linkage with the farming community for deployment of technologies in the farms. AIP thus creates a consent-level approval among all stakeholders through their deep engagement in seeking a win-win situation with higher level of societal acceptability and developing viable business models at local level with potential scale-up possibilities at regional and at PAN-India levels.

Given the unique value proposition of AIP, the partners had to design a customized framework to execute the pilots that could enable start-ups to deploy their technologies in the field. The stage-wise activities undertaken for AIP phase 1 are:

1. **Pre-AIP Stage:** Based on the set of use cases provided by the Department of Agriculture, Government of Telangana for technology applications to address value chain gaps, the partners used the compendium developed by RICH to develop a subset of start-ups (TRL 6 and above) that matched with the stated use cases. Over a three-month period, a comprehensive screening process was undertaken by the partners to develop the final list of start-ups for AIP stage 1 (December 2020)[13]. These start-ups represented a range of technology-enabled innovative platforms – agri-robotics, drones, rapid soil

[13] Vijay Nadiminti, Victor Paul, R. Jagadeeshwar and R. Kalpana Sastry. 2021. The Traverse of AgTech to AgFarm. 28 p.

nutrient assessment, supply chain traceability and market linkages. The research community provided the technology deployment plan and its evaluation. With input from the start-up on their expected outcome from the pilot, the partners were able to map the milestones and resources required for the duration of the pilot.

2. **AIP Stage 1:** In this execution stage of the technical plan in field, the partners organized pilot-specific focussed group consultations (FGCs) sessions were on-site along with setting up of the field execution teams. Rural youth formed part of such teams in several of the pilots. The field immersion period depended on the technology implementation phase against crop growth stage.
3. **AIP Stage 2:** Monitoring and evaluation of the pilots was conducted regularly over the cropping season. Based on the detailed technical review, all pilots were extended for one more cropping season to work on addressing ground level challenges, and to understand and build rapport with the farming community. This also helped for next level technical validation of the technology

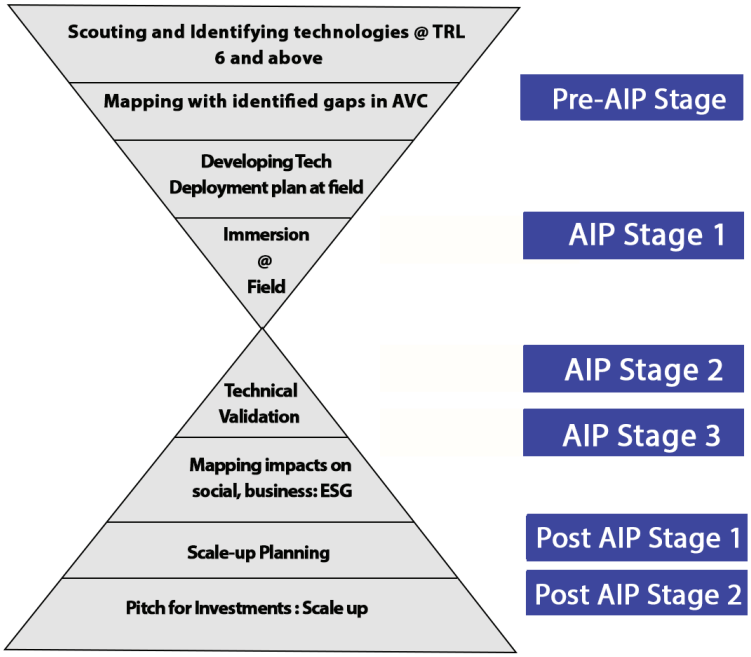


Fig. 1. Framework of Execution.

4. **Post AIP:** This stage of the pilots is to support the start-up with preparation of scale-up operations and fund raise plans for next level of its entrepreneurial journey.

Based on this framework, ten start-ups were selected for AIP-Cohort I during December 2020[14]. The site for the validation trials was selected as per the technical plan designed by the scientists for each technology and its solution application for specific crop and season requirements. These were executed either on experimental fields, or fields across the University extension network - Krishi Vignan Kendras (KVKs), Agricultural Research Stations (ARS) or District Agricultural Advisory and Transfer of Technology Centers (DAATTCs) or at identified FPO centres. Thus, AIP also harnessed the research and extension strengths of PJTSAU. Table 1 presents the technology offered by each start-up for the stated use case in each segment of the AVC. The outcome from the phase 1 trials is provided in the next section.

[14] Out of 10 selected, seven start-ups deployed in real farm situations post AIP stage 1. Two had few challenges at ground level while one did not plan at AIP stage 1 itself for its internal issues.

Table 1. Brief of Start-ups selected for AIP- Cohort I - 2020-2021/22.

S. No.	Start-up	Technology Focus	Segment of Operation in AVC
1	Flic Farm Pvt Ltd (XMachines)	xMachines is an agri-robotic start-up that builds innovative products using AI. The x100 is a multi-purpose platform that can perform major farm operations from seeding to harvesting, with the use of smart attachments. x100 is designed to be crop agnostic and suits both small and large farms. The AI-based smart attachments take precise care of each plant by fusing data points from several onboard sensors to achieve optimum yields. It also enables agricultural operations to be done efficiently and solves the issue of farm labour shortage.	Agri-robotics
2	Satyukt Analytics Pvt Ltd	Satyukt is an agritech company that provides B2B agricultural data and services across providers, built using scientific research and scalable algorithms validated globally. Satyukt bring insights into the crop area, health, risk, and production estimates using its My Farm, a satellite-based agricultural smartphone application. Through the app, users get farm health, irrigation advisory and weather forecast. Satyukt's products are available through an easy-to-use SaaS platform to cater to different stakeholders' needs.	Farm management solutions
3	Transity Digital Solutions Pvt. Ltd.	Transity works to make agri-supply chain efficient, reliable, and convenient by leveraging cloud, mobile, IoT, and analytics so that organizations can manage and optimize its agribusiness supply chain effectively. The platform focuses on automating planning and workflows between organizations involved in the movement of agricultural produce so that significant improvements in efficiency and convenience can be achieved.	Agri-supply chain and logistics

