LANDSCAPE REVIEW

Innovation Gaps in India's Agritech Startup Ecosystem

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CENTRE FOR SOCIAL & ENVIRONMENTAL INNOVATION

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Cover Image: A farmer surveys his pearl millet field in Anantapur district. Credit: Lakshmi Pranuti

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Introduction

India's agritech startup ecosystem was featured prominently in the Union Budget and Economic Survey released in early 2023. Finance minister Nirmala Sitharaman announced that the central government would set up an accelerator fund to support agricultural startups in India, in an effort to bring innovative and affordable solutions for challenges faced by farmers. The promise is of 'modern technologies to transform agricultural practices, increase productivity and profitability'.

This is the latest in a string of developments that indicate a push at the national level to involve startups in India's agricultural sector, which is beset with grave problems from falling farmer incomes to deteriorating soil quality and depleting groundwater. There is evidently an enabling policy environment and an influx of funds directed towards India's burgeoning agritech sector, raising important questions around sustainability, specifically, to what extent climate resilience is factored into their activities.

Agritech startups are growing in importance in India

India is a primarily agrarian economy with almost 54.6% of the total workforce dependent on agriculture. Several segments such as retail, chemicals, packaging and e-commerce directly rely on agricultural output, which magnifies the sector's impact on overall economic growth.

Moreover, India has close to 1,300 agricultural startups and is also the third largest in the world in terms of receiving agritech funding, according to a report by Bain & Company. The same report highlights that India is on the cusp of a massive disruption in the agricultural sector with many impending technology and regulatory advances.

Globally too, there is a clear push for innovations – as well as the money to fund them – to make agriculture and those whose livelihoods depend on it less vulnerable. The annual United Nations climate summit held in November 2022, COP27, launched a new initiative called Food and Agriculture for Sustainable Transformation or FAST, to improve the quantity and quality of climate finance contributions to the food system. It also saw a doubling of last year's investment in The Agriculture Innovation Mission for Climate – an initiative of 42 national governments and 275 partners – to a total of $8 billion. One of the focus areas of this mission is to help farmers, especially smallholder farmers in low and middle-income countries, adapt to climate change by bolstering emerging agritech innovation and agro-ecological research.

These announcements all build on the idea that agritech startups could play an important role in addressing gaps that persist at different parts of the agricultural value chain.

This chain involves the whole range of goods and services necessary for an agricultural product to move from the farm to its final customer. Indian agriculture is susceptible to multiple risks and farmers are grappling with falling productivity and incomes.

We currently have a situation where the agritech sector is thriving but agrarian distress is still pronounced; clearly, there are gaps that must be bridged to ensure that the livelihoods of farmers who are most vulnerable can be addressed, while simultaneously prioritising environmental outcomes in a climate changing world. Through this landscape review, we sought to take a closer look at a sample of agritech startups to identify some of the areas that have been overlooked.

In 2021, the Centre for Social and Environmental Innovation at the Ashoka Trust for Research in Ecology and the Environment carried out a journey mapping exercise to understand the challenges that civil society organisations face in implementing solutions in the agricultural sector. This project required us to speak to grassroots organisations and farmers in four states and analyse the lifecycle of their interventions to identify prevalent 'pain points' or challenges. This experience greatly informed our understanding of the kind of problems farmers face, particularly in the semi-arid regions of peninsular India. We used these findings to inform the current study, funded by the Patrick J. McGovern Foundation.

We begin this report with a detailed explanation of the agricultural value chain as it offers a framework for understanding the multiple steps and phases involved in the farming process from the decision to plant a certain crop to transporting produce to the consumer. Farmers face multiple challenges across this value chain from extreme weather events and degrading soils to fluctuating market prices. It is against this context that we carried out our review of the state of startups in India.

We then delve into what we found out in our review of 105 startups – of which only 85 are active. The work of each startup is categorised based on which step or phase of the agricultural value chain the service or product they offer addresses. For example, a startup offering agrometeorological advisory services would feature at an early pre-production stage as it informs a farmer on what to plant and when. A startup supporting market linkages would fall at the other end of the chain. This analysis helped clarify what kind of solutions the agritech sector offers farmers. We wanted to glean this general understanding as well as hone in on the question of whether these startups work on climate resilient agriculture.

In the discussion section, we detail how only a small proportion of our sample addresses aspects of building climate resilience. This leads us to two glaring gaps in the agritech sector:

> ***One, ecological outcomes, i.e. stressed land and water resources, are not prioritised; and second, small and marginal farmers are largely overlooked despite the fact that they account for a vast majority of the agricultural workforce and are also among the most vulnerable and in need of support.***

The next step for us was to take these findings to venture capitalists and incubators who fund agritech startups to understand why these gaps exist (owing to a lack of time, it was not possible to conduct interviews with individual startups, prompting us to speak to incubators who would be able to consolidate learnings across many organisations). Nobody seems to be making solutions for these problems at scale and it boiled down to a simple and familiar reason - these solutions are not yet monetisable.

