

AgTech: A smarter route to sustainable agriculture

November 2022

pwc

FICCI

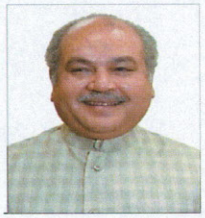
नरेन्द्र सिंह तोमर
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सत्यमेव जयते

आज़ादी का अमृत महोत्सव

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KRISHI BHAWAN, NEW DELHI

30 SEP 2022



संदेश

मुझे यह जानकर प्रसन्नता है कि देश में योग्य और अभिनव कृषि स्टार्टअप की सुविधा के लिए फेडरेशन आफ इंडियन चैंबर्स आफ कामर्स एंड इंडस्ट्री (फिक्की) द्वारा एक नालेज रिपोर्ट बनाई जा रही है। यह कदम उठाने के लिए मैं फिक्की की टीम को बधाई देता हूं।

भारत सरकार कृषि क्षेत्र को व्यवहार्य, नवोन्मेषी और टिकाऊ रखने के लिए अपनी योजनाओं व नीतियों के माध्यम से विभिन्न सहायता प्रदान कर रही है। प्रधानमंत्री श्री नरेंद्र मोदी जी के नेतृत्व में सरकार, कृषि-स्टार्टअप की मदद करने सहित पूरे कृषि पारिस्थितिकी तंत्र को लाभान्वित करने के लिए समर्थन कर रही हैं। विशेष रूप से कृषि के क्षेत्र में अनेक तकनीकी सफलताओं के साथ भारत, दुनिया में बढ़त हासिल कर रहा है। इंडिया डिजिटल इकोसिस्टम ऑफ एग्रीकल्चर (IDEA) के माध्यम से, भारत सरकार डिजिटल इनोवेशन को बढ़ावा दे रही है और सरकारी सहायता व नीतिगत निर्णयों के साथ ही अकादमिक-उद्योग समन्वय व इन्क्यूबेटरों की सहायता से हमारे स्टार्टअप प्रगति कर रहे हैं।

मेरा विश्वास है कि फिक्की की नालेज रिपोर्ट से कृषि स्टार्टअप के विकास में और सहायता मिलेगी, शुभकामनाएं।

30/9/22

(नरेन्द्र सिंह तोमर)

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Message

I am happy to learn that Federation of Indian Chamber of Commerce & Industries (FICCI) is organizing 5th edition of FICCI Summit & Awards for Agri Startup on 1-2 November, 2022 at New Delhi to recognize the potential agri-startups and encourage the promotion of agri-business ecosystem in the country. The Agriculture in India is at the threshold of transformation and looking for innovations and disruption in research and development. This requires more start-ups with innovative technologies and processes to generate more employment opportunities as well as attract smart investments in this area for higher agricultural growth while solving the problems of farmers. FICCI's initiative is an important step for boosting the productivity of the entire agri-business ecosystem and attracting start-ups.

India has been foraying to adopt sustainable solutions that can foster sustainable agricultural growth and ensure sustainable food, feed, fibre and fuel supply to mankind. The new age agtech startups are playing critical role in bringing new novel and innovative product and solution with the support of Governments to commercialize them. The next decade would be very crucial for the agri-business ecosystem in general and agri-startups in particular and could see better products and solutions. The efforts are being made for redefining the sustainable agriculture ecosystem and bringing more synergies among start-ups and government to create sustainable agriculture development in future.

Indian Council of Agricultural Research is promoting startups and supporting new entrepreneurs in the arena of agriculture and agribusiness sector through its 50 Agribusiness Incubators (ABIs) located in its institutes and Deemed to be Universities. These ABIs have supported 818 agri startups including agtech startups.

On this occasion, I compliment FICCI and PwC for their valuable efforts and continuing their vigour to bring on new learnings and sustainable solutions in Agtech Ecosystem space. I believe that increasing R&D in Agtech Startups would be a key factor for realizing evergreen revolution.

I wish the Summit a grand success.