S. No.	Start-up	Technology Focus	Segment of Operation in AVC
4	Thanos Technologies Pvt Ltd	Thanos is a drone technology company building innovative aerial solutions for conventional terrestrial problems. The start-up began with off-the-shelf drone models, but later moved into designing and manufacturing of drones for agricultural field operations.	Pest and disease management using drones
5	TraceX Technologies Pvt Ltd	TraceX provides blockchain-enabled FOODSIGN that digitises agricultural produce, and enables agri and food businesses to build a very transparent and traceable food supply chain for ensuring food safety and quality.	Blockchain technology for supply chain traceability
6	Marut Dronetech Pvt Ltd	Agricopter from Marut Drones aims to provide precision agriculture solution that uses drones to reduce pesticide usage in agriculture and improve farm returns. It also reduces exposure of humans to hazardous chemicals, and addresses the lack of farm labour availability	Pest and disease management using drones
7	Klonec Automation Systems Pvt Ltd (KrishiTantra)	KrishiTantra aims to promote balanced application of fertilizers, resulting in increased farmer income and soil rejuvenation. KrishiTantra offers quick assessment of soil health through its Krishi Rapid Automated Soil Test with Agronomy Advisory (RASTAA) device.	Soil testing and advisory

Before the pilot, start-ups pitched about their status (baseline), requirements from AIP and targeted improvements. For ease of running the trials, the focus was on product development, technology validation/ standardisation, commercialization, market expansion, customer acquisition, stakeholder liaison/networking, and funding.

Scientists from the University designed the trial protocols based on the start-up inputs. AgHub at PJTSAU coordinated the trials at the University Experimental Farms or KVKs (as applicable) (Table 2).

Over the duration of the pilots, AgHub team assisted each start-up with validating process of the technology offer and the planned go-to-market strategies.

Table 2. Details of Pilot Execution Plan.

S. No.	Start-up	Trial Locations	Crops	Specific Support Provided	Technology Acceptance amongst Farming Community	Number of farmers connected
1.	Flic Farm Pvt Ltd (xMachines)	PJTSAU HQ	Maize	Laying of the trial	High	10
2.	Satyukt Analytics Pvt Ltd	Palem; Adilabad	Groundnut, Chickpea	Logistics at farmer fields	High	200
3.	Transity Digital Solutions Pvt Ltd	Nizamabad; Jagtial; Jadcherla	Rice, Turmeric	FPO, farmer linkage	Medium	1000
4.	Thanos Technologies Pvt Ltd	Yadadri Bhongir	Rice	Testing and demo protocols	Medium	100
5.	TraceX Technologies Pvt Ltd	PJTSAU HQ; Warangal; Jagtial	Rice, Blackgram, Greengram	Scientists feedback, logistics	Medium	100
6.	Marut Dronetech Pvt Ltd	Kampasagar; Nalgonda	Rice	Testing and demo protocols	Medium	1500
7.	Klonec Automation Systems Pvt Ltd (Krishitantra)	Tornala, Siddipet	Rice	Facility, Samples to calibrate algorithm	High	500

More details on each individual trial and their achievements/learnings are provided in the next section.

AIP Cohort I- Outcomes

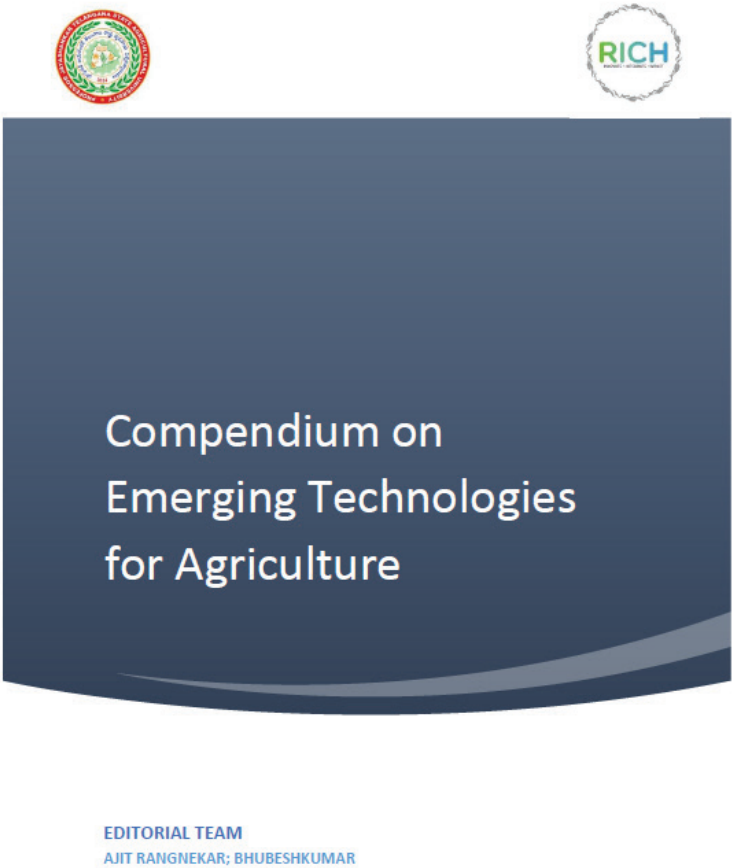







Since its launch in late 2020, AIP has now become a flagship program for AgHub at PJTSAU, attracting market-ready (TRL 4 and above) start-ups to validate its technologies at the farm level along with the guidance of domain experts. AIP is currently running for Cohort V and has so far supported 25 start-ups.