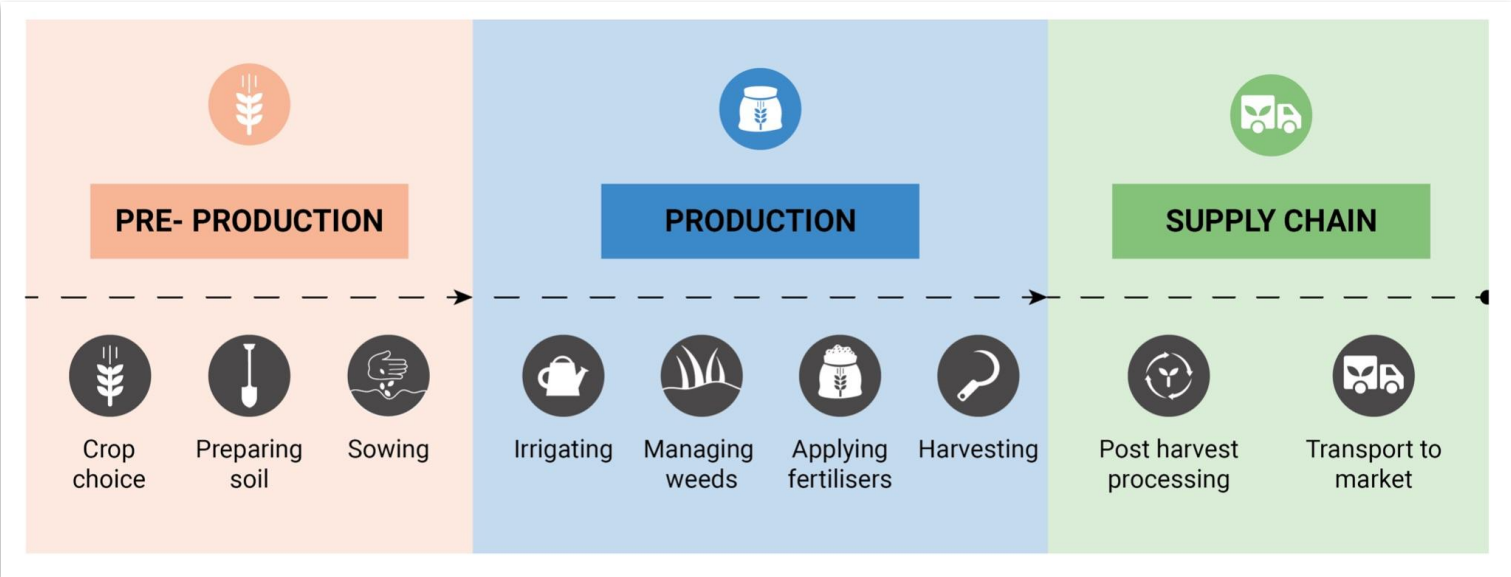
We conclude by highlighting some possible ways forward such as implementing 'sandbox experiments' wherein smaller tracts of land are identified in severely-degraded regions where startups could work closely with farmers and farmer collectives to pilot CRA solutions. This needs to be done in collaboration with research institutes and local CSOs. Deeper engagement with farmers and forging partnerships with the wide range of actors involved in rural livelihoods are necessary for start-ups to begin scaling up climate resilient solutions. It is beyond the scope of this review of the current landscape to provide detailed solution pathways that prioritise ecological outcomes and cater to the needs of farmers with small or marginal land holdings.

Background

The Agricultural Value Chain

(This section has been sourced from a previously published report: Pain Points on a Rocky Road: Journey Mapping Challenges Civil Society Organisations Face with Interventions for Small & Marginal Farmers)

Before we delve into the activities of agritech startups in India, it is important to first understand the agricultural value chain or the farming process. Spanning three broad stages of pre-production, production and the supply chain, this term refers to the whole range of goods and services necessary for an agricultural product to move from the farm to its final customer. We have focused on the agricultural value chain from the point of view of the farmer, i.e. are the challenges or pain points they experience at different stages of the agricultural process being addressed by this fast-growing sector? Right from deciding which crop to plant to logistics that determine how well the crop sells, each step in the agricultural value chain is informed by a number of factors that vary across regions. From our conversations with farmers, Farmer Producer Organisations (FPOs) and Civil Society Organisations (CSOs) involved in agriculture, we identified nine steps:



Pre-Production

To begin with, farmers need to decide what sort of crop is most suitable for the climate, soil type and resources particular to where they are located. These environmental factors aside, the market demand and consequent price that crops are sold for play a pivotal role in helping farmers decide what to cultivate. **Crop choice** is also determined by availability of labour, extent of mechanisation, institutional support that incentivises growth of certain crops. One of the big pain points we identified at this stage is that even though farmers select crops based on market demand, it falls by the time they harvest, spelling losses for them.

Next, the **farmland has to be prepared** for cultivation. This step focuses on enriching the soil and taking precautionary measures against weeds and pests. This process has, to a large extent, been mechanised as farmers either use their own tractor or rent cultivators or rotavators to till the land.

Once the land is prepared, **seeds are planted** usually around the time of the first spells of rain in June and July, unless it is a *rabi* crop (like groundnut) which are planted in October or November. They need to be placed at the right depth and distance from each other but there are different methods by which this part of the agricultural cycle is carried out.

Production

Irrigation or the process of supplying water to the fields is the critical next component of this cycle. Agricultural water use is broadly divided into two categories: rainfed and irrigated. Half of India's agricultural lands is **rainfed**, meaning farmers rely on direct rainfall to replenish their land and crops. But as the likelihood of drought and dry spells increases, our fieldwork found that interventions such as protective irrigation help farmers sustain their crops even during the harsh summer months.

Protective irrigation supplied via pipelines to farmers in Anantapur, Andhra Pradesh, at a time of severe water scarcity. Photo credit: Vishnu at Rythu Nestham FPC

Irrigation entails tapping sources such as groundwater (through wells), and surface water (through canals, rivers, lakes and reservoirs). There are also different types of irrigation systems such as surface irrigation, sprinkler irrigation and, the one used by a majority of farmers we spoke to, drip irrigation.

An important and often labour-intensive part of the agricultural process is **controlling the growth of weeds**. Weeds compete with crops for resources such as soil nutrients, sunlight and water; and can host dangerous pathogens or insects. These factors decrease crop yield and impact its quality. Farmers employ different deweeding measures, the most common being, manual labour. If there's enough space between the saplings (at least 3 feet) farmers also use tractors or traditional tools which are tied to bulls, to extract the weeds. Since employing labour is too expensive for many farmers, they take preemptive measures such as using plastic mulching or spraying herbicides, which cost far less than hiring labourers to deweed acres of land.

Another resource intensive part of the production process is the **application of fertilisers and pesticides**, which are mainly applied at the growth stage of the agricultural cycle. Fertilisers are substances used by farmers to supplement the soil's nutrient levels and thus improve yield; and pesticides are used to eliminate or prevent pests. These are both broad terms used to refer to a wide range of substances with different chemical compositions.

Harvesting marks one of the final stages of the agricultural cycle, when the ripe crop is reaped from the fields. It is carried out when the plant reaches maturity and hence the timeline varies depending on the crop. It is also carried out through different methods, again depending on the type of crop. Like deweeding, it is among the most labour-intensive parts of the process. Workers are hired mainly to gather crops like vegetables, fruits, arecanut, millets like jowar and bajra that cannot be collected using a harvester. Even the manner in which this work is manually carried out varies with vegetables needing to be plucked by hand, while the stalks of ragi are cut using tools like a scythe. Tractors and harvesters are mainly used to harvest paddy.

The timing for harvest has to be precise and increasingly erratic rainfall patterns were cited as a pain point to us because it delays harvests, ruining part of the yield.

Onions sprouting in a farm storage shed in Maharashtra's Ahmednagar district — to be discarded soon. Photo credit: Mukta Deodhar, Srushti Paranjpe

Supply Chain

The crop begins to deteriorate once it has been cut from the main plant. To either retain the quality of the produce or to turn it into a product that can be sold on the market, a set of processes need to be carried out, which could entail cleaning, drying, peeling, dehusking, pressing or powdering. **Post-harvest processing** depends on the crop.