(Himanshu Pathak)

28th September 2022
New Delhi

Message from FICCI



T R Kesavan
Chairman, FICCI Agriculture Committee and Group President, TAFE

Congratulations to FICCI and the PwC team on completing this incredible journey of five years of analysing and disseminating knowledge about the agri start-up sector. This is certainly commendable! Agri start-ups have become key stakeholders in the agriculture value chain today. These young entrepreneurs have a central role in taking Indian agriculture to the next level. As per available data, India could have more than 10,000 agri start-ups by the end of this decade. Such figures are impressive as well as motivating. India certainly needs innovations primarily for two reasons. First, to boost the income of small and marginal farmers and second, to decrease wastage at all levels of the agriculture value chain. These should be the prime focus areas while we aim for technology-led growth for future agriculture. Women-led start-ups too have an essential role to play in this journey.

It's high time that the industry supports agri start-ups and helps them scale up their pilots. Learning through sharing of best practices and mentorship by subject matter experts is imperative. Agri start-ups need to be empowered through access to knowledge, incubation programmes, and facilities for product testing so that they can upgrade their skills and establish successful businesses while also addressing the concerns of the agriculture sector.

A comprehensive and integrated plan with clear, defined roles for different players is important for the growth of agri start-ups in the country. FICCI has been organising the agri start-up programme since 2018. Through this programme, FICCI and PwC have strived to create a common platform that can be utilised by agri start-ups and other value chain players to develop strong linkages. I wish the programme great success!

Message from FICCI



Hemendra Mathur
Chairman, FICCI Task Force on Agriculture Start-ups

The Indian AgTech sector, which took root in the last decade, has evolved to a level where there is a solution for every problem which the Indian farmer is facing, including the sustainability challenge. We now have over 2,000 AgTech start-ups in India, founded by highly talented entrepreneurs. I am sure India will have more than 10,000 sustainable start-ups in the next 8–10 years. I am also delighted that many start-ups are founded by the sons and daughters of farmers, making the ecosystem more inclusive.

Indian AgTech is entering the third phase, which will be driven by increasing farmer adoption of new age innovations and a significant degree of consolidation in the start-up space. For a change, we are also witnessing significant participation from agri corporates trying to partner with start-ups or building their own platforms. The intersection of agribusinesses and AgTech will further drive the scale and innovation agenda in the sector.

As we enter into the next phase of AgTech, I see big opportunities in solving for climate risks which is challenging the sustainability of food systems and farmer incomes. We need to create an enabling ecosystem with participation from governments, multilaterals and financial institutions for climate-linked innovations to scale further. This is precisely the reason that we have chosen sustainability as the core theme of this report.

As Indian agriculture is becoming more feminine, I would like to see more women entrepreneurs in the sector bringing in more diversity and building more women farmer-centric solutions. There are already a handful doing some path-breaking work, and I am hopeful that they will inspire many other women entrepreneurs to join the ecosystem. Another challenge staring at the sector is lack of talent. It's high time we re-orient curriculum in our agricultural universities to make it multidisciplinary by including data science, digital tech, biotech, nutrition tech and behavioural sciences. We need to build capacity to cater to the emerging talent needs of the start-up ecosystem.

The scale of Indian AgTech start-ups depends on the partnerships that they are able to stitch with ecosystem players including farmers, FPOs, cooperatives, CSCs, research institutions, agricultural universities, incubators, investors, and Central/state government and district administration.

The success of the recently organised agri start-up conclave, inaugurated by the prime minister, is an indicator of Government support for promoting innovations in this sector. The Government is setting up a dedicated division for agri start-ups in the Ministry of Agriculture, which will further boost the role of start-ups in integrating technology in all aspects of Indian agriculture.

At FICCI, we are facilitating partnerships for agri start-ups with industry and policymakers, with the objective of accelerating the adoption of AgTech solutions. In order to achieve this, we conduct a series of events, publish many reports, undertake research, and organise meet-ups to drive interactions on a continuous basis. This report is a step in this direction, in order to bring the latest and best of Indian AgTech for the benefit of readers.

I acknowledge and appreciate the significant effort put in by my colleagues at FICCI and PwC in bringing out this report.