AgHub and RICH conducted an assessment survey with start-up founders from AIP phase 1 during June 2023. Almost all start-ups found the trials to be productive and helped in their scale-up operations over the past two years. The main highlights from the responses are included in this section, along with milestone-based achievements and individual profile of the start-ups. In some instances, start-ups were able to achieve more than targeted areas of improvement.



1. Flic Farm Pvt Ltd (XMachines)

- **Objective in AIP:** Test and validate AI and robotics technology models, and develop robots' weed control capabilities.
- **AIP Duration:** Two seasons at PJTSAU research farm on maize in 2021.
- **AIP Support:** Successfully trained the precise AI system with the support of the scientific team. The team guided testing procedures by offering relevant packages and practices[15] for training the model.
- **Technical Mentor(s):** Drs. T. Ram Prakash and B. Padmaja, PJTSAU.

Table 3. Details of Pilot Execution Plan- Flic Farm (X Machines).

Focus areas for AIP	Pre-pilot phase status	Post-pilot milestones achieved & Status
Technology Validation	AI model was trained on limited datasets	Successful in extensive training and testing of the model using details on package and practices related to maize provided by scientists.
Market Expansion	Not validated	Completed field validation on weeding operations using AI-based weed detection models.
Customer Acquisition	Not done	Received orders from various locations in India, and exported units to Malaysia, EU, Japan.
Stakeholder liaison/ Networking	Limited stakeholder connections	Facilitated stronger government agencies linkage in Telangana.
Funding	Under process	Secured seed funding from Dare Ventures, Coromandel group, October 2023. Secured INR 2 lakh grant under the Telangana state incentive for Rural Innovators Scheme facilitated by RICH and TSIC in May, 2022.

[15] Trivikram Kumar., T. Ram Prakash, B. Padmaja. 2022. See and Spray Agribot of X Machines.In :Trailblazer: A Series of Agritech Use Cases. Volume I. V. Praveen Rao; R.Kalpana Sastry; R. Jagdeeshwar; Vijay Nadiminti; R. Vijaya Kumari, and Mukesh Ramagoni. (Editors) (2022). AgHub Foundation (PJTSAU), Hyderabad, Page 43-49.

'This is a one-of-a-kind program for agri-tech start-ups and has really helped us to refine our technology platform.'

- Trivikram Kumar, Founder & CEO, Flic Farm Pvt Ltd

2. Satyukt Analytics Pvt Ltd

- **Objective in AIP:** Validate farm management solutions and introduce tailored solutions to address the specific needs of farmers such as weather forecast, crop planning, irrigation, and crop health monitoring etc.
- **AIP Duration:** Rabi season of 2021, focused on groundnut and chickpea crops at KVK, Palem and ARS, Adilabad.
- **AIP Support:** Scientific team at KVK and ARS played a crucial role in facilitating connections with farmers, gaining insights into their requirements, and providing field and logistical support to onboard farmers[16].
- **Technical Mentor(s):** Drs. Prabhakar Reddy, M. Rajashekar, G. Sheshu, B. Srinivas, P. Sadvi, and Naveen Prabhakar Reddy, M. Rajashekar, G. Sheshu, B. Srinivas, P. Sadvi, and Naveen, PJTSAU.

Table 4. Details of Pilot Execution Plan- Satyukt Analytics.

Focus areas for AIP	Pre-pilot phase status	Post-pilot milestones achieved & Status
Technology Validation	Platform limited to only soil moisture details	Developed comprehensive dashboard for farmers to monitor and manage their farm practices.
Market Expansion	Platform was in ideation stage	Gained deep understanding of farmer requirements, identified gaps in the value chain, and customized the platform accordingly.
Customer Acquisition	Not done	Expanded operations to Bangladesh and Ghana. Forged partnerships with Mahindra and Corteva.
Stakeholder liaison/ Networking	Limited customers	Over 10 lakh farmers have now subscribed to the platform.
Funding	Under process	Grant funding of INR 2 lakhs through Pusa Krishi; INR 50 lakhs through Atal New India Challenge-AIM grant; and INR 40 lakhs from Krishi Mangal supported by CISCO.

[16] Pramod; Sreedhar Chowhan, G. Anil Kumar, M. Raghuveer, K. Sreedhar, K. Ramakrishna, and P. Archana. 2022. Enhancing Water Use Efficiency in Chickpea & Groundnut Farming through Sat2Farm App. In :Trailblazer: A Series of Agritech Use Cases. Volume I. V. Praveen Rao; R.Kalpana Sastry, R. Jagdeeshwar; Vijay Nadiminti; R. Vijaya Kumari; and Mukesh Ramagoni. (Editors) (2022) AgHub Foundation (PJTSAU), Hyderabad,Page 19 to 25.

'AIP was our first pilot for Sat2Farm product and solutions. The pilot helped us to understand the grassroot level requirements and made us to think and develop these products,'

Sat Kumar Tomer, Founder & CEO, Satyukt Analytics Pvt Ltd

3.Transity Digital Solutions Pvt Ltd

- **Objective in AIP:** Establish connections with progressive grassroots organizations, such as FPOs and Self-Help Groups (SHGs) and acquire valuable insights on the value chain of specific crops.
- **AIP Duration:** Conducted from August 2020 to October 2021, focusing on turmeric and paddy in Nizamabad, Jagtial, and Jadcherla in Telangana.
- **AIP Support:** Successfully established links with 10 FPOs through the assistance of the KVK team, which helped in validating the platform features through target user segmentation and requirements[17].
- **Technical Mentor(s):** Drs. Prabhakar Reddy, M. Rajashekar, G. Sheshu, B. Srinivas, P. Sadvi, and Naveen, PJTSAU.

Table 5. Details of Pilot Execution Plan- Transity Digital Solutions.