Value-addition at this processing stage of the agricultural cycle holds potential in terms of improving farmers' income. For instance, if millet is sold for Rs. 90/kilogram, millet flour is sold for Rs. 240-300/kilo in urban areas. Once the crop has been harvested and/or processed, it needs to be transported to markets for sale. Robust storage and transportation systems are critical to the success of the entire farming process. Without them, the farmer's investment, in terms of money, time and labour, is wasted if the produce does not make it to the consumer on time and in good quality.

Challenges Farmers Face

The steps summarised in the previous section offer a framework for understanding challenges farmers face at different stages of the agricultural value chain. The agrarian crisis in the country, spans erratic markets, high-input commercial crop production to extreme weather events and a warmer climate. With nearly 30% of India's natural assets undergoing degradation, threatening the bedrock of food security and livelihoods of millions, it is critical to support rural communities and improve their quality of life (by reducing their vulnerability to risks), while protecting the environment.

Low agricultural productivity

India's top soil is eroding at an alarming rate: 5,334 million tonnes per year.

Around 30% of total geographical area is degraded: 96.40 million hectares.

27% of extractable groundwater is currently being drawn at levels above safe limits. Irrigation accounts for 87% of total annual ground water extraction.

Low incomes

The average monthly income per agricultural household (from crop cultivation, NREGA wages, livestock rearing, non-farm businesses) from July 2018 to June 2019 was reported to be ₹10,218.

The annual increase in income derived from from crop cultivation fell sharply between 2012-13 & 2018-19.

Erratic weather, increasing seasonal variability

Climate change is affecting the Southwest monsoon and increasing the frequency of localised extreme rainfall events or altering seasons. Rainfed farmers need data-driven information to plan their cropping cycles.

Rising temperatures also impact crop yield.

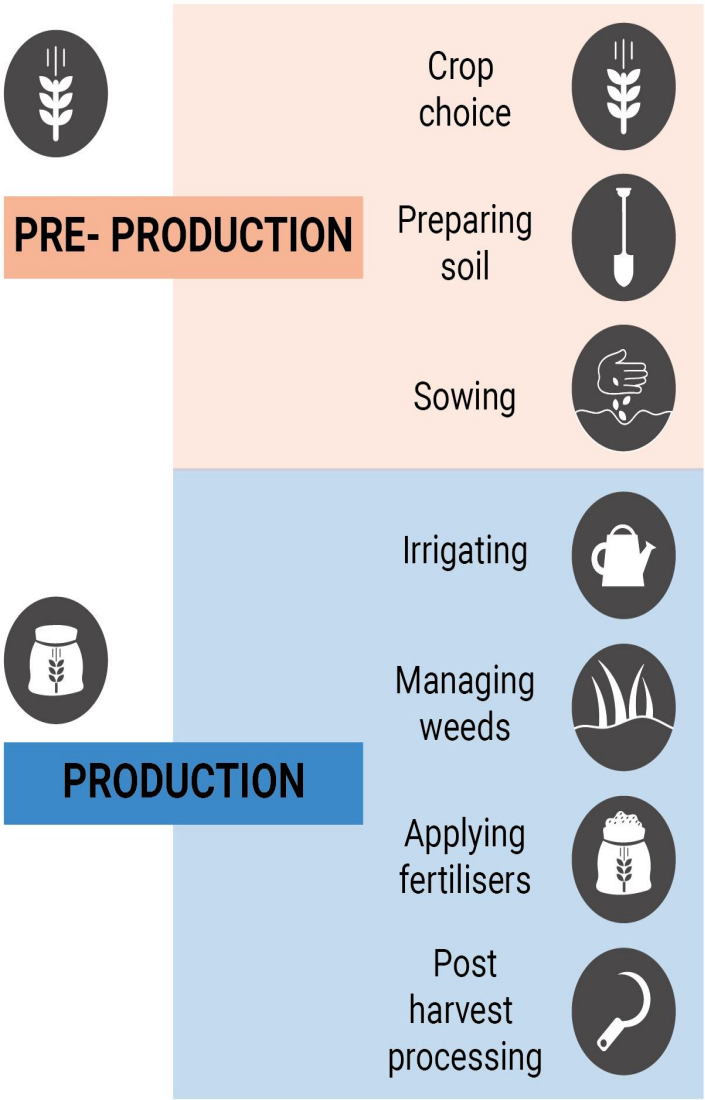
Financial challenges

Farmers face many challenges in acquiring credit at all stages of the agricultural value chain, the biggest one being that banks take too long to process loans. Small and marginal farmers struggle with this most since their land holdings are often fragmented and they lack the proper documentation needed by creditors.

To examine these broad challenges more closely, the Centre for Social and Environmental Innovation tracked 'pain points' experienced by Civil Society Organisations (CSOs) at different stages of the agricultural value chain. The findings of this journey mapping exercise carried out in 2021 can be found here: Journey mapping challenges civil society organisations face with interventions for small and marginal farmers.

For the purpose of this report, we have gleaned insights from this previous study that shed light on some of the specific challenges that farmers said affected their livelihoods. We interviewed farmers in four states - Karnataka, Andhra Pradesh, Telangana and Maharashtra.

Challenges with pre-production and production



Poor quality and expensive inputs

Seeds procured from Krishi Vigyan Kendras or government extension centres or cooperatives like the Indian Farmers Fertiliser Cooperative were reported to often be of poor quality - this affects the productivity of the crop. Fertilisers don't arrive on time and even when they do, they are expensive.

Small and marginal farmers cannot afford to buy and maintain mechanised farming equipment such as tractors.

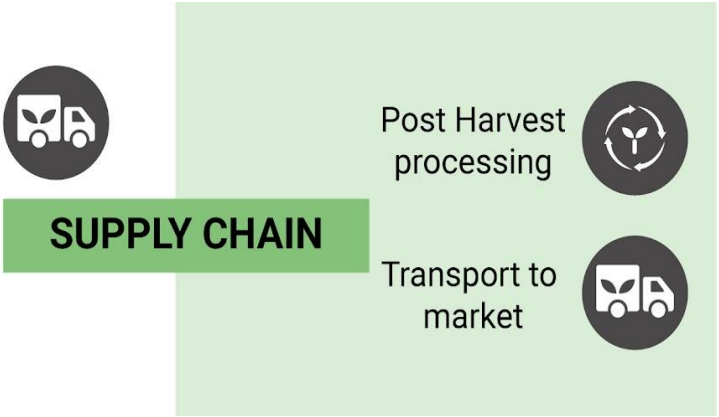
Highly-stressed water resources and water scarcity

Inadequate water for rainfed crops in semi-arid areas, insufficient or untimely rainfall, depleted groundwater levels due to overabstraction of water, insufficient water for *rabi* season (sometimes even for drinking) rank high among farmers' concerns. Information about appropriate crop choices and optimising use of water is often available but not in formats that are easy to understand for the farmer.