Message from the U.S. Soybean Export Council (USSEC)



Kevin M Roepke
Regional Director – South Asia and Sub-Saharan Africa (SAASSA), USSEC

Sustainability is like a diamond – with many facets and, depending on your perspective, looks different at any moment. The Paris Agreement attempts to limit global temperature rises to 2°C, preferably 1.5°C, compared to pre-industrial levels. Agriculture is uniquely positioned as against many other industries because it has the potential to be a carbon sink if the right policies, technology and practices come into alignment. In the US, we aim to halve carbon emissions by 2030 and ultimately become carbon neutral by 2050 – quite ambitious for the world's largest economy!

To accomplish this, agriculture will need to transform itself. The Environmental Protection Agency estimates[1] that agriculture in the US contributes approximately 11% of all greenhouse gas emissions from the country. To combat this, the US Government has awarded over USD 3 billion[2] to companies and stakeholders to transform US agriculture into a carbon sink.

The US soy industry is deeply devoted to this effort. To that end, the USSEC has developed the Soybean Sustainability Assurance Protocol (SSAP), which has been internationally recognised and approved for compliance by organisations like the Tokyo Olympics and the European Feed Manufacture's Association. The SSAP covers four different directives of sustainability – biodiversity/high carbon stock, production practices, public and labour health/welfare, and finally continuous improvement, and has verified over 100 MMT of shipments.

Forests are a substantial contributing factor to sequestering carbon in the ground. After cattle ranching and palm oil, soybean production is the third leading cause of deforestation.[3] However, in the US, we are proud of the fact that our area of forest has gone up, dating back to 1920.[4]

Despite cutting fewer trees, US soybean production continues to climb. Soybean production has gone up 500% since just 1960. This is even more astonishing when you add that the US has lost an area roughly the size of the state of Haryana to urban and suburban housing over the last 15 years[5] (approximately 44,000 square km).

So how does the US accomplish this? Like many things, the answers can be found in technology. And this circles us back to how we can achieve the UN's Sustainable Development Goal (SDG) 2 of Zero Hunger while also becoming a net sink of carbon.

Innovative biological technologies like microbial-based nitrogen are combined with digital technologies like precision-based farming, synergising to increase productivity and decrease resources. Production practices are becoming more fine-tuned to enable carbon sequestration, like no-till farming and cover crops. Genetically modified organism (GMOs) enable farmers to use fewer pesticides and make fewer passes. Biofuels like renewable diesel, biodiesel and sustainable aviation fuel are helping to bridge the gap from fossil fuels. Farmers are now looking at ways to monetise carbon credits for companies to purchase to offset their own emissions.

While food production will probably never become a byproduct of 'carbon farming', it is no secret that agriculture must continue to feed the world while ushering in a new era of net zero emissions. The USSEC stands ready to collaborate with all partners to solve this global challenge.

1 https://www.ers.usda.gov/topics/natural-resources-environment/climate-change/
2 https://www.agri-pulse.com/articles/18241-climate-smart-funding-balloons-to-35b-vilsack-announces-first-projects
3 https://www.wri.org/insights/just-7-commodities-replaced-area-forest-twice-size-germany-between-2001-and-2015
4 https://mff.forest.mtu.edu/TreeBasics/Trends.htm
5 https://csp-fut.appspot.com/

Message from Corteva Agriscience



Vedika Kapoor
Head of Government and Industry Affairs – South Asia, Corteva Agriscience India Pvt. Ltd.

Adopting the best practices for sustainable agriculture is no more an option but a necessity. The challenge is to produce 56% more food by 2050 from the same land while reducing the environmental footprint. This can be achieved by promoting collaboration among relevant stakeholders to advance innovations that are sustainable, productive and customised to the needs of the farmers. It's a huge responsibility that should be shared in a holistic manner. The Government of India has embraced and begun to implement this vision at the country and regional levels. Agribusiness players are adopting new strategies aimed at sustainably increasing agricultural production while augmenting farmers' income. However, in the long run, broadening stakeholder engagement will be crucial for scaling up this impact and agri start-ups are coming up as potential partners in this journey. They are earning the trust and credibility of investors, the private sector and farmers.