Focus areas for AIP	Pre-pilot phase status	Post-pilot milestones achieved & Status
Technology Validation	SaaS platform designed with certain components of the value chain	Launched platform with additional features that increased flexibility and features, catering to the AVC, including post-harvest processes, value-added products, and traceability.
Market Expansion	Not done	Expanded operations to four states in India.
Customer Acquisition	In pipeline	Onboarded over 100 FPOs, engaging with approximately 3,000 farmers.
Stakeholder liaison/ Networking	Few networks	Additional exposure to larger farmer network that enabled start-up to gain valuable insights on challenges faced by FPO/SHG, and other product-based food start-ups seeking digitization.

[17] Krishna; R.T. Prabhakar Reddy, M. Rajashekar, G. Sheshu, B. Srinivas, P. Sadvi, and Naveen. 2022. Transity fresh FLO- A Digital Platform for Bettering Farmer Supply chain. In :Trailblazer: A Series of Agritech Use Cases. Volume I. V. Praveen Rao; R. Kalpana Sastry; R. Jagdeeshwar; Vijay Nadiminti; R. Vijaya Kumari; and Mukesh Ramagoni. (Editors) (2022). AgHub Foundation (PJTSAU), Hyderabad, Page 35 to 41.

'AgHub team was supportive in our journey. The team goes out of its way to help us whenever we need any support from them. The model of AgHub is very innovative, wherein we could leverage the PJTSAU network to reach our target audience to discuss our platform.'

Krishna Kumar, Founder, Transity Digital Solutions Pvt Ltd

4.Thanos Technologies Pvt Ltd

- **Objective in AIP:** Demonstrate use cases of drones, establish protocols, conduct technology demonstrations for farmers, and collect feedback on the field execution model and service pricing.
- **AIP Duration:** The pilot program took place at Yadadri Bhongir, covering rabi 2021 to rabi 2022 seasons, with a focus on paddy.
- **AIP Support:** Scientists played a pivotal role in facilitating the connection between start-up and farmers, thereby creating opportunities for large-scale demonstrations.
- **Technical Mentor(s):** Drs. R.T. Prabhakar Reddy, M. Rajashekar, Dr. G. Sheshu, Dr. B. Srinivas, P. Sadvi, Dr. Naveen, PJTSAU.

Table 6. Details of Pilot Execution Plan- Thanos Technologies.

Focus areas for AIP	Pre-pilot phase status	Post-pilot milestones achieved & Status
Technology Validation	Use case not developed	Soft-landing of technology in farmers fields with standardised protocols.
Market Expansion	Pending	Helped in establishing protocols in new crops including chillies.
Customer Acquisition	Few networks	Engaged in IFCO Kisan Drone programs in more locations.
Stakeholder liaison/ Networking	In pipeline	More connects with major input agencies and industry players developed.
Funding	In pipeline	Commercial orders in place.

'We carried out large scale demonstrations in farmer melas and a few pilots on progressive farmer fields. Through the demos, we could generate many more leads from interested people across the state.'

Pradeep Palleli, Co-founder & CEO, Thanos Technologies Private Limited

5. Marut Dronetech Pvt Ltd

- **Objective in AIP:** Conduct trials for drone-based diagnosis of major pests and diseases in rice.
- **AIP Duration:** One year pilot at KVK Kampasagar and Nalgonda covering 1500 farmers.
- **AIP Support:** Scientist mentors provided insights and contributed to ground-truthing exercises to ensure the success and accuracy of the pilot[18].
- **Technical Mentor(s):** Drs. C. Sai Kumar, P. Suraj., K. Sumalini, G. Shiva Prasad, and M. Shankar C. Sai Kumar, P. Suraj., K. Sumalini, G. Shiva Prasad, and M. Shankar, PJTSAU.

Table 7. Details of Pilot Execution Plan- Marut Drones.

Focus areas for AIP	Pre-pilot phase status	Post-pilot milestones achieved & Status
Product Development	Drone developed, but no SoP were available to optimize spraying	Together with PJTSAU scientists, start-up was able to develop SoP for autonomous drone spraying for seven crops[19].
Technology Validation	Pending	Completed; multi-location trials conducted with different crops to gain comprehensive insights.
Commercialization	DGCA Certification not done	Trial helped with obtaining DGCA certification. Start-up was able to generate up to INR 1 Cr. revenue in 2022-23.

[18] Prem Kumar, C. Sai Kumar, P. Suraj., K. Sumalini, G. Shiva Prasad, and M. Shankar. 2022. The flight of Marut Drones into Agriculture. In: Trailblazer: A Series of Agritech Use Cases. Volume I. V. Praveen Rao; R. ; R. Jagdeeshwar; Vijay Nadiminti; R. Vijaya Kumari; and Mukesh Ramagoni. (Editors) (2022). AgHub (PJTSAU), Hyderabad, Page 9 to 16.

[19] https://pjtsau.edu.in/files/publications/2022/autonomous-drones-pjtsau.pdf accessed on 02 August 2023.

'AIP has been instrumental in aiding Marut drone for the DGCA certification. This certification holds significant importance for drone companies. Moreover, AIP has actively supported the development of SoPs for drone spraying in collaboration with PJTSAU.'

Prem Kumar V., Founder, Marut Dronetech Pvt. Ltd.