Issues with implementation

Data-driven recommendations are not always practical for farmers to implement; they are driven to make decisions based on financial viability over long-term sustainability. Which is why they hesitate, for instance, to shift to less water intensive crops even in semi-arid, water stressed regions because these are not profitable.

Challenges with the supply chain



Market linkages

This relates directly to the last point under challenges in the production stage - that farmers base their decisions on financial viability. Without market linkages, farmers are averse to shifting to other crops. Moreover, farmers don't have direct access to buyers for their produce, they have to sell through channels with many intermediaries, leading to unfair pricing for the farmer.

Fluctuating market prices

Most produce is subject to high market variability, which leads to farmers needing to store produce until the price is profitable. Small or marginal farmers with land holdings of less than five acres simply cannot afford to store produce for very long.

Discarded tomatoes lay strewn for miles on both sides of the highway near Anantapur in Andhra Pradesh. Read more about this in this article. Credit: Lakshmi Pranuti and Surabhi Singh

Review of Agritech Startups in India

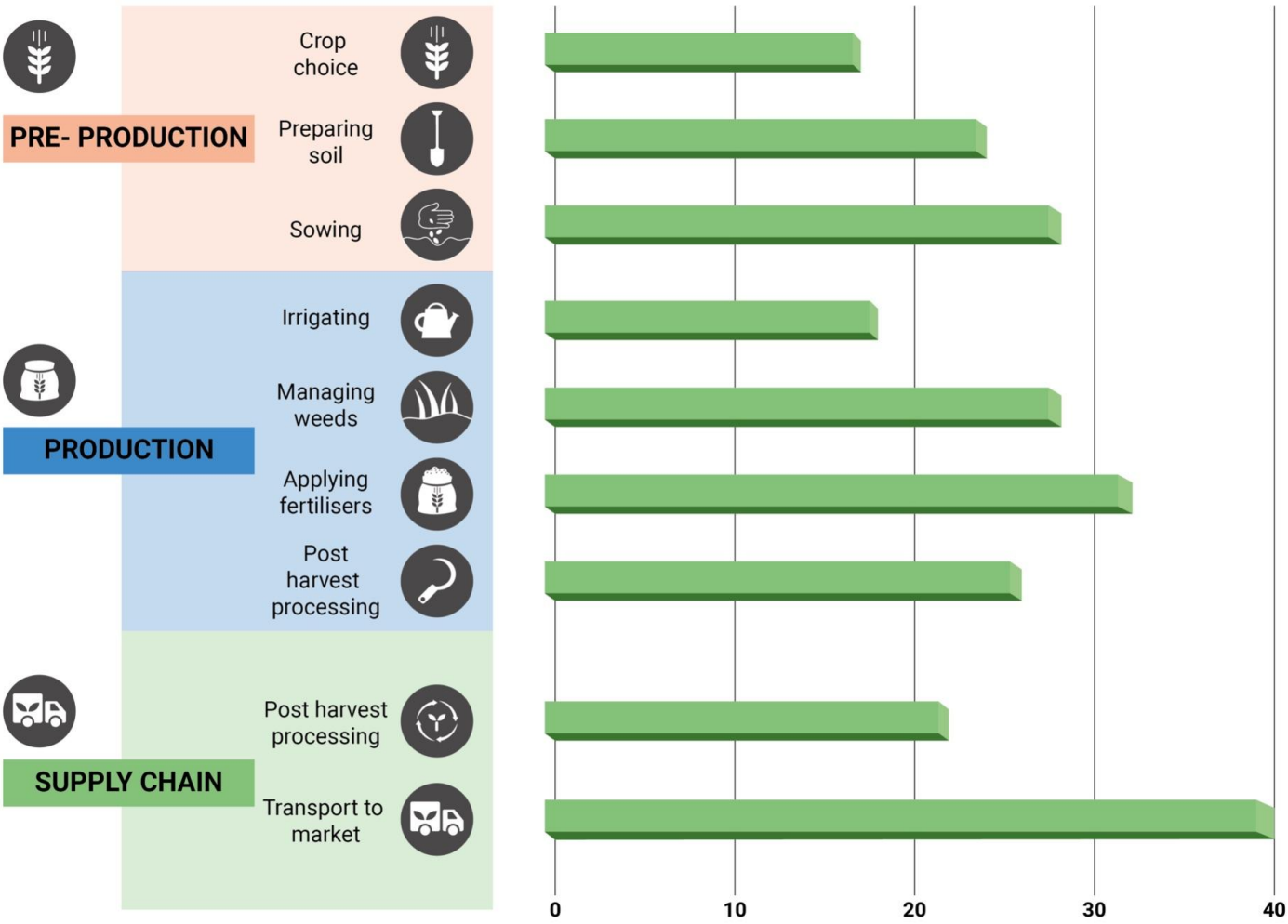
We conducted a review of 105 startups across India to understand the solutions they have been working on. These startups were picked up from an exploratory study by Chandra S.R. Nuthalapati and Chaitanya Nuthalapati on the evolving agritech ecosystem in India and is fairly representative of the agritech ecosystem in India, according to the authors. The study curated this list from a large database of startups from Tracxn Technologies Pvt Ltd. and also collated it against other published literature. We have used their entire list except animal husbandry-related startups.

Of the list of 105 startups, 85 are still active (as of July 2022).

We studied these startups to identify:

- What product/service they are offering and the stage of the agricultural value chain they are innovating for
- Who their target beneficiaries are
- What region they are operating in
- Whether they focus on climate resilient agriculture

Our data collection sheet linked here offers details on each of the 105 startups we looked at.



We studied the reported activities of each of the 105 startups and based on their work, placed them along these stages of the agricultural value chain.

We found that a majority of agritech startups focus on market linkages.

Most startups focus on linking farmers to the market, either directly to the consumer or to other players in the food supply chain (Direct-to-Consumer (D2C)/Business-to-Business (B2B). A report by Ernst & Young says that because the agritech sector in India is still at an infancy stage, there is a tendency to focus on low-hanging fruit like market linkages. The same report identified key market segments for the future of agritech, of which only quality and traceability management are easy to penetrate as compared to precision agriculture and farm management.