While India is progressively building a favourable ecosystem for agri start-ups, efforts should also be made to sharpen our focus on four critical areas which relate to sustainable innovation; biodiversity; greenhouse gas emissions; and inclusion, diversity and equity. Corteva Agriscience strongly believes that by focusing on these four critical areas, we can harness proven science and meaningful efforts to support agricultural production – for food, fuel and fibre, as the world continues to undergo tremendous disruption.

Another important element that should be at the core of sustainable management of natural resources strategy is the upgrading of soil health and fertility. For instance, nematodes are pests that can destroy the soil and have a negative impact on farming. Protecting against plant parasitic nematode damage is critical to maximising water and nutrient utilisation and realising yield potential in crops. It is crucial to educate farmers on soil health and why it is important to preserve and promote it. AgTech start-ups should come up with innovative ideas to address such critical gaps.

Farmers are the backbone of the nation. They should benefit from the developing start-up ecosystem in the country. Secondly, achieving zero hunger through sustainable agriculture practices is one of the SDGs for 2030. I do hope this report will address some of the critical interventions necessary to achieve that.

Message from PwC



Shashi Kant Singh
Executive Director, Agri and Natural Resources, PwC India

The world today faces a severe threat due to increasing greenhouse gas (GHG) emissions, and agriculture, forestry and land use are the largest contributors to these emissions, with a 24% share.[6] Policymakers and global players in AgTech are making efforts to balance food security with environmental conservation. As per the Global Startup Ecosystem Index 2022, India ranked 19 globally for promotion of the start-up ecosystem.[7] In the current situation, AgTech start-ups play a crucial role in creating innovative solutions for achieving sustainable agriculture.

The Government is taking strategic steps to change agricultural practices through various schemes and policies that focus on rainfed area development, agroforestry and soil health management.[8] These efforts can be coupled with the integration of technological solutions and products. The Government of India, is promoting sustainable agriculture through a series of adaptation measures focusing on multiple dimensions which can be further leveraged through the AgTech start-up system.

The rising population and growing demand for food necessitated the use of fertilisers, pesticides and commercial seed varieties to increase yield and hence production, which led to the Green Revolution. However, some practices of modern agricultural practices have raised questions about the longevity of a crop production system which results in high emissions. Hence, there is a need to change the strategy and usher in an 'evergreen revolution'. Reducing GHG emissions from the agriculture sector by around 50% would require a host of interventions from AgTech start-ups in terms of innovative and affordable solutions for reduction of food waste, increase in agricultural efficiency, and use of technology for low carbon food options.[9]

This knowledge paper aims to help policymakers, the private sector and stakeholders find a synergistic path towards implementing sustainable agricultural practices and defining challenging roles for AgTech start-ups in order to meet the SDGs and ensure a brighter and sustainable future.

6 https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data
7 https://affairscloud.com/global-startup-ecosystem-index-2022-bengaluru-boasts-strongest-startup-ecosystem-in-india-8th-globally/
8 https://nmsa.dac.gov.in/frmComponents.aspx
9 https://ourworldindata.org/food-ghg-emissions



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01 Executive summary

In recent decades, sustainable agriculture has gained prominence on account of population growth and challenges to agriculture due to climate change. With world population continuing to rise and estimated to reach 9.73 billion by 2050, availability of food for all will become be a key challenge as agriculture production needs to double to meet consumption needs. The increasing cost of farming, environmental uncertainties, crop loss and poor yield are severely impacting farm households globally and call for sustainable agriculture interventions and practices. Also, achieving zero hunger, responsible consumption and production is one of the Sustainable Development Goals (SDGs) to be achieved by 2030, and its realisation depends on the performance of the agriculture sector worldwide. With their innovative ideas and technology solutions, AgTech start-ups have a critical role to play in addressing the issues and challenges faced by sustainable agriculture. Favourable government policies, private sector investments and the rise of digital business models have led to a wave of tech start-ups in agriculture and other domains, with nine start-ups coming up every minute globally. Overall, the AgTech start-ups are likely to influence the global GDP by approximately 50%.[10] The internet of things (IoT), robotics, artificial intelligence (AI) and drones are the major innovations to which AgTechs have contributed significantly. In particular, with supportive Government policies, India has become a hub for AgTech start-ups that provide solutions and services on input market linkage and farming as a service (FaaS), supply chain, post-harvest management and output market linkage, precision farming, advisory and analytics, and FinTech.