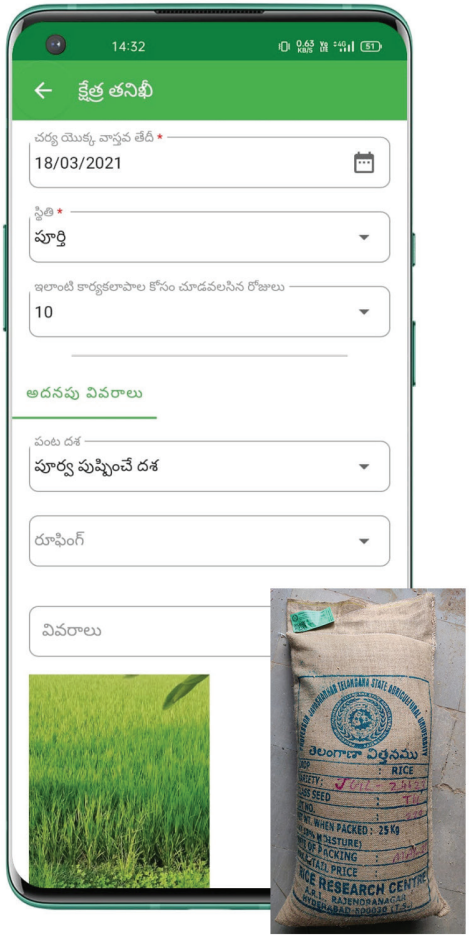
6. TraceX Technologies Pvt Ltd

- **Objective in AIP:** Develop traceability modules for tracing labelled seeds sourced from farmers and seed research technology centres.
- **AIP Duration:** Conducted in Hyderabad, Warangal, Jagtial, and Rajendranagar over a period of one year, covering paddy, black gram, and green gram.
- **AIP Support:** The scientist mentors' team provided field access and best practices in seed production and processing[20].
- **Technical Mentor(s):** Drs. K. Parimala, B. Pushpavathi, Y. Chandra Mohan, P. Jagan Mohan and P. Sujatha.

Table 8. Details of Pilot Execution Plan- TraceX Technologies.

Focus areas for AIP	Pre-pilot phase status	Post-pilot milestones achieved & Status
Product Development	Use case not developed	AIP helped in designing and refining the seed traceability system focused on truthfully labelled seeds
Technology validation	Pending	Contributed to overall growth of the start-up by aiding in the development and validation of the technology.
Stakeholder liaison/ Networking	Few networks	TraceX is now involved in multiple projects and connected with seed companies. Involved in NeGPA sub-project of Government of Telangana.
Market Expansion	In pipeline	Part of the T-Blockchain program helped with market expansion and corporate connections.
Fund Raising	In pipeline	Secured funding of INR 7 Crores through NAB Ventures.

[20] Srivatsa,T.S.R., K. Parimala, B. Pushpavathi, Y. Chandra Mohan, P. Jagan Mohan and P. Sujatha.2022. Blockchain based Paddy seed traceability through TraceX. In :Trailblazer: A Series of Agritech Use Cases. Volume I. V.Praveen Rao; R. Kalpana Sastry, R. Jagdeeshwar; Vijay Nadiminti; R.Vijaya Kumari; and Mukesh Ramagoni.(Editors) (2022). AgHub Foundation (PJTSAU), Hyderabad, Page 27 to 32.



'Piloting innovations especially in the agriculture sector requires deep connects at the grassroot levels which is often a challenge for many start-ups, especially for someone like us coming from a different state. It would not have been possible to establish the connects with the pilot sites without this program. We clearly see a leap in the maturity of our product from where we started to where we are now.'

Srivatsa Sreenivasarao, Co-founder & CEO, TraceX Technologies Pvt Ltd

7. Klonec Automation Systems Pvt Ltd (Krishitantra)

- **Objective in AIP:** Validate and assess the accuracy of Krishi RASTAA.
- **AIP Duration:** Pilot was carried out over a period of eight months on paddy crop in Tornala, Siddipet.
- **Support:** Scientists and mentors provided support by offering facilities and provisions for testing soil samples and standardizing the algorithm. The scientists helped in validating and enhancing the device's efficacy[21].
- **Technical Mentor(s):** Drs. S. Sreedevi, N. Sainath, and A. V. Ramanjaneyulu, S. Sreedevi, N. Sainath, and A. V. Ramanjaneyulu, PJTSAU.

Table 9. Details of Pilot Execution Plan - Krishitantra.

Focus areas for AIP	Pre-pilot phase status	Post-pilot milestones achieved & Status
Technology validation	Pending	Successfully conducted accuracy assessments of their device, identified operational challenges and other critical factors through AIP.
Customer Acquisition	Unclear	Created network of over 750 rural entrepreneurs who assist farmers with soil analysis.
Stakeholder liaison/ Networking	Farmer network was not available.	Engaged with the Ministry of Agriculture & Farmers Welfare, Government of India for soil health care initiatives. Part of the NeGPA sub-project on soil health assessment, run by the Government of Telangana.

[21] Sandeep K.V., S. Sreedevi, N. Sainath,and A. V. Ramanjaneyulu. 2022. Krishitantra's Tryst with Soils of Telangana Through Rapid Soil Testing Technology. In :Trailblazer: A Series of Agritech Use Cases. Volume I. V. Praveen Rao; R. Kalpana Sastry; R. Jagdeeshwar; Vijay Nadiminti; R. Vijaya Kumari; and Mukesh Ramagoni. (Editors)(2022). AgHub Foundation (PJTSAU), Hyderabad, Page 1 to 6.

'The AIP helped Krishitantra by providing a platform to showcase our innovation. The technical team guided us in reprogramming the algorithm and make the bug fixes accordingly.'

Sandeep Kondaji, Founder & CEO, Klonec Automation Systems Pvt Ltd

Summarizing the inputs collected from the AIP teams (start-ups, technical scientists and clients), the pilots in AIP helped start-ups with various aspects of their technology development and validation, improving its accuracy, assessment of operational challenges, and recalibration of the prototype designs leading to an important set of use cases of agri-technologies[22]. Table 10 presents a summary assessment of AIP for each start-up.

Table 10. Milestones & Outcomes from AIP (Cohort I).