Farmer Challenges that Agritech Solutions Address

The graph in the previous page gives an overall view of what kind of solutions agritech startups are working on. We took a closer look at solutions across each of the different stages of the agricultural value chain to identify the gaps that hold back the potential of this sector.

Pre-production

This first stage involves choosing the crop, preparing the land and sowing. We sum up four agritech solutions below that address two important gaps or 'pain points' here:

*Farmers need **access to knowledge and guidance** that will help them plan cropping cycles in advance and thus mitigate unforeseen losses (such as from erratic weather).*

*Farmers need **capital or credit** to buy or rent farming equipment.*

***Decision making tools for farming** - based on IoT sensors, forecast data, historical data, farmer data. These generate farm-specific crop schedules for crop yield improvement (eg. when to sow seeds based on crop type, soil type and weather and pest forecasts). This enables:*

- *Demand-based crop choice based on market trends or when buyer is guaranteed for certain crops.*
- *Farmer to farmer connections for better decision making at the landscape level and knowledge exchange.*

***Online marketplaces** connect input sellers and equipment manufacturers to farmers or farmer collectives who will buy/rent from them.*

***Banking and credit services** connect farmers to creditors/relevant schemes.*

***Apps/web platforms that track farming decisions** at plot level help farm managers, buyers and insurance providers to monitor farms.*

Production

The second stage involves irrigation, management of weeds, application of pesticides and fertilisers, and harvest. These are important steps contingent on multiple external factors that could affect yield and thus farmers' incomes.

*Farmers need guidance on how to make the best use of **high-cost inputs** since inefficient use leads to a net reduction in profits.*

*Farmers need solutions that will help them against losses caused by **erratic weather and pest/disease** attacks.*

*Water use at the farm level is often unplanned and inefficient. Farmers need guidance on **how to irrigate better** and manage pump motors in a way that lessens drudgery (farmers need to walk long distances at odd hours of the night to switch pumps on and off).*

***Farmer apps for knowledge sharing** provide key agronomy insights to farmers throughout a crop's lifecycle. These are often powered by IoT sensors, AI and plot-level data from farmers (field-level data, for example, soil health, cropping data, input data, historical crop and weather data).*

They also provide weather/pest/disease forecasts and data analytics (like yield estimation) to generate recommendations specific to each field. (This is similar to decision-making tools we listed in the pre-production section).

Some of the benefits of such apps are:

- ***Right timing** for application of inputs/deweeding/irrigating/harvesting through irrigation management software and smart pump controllers*
- ***Warnings** for disease and pest management*
- *Help design the **most optimal and cost-effective agri input** combination*
- *A social network for **knowledge exchange** between farmers*
- ***Credit risk modelling** and farmer earning predictions*
- ***Crop consultancy** - knowledge inputs through blogs, videos, best practices guides, Q&A phone lines/chat groups, advisory centres (specially in local languages) that enable farmers to directly talk to experts.*

***Equipment rentals** for irrigation, fertigation and harvesting.*

***End-to-end setups** for polyhouses, covering all inputs and seeds, crop calendar, sensors and smart controllers for irrigation and fertigation, market linkages.*

Supply Chain

The final stage of the agricultural value chain involves post-harvest processing, such as turning millet grain into flour, as well as transport infrastructure to get the harvest to markets or to warehouses for storage.

***Farmers need direct and transparent linkages** to consumers and buyers that fetch them better prices for their produce than what they get in mandis (APMC).*

*Farmers need **better storage and transport solutions** to minimise food wastage.*

*Agritech solutions that **link farmers to markets** focus on:*

- *Guiding farmers on **produce specifications** that fetch more value in the market and provide storage solutions.*
- *Linking farmers to **value addition units** for processing, sorting and packaging as well as warehousing solutions and export managers.*
- *Finding **trustworthy marketplaces**, including private mandis, with fair prices and better deals and transparent transactions.*
- *Enabling farmers to **use digital platforms** to access networks of suppliers, buyers, traders, thereby matching customers to farmers. This includes:*
    - *B2B platforms: for small businesses such as hotels, restaurants and caterers; industries that require farm produce as raw material; businesses that carry out procurement, vendor management.*
    - *B2C platforms: farmers/farmer collectives can directly sell their produce to the consumer through online marketplaces, apps, subscription bundles. All startups that offer B2C services also offer source traceability for the consumer and many facilitate visits/agrotourism/virtual tours of the farm plot and produce.*

*Agritech solutions providing **supply chain financing** focus on:*

- ***Flexible and collateral free credit** for businesses (to bridge gaps in their credit cycles).*
- ***Digitising transactions** across the supply chain in a bid to ensure transparent and fair financial transactions for all players involved.*
- ***Connecting banks and insurance providers** to supply chain stakeholders.*

***Integrated supply chain monitoring platforms** provide supply chain traceability, farm to fork traceability, and source traceability for consumers.*

Efficiency and Profitability

To sum up, agritech startups aim to address challenges that plague different stages of the agricultural value and work towards improving efficiency and profitability for all actors involved.

At the pre-production and production stages, there is a knowledge gap that prevents farmers from making decisions that are most suitable for the environment and can help them to earn better. The impacts of climate change are manifesting with increasing severity, pushing us into new territory where the contextual and traditional knowledge of farmers and indigenous communities needs to be integrated with better data.

Providing farmers with timely access to high quality inputs and mechanised solutions (eg. smart pump motors)

↳ ***Increases input efficiency, farmer gets a higher yield while reducing water and other costly inputs such as fertilisers and pesticides.***

Infusing technologies such as IoT and artificial intelligence into age-old farming practices

↳ ***Increase in income and profits for farmer due to timely decisions that temper losses (for eg. electricity and labour costs).***

Providing real-time soil and climate information as well as decision support frameworks

↳ ***Access to real time data helps farmers and other stakeholders like insurance providers keep track of farming decisions and mitigate risks.***

At the supply chain end, agritech solutions aim to improve efficiency and profitability by linking farmers to markets in easily traceable ways.

Enabling direct transparent transactions between buyers and sellers.

↳ ***Fair pricing for both buyers and sellers.***

Setting up direct-to-consumer platforms that inform farmers on post-harvest best practices and give consumers daily visibility of produce via preset calendars or order-based harvests.

↳ ***Minimises food wastage and allows farm to fork traceability for consumers.***

Providing quality assurance services for different players in the supply chain.