Qualitative Parameters	XMachines	Satyukt Analytics	Transity	Thanos	TraceX	Marut Drones	Krishitantra
Product development							
Technology validation/ standardization							
Commercialization							
Market expansion							
Customer acquisition							
Stakeholder liaison/ Networking							
Funding							

Milestone target set by start-up and achieved during AIP

Additional milestone achieved

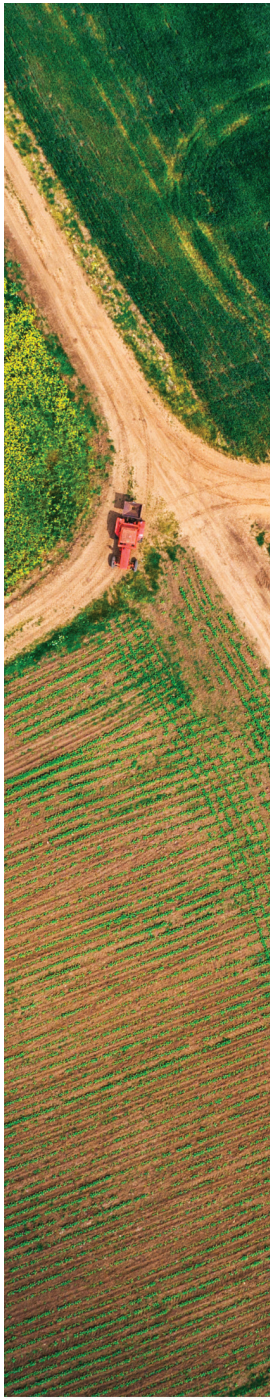
[22] V. Praveen Rao; R.Kalpana Sastry; R. Jagdeeshwar; Vijay Nadiminti; R. Vijaya Kumari; and Mukesh Ramagoni. (Editors) 2022. Trailblazer: A Series of Agritech Use Cases.(Volume I.). AgHub Foundation (PJTSAU), Hyderabad. 77 Pages.

The multi-location nature of the trials helped start-ups to expose the technology to farmers and extension officers for its adoption and to evaluate technology and product performance in different agro-climatic conditions in the State. The involvement of scientific mentors from the university, KVKs and ARS helped in knowledge transfer and an understanding of the scientific trials involved in the testing of technologies.

AIP provided valuable insights into market and business modelling, contributing to a comprehensive understanding of how to scale-up the technology post-validation. It fostered connections with farmers through FPOs and SHGs to address their specific needs. The field demonstrations organized by KVKs helped start-ups to run the product/service in real-world conditions, assessing for acceptance of the technology and clarifying any concerns from the user (farmer). Start-ups felt that AIP helped with improved market access and establishing strong connections with dealers due to the validation results, which helped with market expansion, both domestically and internationally. Association with PJTSAU through AIP helped in brand credibility development as well. Validation through AIP has positioned start-ups for fund raise including higher level grants, seed funds and even investments[23] from venture capital firms.

All the start-ups indicated that there has been an improvement of their technologies, increase in revenue and led to team expansion, following AIP trials. The experience expanded their understanding of their technology application in farm conditions and helped in making pragmatic decisions for their business plans. A significant gain was the change in perception of inculcating a social capital along with business capital among their stakeholders.

The gains from AIP were not limited to start-ups. Exposure to novel agri-techs provided scientists with an overview of the major developments in the digital agriculture domain and its applications, and research application possibilities. Research studies in emerging technology areas such as generative AI, regenerative agriculture, agri

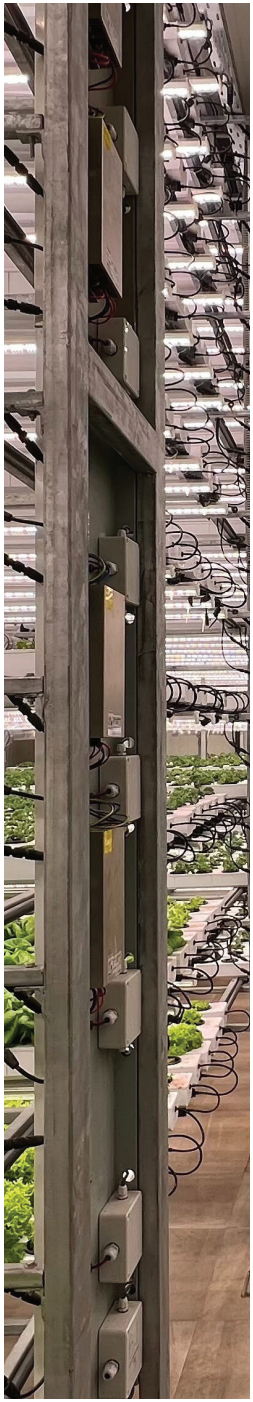


[23] Source:https://www.thehindubusinessline.com/economy/agri-business/agritech-tracex-technologies-bags-1-m-from-nabventures-fund/article65295475.ece accessed on 20 October 2023.

photovoltaics etc are currently underway in PJTSAU, based on the start-up technology models under validation in AIP. Co-Innovation programme with start-ups through R&D programmes were a direct result of the AIP engagement. Recently in 2023, PJTSAU developed standard operating procedures for autonomous drone-based spraying of agri-chemicals through an innovative project in this direction during 2020-21 and developed crop specific standard operating procedures targeting seven crops viz., rice, cotton, redgram, groundnut, soybean, sesame and safflower through the engagement of the start-up, Marut Drones during AIP[24]. These protocols now form part of the drone regulatory compliance protocols at a national level announced during July 2023[25]. Thus, AIP was able to develop partnership channels between research experts, start-up teams and policymakers setting the much-needed convergence models across the agri-innovation ecosystem.

Start-ups such as Krishitantra and TraceX were selected for the sub-projects in the National e-governance Plan in Agriculture (NeGPA) project sanctioned to the Government of Telangana. These sub-projects, coordinated by the Department of Agriculture, Government of Telangana, has further bolstered the credibility of the start-up and its technology capability. The work of three start-ups - TraceX[26] , Satyukt[27] and Krishitantra under AIP forms part of well documented case studies for academic use through IIM-Bangalore and AgHub partnerships for Case Studies series for agritech start-ups.

The Government of Telangana and the World Economic Forum recently designed

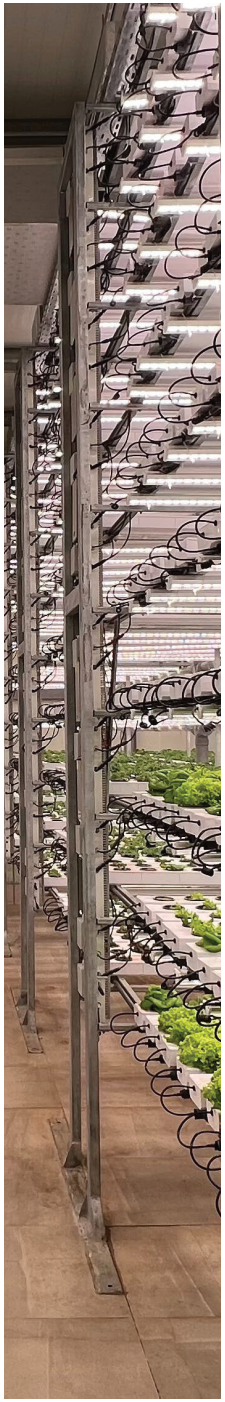


[24] Varma, N.R.G., Babu, T.K., Ramakrishna, A., Sunitha, V., Kavitha, K., Reddy, P.R.R., Ramana, M.V., Sridevi, G., Ramulu, V., Rahman, S.J., Umadevi, G., Rao, V.V., Jagadeeshwar, R. and Rao, V.P. 2022. Standard Operating Protocols (SOPs) for Drone Based Pesticide Application in Rice. Publication No. 41/MG/PJTSAU/2022. Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad- 500 030. Telangana State, India, 104 p.

[25] https://static.pib.gov.in/WriteReadData/userfiles/SOP%20for%20Drone.pdf accessed on 20 October 2023.

[26] Gopal Naik, Menaka Rao, Jacqueline Gomes, V.Praveen Rao, R.Kalpana Sastry, Vijay Nadiminti and Mukta Sharma.2023. Tracex: Blockchain Technology in Agriculture IIM-B Case Study Series. NSRCEL, IIMB prepared this case for class discussion only.

[27] R Srinivasan, Pramoth Joseph, Sandeep Lakshmipath. Satyukt™ Platformization of AI in Agriculture. IIM-B. (Draft Copy under Process). NSRCEL, IIMB prepared this case for class discussion only.



and deployed public-private partnership framework for the digital transformation of the agriculture sector in Telangana. Project Saagu Baagu aims to scale agritech services to the last mile. Start-ups validated through AIP were part of the first phase. The Government of Telangana will soon launch an Agritech Sandbox wherein agritech start-ups can test their model in a safe environment, similar to the AIP framework and which will involve AgHub at PJTSAU, RICH, ET Wing and other partners. Post validation, these start-ups will be assisted in scaling-up operations across the state. Some of start-ups listed in Cohorts II and III are also part of initiatives under Mission 10X[28] and Robotics Mission Programmes[29] jointly executed by RICH, TSIC, T-Hub, AgHub, IKP and ET Wing, GoTS.

This study also highlighted a few issues and challenges faced during AIP execution. There was a distinct need for data availability and better coordination between start-ups and field team at different locations. The duration of the pilots did not allow for extensive and comprehensive data gathering and insight generation. Operational hurdles and cultural challenges were some of the issues leading to deferment of the pilot by one selectee. In some instances such as with drone-based trials, scheduling conflicts due to the unavailability of drones and pilots affected the project timeline that required additional resources to meet the expenses for the extended duration. In fact , though Aghub had on-boarded 10 startups for Cohort II & III during early 2023, the implementation of the technical porgrams for some of these start-ups was hindered or delayed owing to resource constraints including minimal budgets for field level logistics.

AgHub continues to voice this felt need across innovation ecosystem including Government-supported grant programmes, acceleration tracks and investor platforms. For instance, AgHub-incubate start-up Renkube Pvt Ltd was on-boarded for AIP Cohort II during early 2021, but could execute its work only during late 2022. Its selection for grant of INR 50 lakh under the Biotechnology Ignition Grant of BIRAC, Call 2022 proved a major

[28] https://rich.telangana.gov.in/Mission-10X-SIGs.html.

[29] https://it.telangana.gov.in/wp-content/uploads/2023/05/Telangana-State-Robotics-Framework.pdf.

trigger for deployment for technical validation. This pilot is now in operation and will run for 18 months.

Recently, IKP along with BIRAC (Department of Biotechnology, Govt. of India) launched a new initiative, "Agriculture Grand Challenge (Agri-GC)[30] to award ten proposals under seven broad thematic areas such as Quality inputs, Sustainable farming, Farm mechanization and Digital Farming, Post-harvest loss management, Livestock Technology, Agri-fintech solutions and supply chain management and other allied areas. Through this program, funding is provided to the selected start-ups in two stages. At Stage 1, ten innovations with TRL 6 and above are selected for funding up to a period of six months. Deployment collaborating institutions help execute the programme during Stage 1 and the technology offer validated in real-farm sites. At Stage 2, five out of the ten Stage 1 proposals are to be selected for further funding for up to a period of 16 months. Currently Stage 1 is in place and three startups are in validation trials at AgHub, PJTSAU, a deployment partner in this programme.

Indeed the experience in execution of AIP Cohort –I has been insightful and useful for all the players engaged in it. Summing this experience, the learnings gained include:

i. Recognizing the potential of collaborative platforms for catalysing the emerging innovative solutions across the value chains.
ii. Enhancing the scope of R&D for identifying best-fit problem solving innovations.
iii. Standardising protocols for data sharing ,data access and data regulation.
iv. Nurturing agri-tech start-ups and developing mandatory validation models at the real farm level.
v. Developing specific grant programmes for technology validation at field level.
vi. Creating unique soft landing platforms for infusing rapport with users, help reduce cultural challenges.
vii. Building people-centric business models with better levels of user acceptance at market entry.
viii. Developing use cases for agritech innovations for new policy advocacy of deployment of emerging technologies.