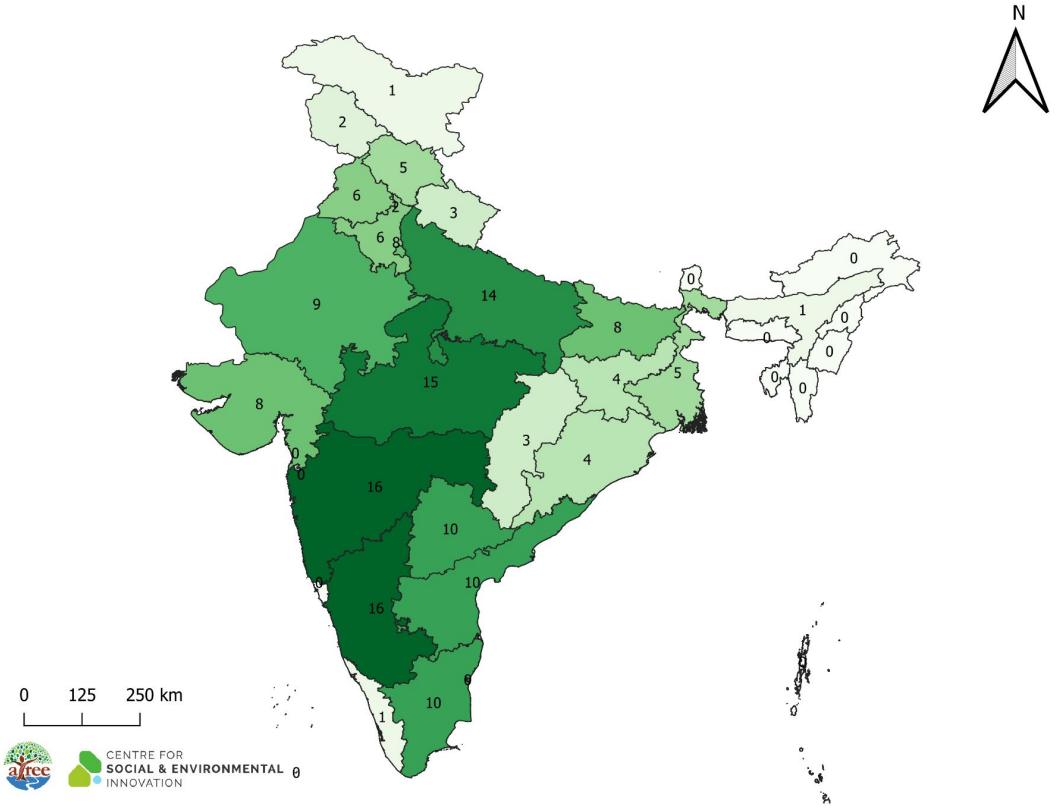
↳ ***Quality assured produce moves through the supply chain.***

Providing energy efficient and affordable solutions for storing fresh produce safely.

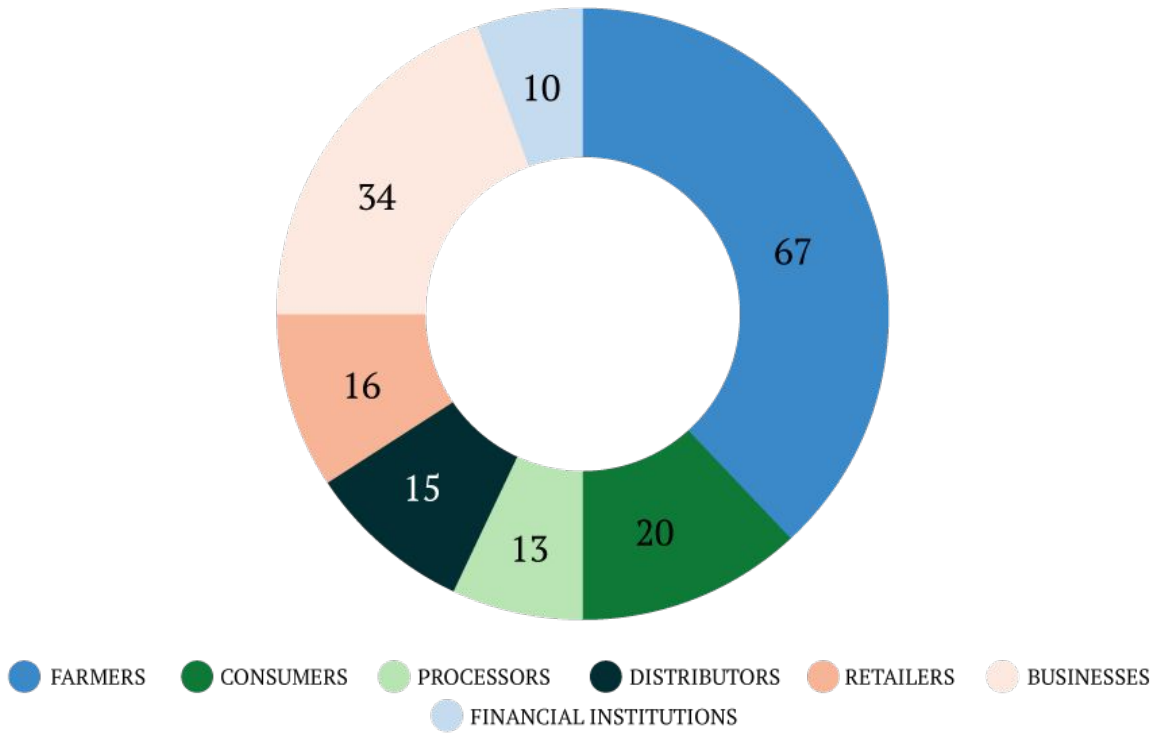
↳ ***This reduces food wastage and energy costs.***

Other Highlights

We also wanted to chart the **geographical distribution** of agritech startups in India - this data was available for only 57 of the 85 startups (still active) we reviewed.



We also examined the target customers of agritech startups. The products and services of the 85 active startups we review aim to support mainly farmers, followed by businesses and consumers.



Discussion

Agritech and Climate Resilient Agriculture

Indian agriculture is susceptible to multiple risks, and small and marginal farmers – who own less than five acres of land – are grappling with falling productivity and incomes. Their situation is exacerbated by the changing climate, increasing seasonal variability and unpredictable extreme weather events that affects crop cycles negatively. The agriculture sector also accounts for high levels of greenhouse gas emissions, contributing to climate change. These factors have led to climate resilient agriculture (CRA) emerging as an important area of research and practice.

While it is evident that agritech startups have the potential to build climate-resilient agricultural value chains, the number of startups doing so currently is low.

Despite how entwined agriculture and climate action are, our review of the work being done by 105 agritech startups in India found that only 38 of them are contributing to CRA.