[30] https://birac.nic.in/webcontent/1653886710_BIRAC_IKP_Agri.pdf. Accessed on 10 November 2023.

Epilogue

"You can't solve a problem on the same level that it was created. You have to rise above it to the next level." – Albert Einstein

With more than 65 percent of the Indian population residing in villages and over 47 percent of the population practicing agriculture, the various stakeholders of the agri-food sector including policymakers and government agencies have a huge responsibility to enhance food and nutritional security at the national level and position the country as a global food producer. The focused implementation strategy of government-led policies especially during last three decades along with the phenomenal contributions from all stakeholders of the National and State Agricultural Research, Education and Extension Systems (NAREES) have spearheaded the positioning of India as a 'food-secure' nation today. It is also a matter of pride that the share of agricultural sector in Gross Domestic Product (GDP) reached almost 20 per cent for the first time in the last 17 years, making it a single contributor in GDP performance during 2020-2022, the most adverse period of the severe pandemic that drastically affected all other sectors. It signifies the resilience of the entire agri-community across the levels of national agricultural system.

However, the agri-food sector continues to face major challenges under climate-change impacts and dwindling natural resources. The demand to add value to surplus yields and build healthy, nutritious, wellness-driven food products to neo-generation clients with changing lifestyle needs and higher income further add to the list. Consumer demand for transparency in food production systems and adherence to new standard operating practices along with statutory regulatory systems are the newer emerging nuances. The constant demand-supply 'tug-of-war' leading to crop failure, lower price realization despite good production, lack of dependable supply chain, major disruptions in trade especially during pandemic indicate the vulnerabilities in the supply chain and opportunities for possible infusion of technology–driven tools across the AVC. A new 'Basket of Technologies' for AVC is currently emerging and laying a path for the next revolution in agri-food systems. The transformative power of several emerging technologies like Big Data, Internet of Things (IoT),

and biotechnology positions them as 'key enablers of sustainable development' with potential applications across several AVCs. However, shortage of skilled human resources, limited access to quality control mechanisms, fear of exclusion of smallholder farmers and farm communities along with lack of regulatory framework on data and technology governance emerges as major constraining factors across all sectors. Establishment of strong platforms converging start-ups, universities, incubators, investors, and other stakeholders reducing urban-rural divide is perhaps a model worth pursuing. For agrarian economies like India and several developing countries especially from South-South regions, it becomes important to explore pathways to trigger innovations into this sector. Transformative innovations to improve the existing forms of food production, develop value-added nutritive products, better distribution networks, leading to more sustainable production systems are some of the emerging opportunities.

Technology development and deployment approaches at translational levels cannot work in a vacuum. They need to be introduced into both the formal research ecosystem and the informal sectors of farmers' level through appropriate integration. This approach will co-essentially lead to convergent model of science-based technologies, with traditional knowledge, local cultural beliefs and practices. Such an approach has potential for a win-win return with positive acceptability by all.

The model of AIP proposed in this brief aims to fulfil this gap. The results from the efforts under this unique platform bring a science-based validation model at the real-farm level with a close engagement of all-technology developers, technology users and technology-deployment support catalysing institutions (incubators, Governments, policy makers, industry etc). If the potential of new technologies are to harnessed into agriculture and food value chain, it is essential such forward-looking initiatives in a collaborative mode be in place and bring in the inclusivity of all stakeholders to realise the benefits to all.

AUTHORS NOTE

This brief forms part of an ongoing programme Agritech Innovation Pilot (AIP) at AgHub, PJTSAU. Collaborating with Research and Innovation Circle of Hyderabad, (RICH), a prominent player in the innovation ecosystem in the State and across the country, AgHub, PJTSAU undertook a study to assess the AIP-Cohort I administered during 2021-22. The attempt was to understand the gains and the pain points in the designing and execution of AIP with a sole objective to improve the programme offerings. While the potential of several platform technologies including digital tools is well recognised, the challenge to develop a win-win platform for technology creators and technology users in a seamless manner. As part of analysis of this felt need, AgHub designed and executed AIP and initiated an evaluation with RICH to take mid-course corrections of this programme.

The authors would like to thank Chairperson(s) and Board of Directors, AgHub Foundation, PJTSAU and Director General, RICH for their constant mentoring and encouragement in shaping and delivery of this programme. The support for reviewing this document by Mr. Ajit Rangnekar, and Ms. Rashmi Pimple, RICH; and Dr. R. Kalpana Sastry, AgHub, PJTSAU was of immense value. The encouragement from ecosystem leaders, Mr. Jayesh Ranjan, Principal Secretary, Government of Telangana; Dr. V. Praveen Rao, Former Vice Chancellor, PJTSAU; Mr. Ajit Rangnekar, Director General, RICH; and Ms. L. Rama Devi Director, Emerging Technologies, Govt of Telangana continues to be inspiring and motivating the team to continue this initiative with the learnings gained. Sincere thanks to the start-up founders, esteemed scientist teams from PJTSAU and farmer clients for their unstinted help during the execution of the Cohort-I. Special thanks to Ms. Athira Nair for her support during the planning and initial execution of the study.

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- **Mr. Jonathon Philroy**, Director (Food and Agriculture) at RICH, Govt. of Telangana is a Rural Management professional with 15 years of experience in identifying and nurturing entrepreneurs, helping them achieve their true potential. An academic/professional background in rural management, he has a deep understanding of India's agribusiness ecosystem for start-ups, ability to build partnerships with key players, and experience in the design and execution of programs.

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