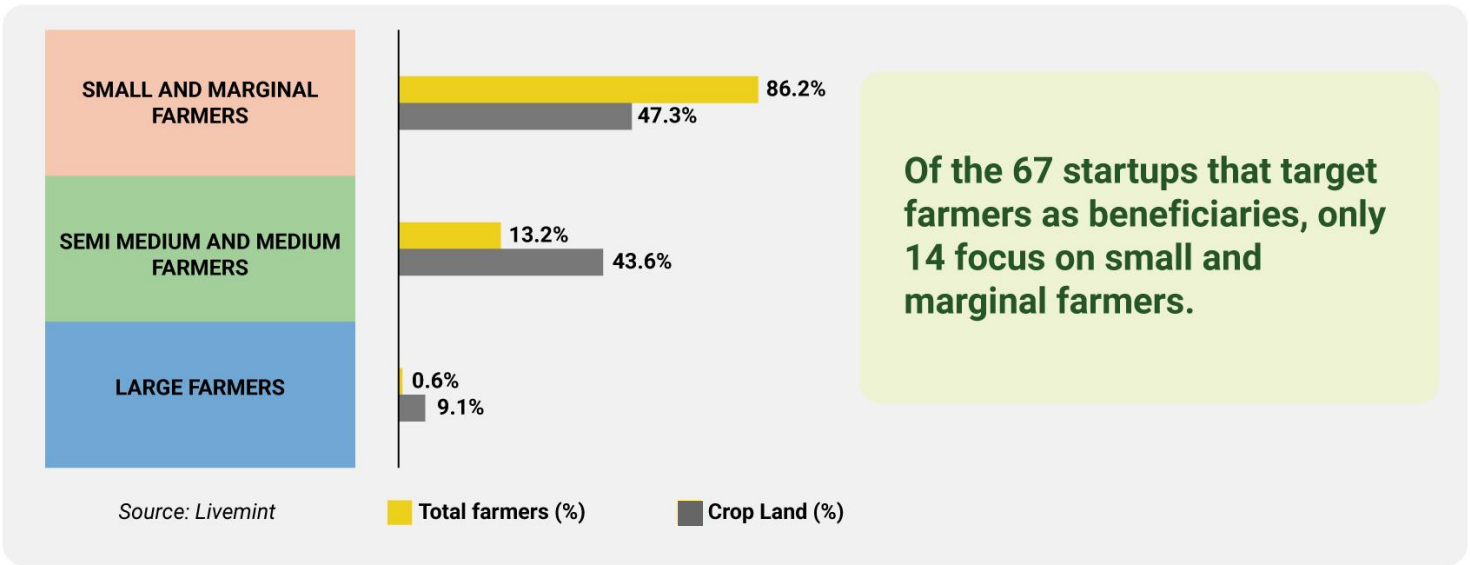
These contributions are mainly across three categories of CRA interventions that the Food and Agriculture Organisation has outlined in this report.

- ***One pertains to climate resilience in cropping systems. Of the 105 start-ups, we found that 29 carry out a range of tasks that build resilience*** by providing climate-optimised crop calendars and advisories through text messages that warn farmers about extreme weather events. This category also involves improving soil health through soil testing and promotion of appropriate inputs and farming methods; on-farm sensors and data analytics to optimise farming decisions like crop choices and when to sow seeds; smart irrigation for more efficient use of water.
- ***We found that nine startups address the second category – governance for climate change adaptation and mitigation.*** This involves monitoring mechanisms for crop insurance providers and agricultural extension services focused on climate resilience, such as capacity building and agri-consulting forums in addition to risk advisories.
- ***Finally, we found that only six startups contribute to climate-resilient practices across food value chains.*** These look into reducing food wastage through demand-based harvest advisories and decentralised storage/warehousing solutions that are energy efficient or powered by renewable energy.

Innovation Gaps

Agritech startups have grown at a remarkable pace over the past few years but our review found that there are important issues that remain unaddressed. For a vast majority of farmers in the country, their wages are stagnating, land is degrading and water is depleting. We list the two gaps that stood out in our review. In the next section, we attempt to shed light on how these could be addressed based on our conversations with venture capitalists who incubate agritech startups.

- ***The problem of stressed resources like soil and water is a major concern that warrants greater attention by the agritech sector.*** Positive ecological outcomes is not a priority, which could lead to serious problems in the near future –both in terms of the well-being of millions of farmers and other workers involved in the agricultural value chain as well as the country's food security.
- The matter of building climate resilience in agriculture is particularly relevant in terms of the ***well-being of small and marginal farmers***. An extended heat wave, late onset of monsoon, more frequent intense spells of rainfall - these events often result in lower quantity and quality of yield and thus less profit for the indebted farmers. 86.2% of all farmers in India are small or marginal and own 47.3% of crop land.



The limited available evidence points to startup innovations being more accessible to farmers with large land holdings. This puts small and marginal farmers at a disadvantage in terms of net welfare gains and reinforces existing inequities.

Small and marginal farmers still have trouble accessing most of these solutions since they rely on farmers being tech savvy, i.e. comfortable using smartphones and has consistent internet access. India has 120 million farmers, out of which only 30 million use smartphones and have an understanding of how digital marketplaces work. Problems such as the lack of smartphone penetration, network connectivity, distrust of technology persist.

Insights from Startup Incubators

To clarify our findings, we spoke to three firms who have years of experience funding and incubating startups in the agritech space. We wanted to understand why these innovation gaps exist and what is needed for incubators to to be able to address these gaps.

Before we go into specific findings, it is important to briefly go over the broad criteria that incubators follow when they assess applicant startups. This underlines a key observation from our interviews – that financial viability is of paramount importance.

Villgro evaluates all startups based on a standard investment template. They assess whether the organisation is solving the problem or the 'problem-solution fit' and whether people will pay for the solution they are offering, i.e. the 'product-market fit'. They also study the nature of potential impact in terms of farmer profiles and focus areas (whether the solution focuses on water access, on small farms or certain crops); and the ability of the solution to scale.

Accel evaluates whether the startup that approaches them has enough background in the agricultural sector and thus has a deep understanding of the space. They also study the applicants' business models and growth trajectories – are they clear on what they want to focus on and do they have a vision to scale? They assess potential for export and look at whether anyone else has attempted the same set of solutions and run into challenges. Accel is interested mostly in full stack service providers premised on the understanding that forging market linkages is the only way to make money. This means that most startups that work on advisories (focused on the pre-production and production stages of the agricultural value chain) eventually have to become full stack.

For Upaya Social Ventures, their mandate is creating jobs, so their primary criteria is to check how many jobs the startup can enable over a certain number of years. They look for innovative models that are solving an important and specific problem, scalability and founders that are aligned with Upaya's mission.

Funding and the profit-making goal

Clearly, money matters; it is a big reason why startups focus on one part of the agricultural value chain or one set of farmers over another. To explain these trends further, for one, there are variations across states, as shown in the map on page 13. Donors and therefore startups seem to prefer some states over others. This preference is usually based on acuteness of farmer challenges and education levels. For instance, the Bill and Melinda Gates Foundation has been running an agritech pilot and acceleration programme in partnership with Tata Trust and the Indian Institute of Technology, Kanpur. The testing ground for these pilots is Uttar Pradesh, where this review has identified one of the highest concentrations of startups.

Secondly, agritech startups are built as businesses and therefore their primary goal is making profits to stay viable. Nobody has yet been able to crack sales and funding for solutions that focus on creating positive ecological outcomes. Both startups and incubators recognise that solutions that prioritise climate resilience and sustainability are needed. However, they are not seeing sales move in that direction unlike for solutions based on market linkages – ***there is a business model issue here as farmers are not able or willing to pay for outcomes based on ecological services.***

Soil testing is an example. There is mistrust because the tests usually indicate that the farmer needs to use the right quality of outputs that are more expensive and not as easily available.

A representative of Accel, a venture capital firm, testified to this point – that the challenge with climate resilient agriculture and focusing on ecological outcomes is rooted in monetisation. 'As venture capitalists, we want our companies to bring in million dollar revenues. Farmers don't pay so much for ecological outcomes like soil testing, and we need startups to be money making machines.'

'Sandbox experiments' and financial inclusion

One way this could be addressed is through 'sandbox experiments'. Villgro, a social enterprise incubator we spoke to, said that it would be useful for them to identify smaller tracts of land in regions where soil quality is severely degraded and water is scarce, where they can test new solutions.

They also need viable revenue models, which means it is necessary to explore ***ways to make current solutions less expensive***. For instance, instead of collecting extensive primary data, one could use satellite data instead. The secondary data can help determine soil quality and irrigation status and then be corroborated through fewer on-ground sensors. This would reduce the cost of a precision irrigation or on-farm decision making solution significantly.

Villgro also talked about the need for ***measures that guarantee financial inclusion***. This could be in the form of credit linkages, support for on-farm expenses and access to warehouses to help farmers avoid distress sales. When they are more financially secure, farmers may be more motivated to invest in ecological outcomes.

Regarding small and marginal farmers being neglected, a representative of Upaya Social Ventures, had an explanation. When agribusinesses grew more tech-centric, market linkages stood out as the biggest challenge. Startups already involved in setting up these linkages needed a certain volume of product to move to stay financially viable. A single farmer with large landholdings can supply a large volume of product, making this demographic more appealing to startups.

This is a problem for small and marginal farmers. We asked whether Farmer Producer Organisations (FPOs), a collective of farmers, could be the answer to smaller quantities as these groups would aggregate produce from many farmers. This is not easy, we were told, because of a lack of traceability. FPOs currently don't have systems where they keep close track of which farmer is providing how much of their stock. Startups need this to assure quality and to provide source traceability to their customers.

Conclusion

The number of agritech startups in India is rapidly growing. They hold great potential in terms of addressing some of the acute problems plaguing the agricultural sector, for example, by adapting to climate stresses or forging market linkages that help farmers earn a profit. As more funding opportunities open up and more of these startups intervene in the agricultural value chain, it is critical to take stock of what work they do and hone in on existing gaps. This review of the current landscape attempts to do that from the perspective of the farmer and the kind of challenges or 'pain points' they face.

We studied 105 startups - of which only 85 were found to be active - to mainly collect information on what kind of services or products they offer, who their target beneficiaries are, and whether climate resilience factors into their solutions.

Two gaps stood out

1. ***Solutions that drive positive ecological outcomes, i.e. those that combat stresses on land and water resources, are not a priority.***
2. ***Small and marginal farmers are largely overlooked despite the fact that they account for a vast majority of the agricultural workforce and are also most vulnerable.***

To dig deeper into why this is, we spoke to incubators of agritech startups, who all agreed that the lack of financial viability is a strong deterrent. Solutions focusing on ecological outcomes are simply not monetisable - farmers are less inclined to pay for solutions like soil testing when they are struggling to make ends meet and need quick fixes to earn better.

The challenge with focusing on small and marginal farmers is also similar. Farmers with large landholdings make for an easier demographic to target as a beneficiary because they can pay for services more easily and they also supply large quantities of produce. Even startups with profitable business models (predominantly working on market linkages) need a certain volume of product to move, and small farmers don't have that much produce. It is therefore not viable for startups to work with them. Incubators have explored associating with collectives like Farmer Producer Organisations (FPO) to be more inclusive of small and marginal farmers. But this has proven to be difficult because of lack of traceability – FPOs don't have well-designed and traceable systems where they keep track of how much of what they are stocking comes from which farmer.

Another problem startups run into is that even for the best designed products, there is often a need for on-ground tech support to enable penetration - even for solutions that are easy to use and to monetise, like weather advisories.

Based on conversations with incubators, we are proposing some ways to prioritise small acreages, less water intensive crops and positive ecological outcomes in the agritech ecosystem in India.

One way is to make these solutions more viable by making them cheaper - for instance, instead of relying purely on primary data collection for a decision making software, using satellite data for soil quality and corroborating this data by on-ground sensors reduces the cost of the solution significantly. Incubators are already encouraging startups to work on this.

We need a real push towards more innovation in the agritech space that services the mitigation of climate risks for farmers and reduces the food system's impact on nature. For this, we need climate positive outcomes to be rewarded by the mechanism that funds agritech companies. In other words, we need incubators and donors to prioritise startups that integrate climate resilience into their innovations. The mechanism for releasing this, however, remains unaddressed.

There is also immense scope to expand access to users, especially small and marginal farmers in areas where there is potential to monetise ecological outcomes. For instance, many farmers who practise rainfed cultivation need support to shift to improve livelihoods. This includes alternative cropping practices that focus on improving soil quality and using water more prudently, as well as diversification of livelihoods to enable them to earn better. In particularly vulnerable districts, such as in the semi-arid belts of the country (eg. Raichur in Karnataka), start-ups could work closely with small farmers and farmer collectives to pilot CRA solutions in collaboration with research institutes and local CSOs.

Deeper engagement with farmers and forging partnerships with the wide range of actors involved in rural livelihoods are necessary for start-ups to begin scaling up climate resilient solutions.

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Photo by Lakshmi Pranuti: A new lily farm in Edganpalle in Telangana's Mahabubnagar district.