As per the Food and Agriculture Organization (FAO), sustainable agriculture practices deal with sustainability issues in the food and agriculture ecosystem based on five principles: increase productivity, employment and value addition in the food system; protect and enhance natural resources; improve livelihoods and foster inclusive economic growth; enhance the resilience of people, communities, and ecosystems; and adapt governance to new challenges.[11] These practices encompass a wide spectrum of interventions and practices from production to consumption and from delivery of inputs to farms to delivery of products to end consumers. They include sustainable solutions from AgTech start-ups for addressing issues and challenges with respect to energy efficiency, climate change, wastage reduction, soil and water depletion, and food supply while ensuring quality and nutrition value.

Sustainability issues in agriculture are majorly linked, but not limited, to pre-production and post-production agri-ecosystems. These include production of more food for the increasing population by 2050, the shrinking size of cultivable land, green energy and climate change, availability of appropriate resources, and political and legal frameworks. There has been tremendous scope for AgTech start-ups to address these challenges through technology solutions for sustainable use of inputs, optimisation of agricultural output to realise higher yield through use of technology for controlled environment agriculture, hydroponics and aeroponics, and sustainable food supply chains to reduce wastage of food from harvesting to consumption.

Agriculture contributes to 25% of GHG emissions and also leads to air and water pollution and soil degradation. AgTech start-ups can provide effective technology solutions for agriculture ecological management systems and help in reducing GHG emissions across the agri-value chain, providing green energy and minimising the effects of environmental disasters such as floods and droughts.

Maintaining biodiversity along with agriculture is a major concern for ensuring sustainability as it helps in the preservation and enhancement of agricultural systems. It would help in achieving food security, better nutrition and creating livelihood opportunities along with maintaining soil fertility and controlling pests and pollination. The shift towards vegan food culture and optimum consumption of available food through processing and value addition would contribute towards a sustainable food system. AgTechs have vital roles to play towards maintaining biodiversity and providing technology solutions for food processing.

AgTech start-ups have revolutionised the age-old agricultural system with their relevant, innovative and

10 www.startgenome.com
11 https://www.fao.org/3/I9900EN/i9900en.pdf

affordable solutions. Interventions such as ICT-based applications, farm automation, weather forecasting, drones, inputs retailing and equipment renting, online agri-produce marketing, protected cultivation, innovative food processing, packaging and marketing which are being implemented at different stages of the agricultural value chain, AgTech start-ups are driving sustainable agriculture practices to realise the optimum potential of agriculture sector. Also, traceability in the agriculture system is helping to identify a at the different stages of production, harvesting, manufacturing, processing, distribution, and handling of food. As a result, there is less recall of products from the marketplace and thus loss reduction and greater protection of consumer health. AgTechs have significant roles to play in providing solutions to ensure fast, efficient, and less costly recall of defective or unsafe products.

Agri-based start-ups are addressing critical gaps across the agricultural value chain by leveraging big data analytics, supply chain and market-linked models, FaaS, IoT, engineering-led innovation and so on. Although enabling policies and institutional mechanisms have been created by the Central and state governments to support agri-based start-ups, there is scope to do more. Support from the Government as well as the private sector is required to promote and sustain AgTech start-ups and realise the larger socioeconomic and sustainability impact.

Although India has a large number of AgTech start-ups in comparison to the rest of the world (marketplace and distribution: 25%, farm inputs: 25%, crop quality assessment: 5%, precision agriculture and farm management: 10%, finance and insurance: 20, farmers advisory services: 20%, hydroponics: 7.5%,[7] these start-ups face several challenges with respect to sustainability, research and development, collaboration, capacity building/ skill development and funding.

It is important to create a long-term framework for sustainable agriculture and the environment that integrates the solutions developed by AgTechs as a key driver. The key strategies recommended are (a) regenerative practices and natural solutions, (b) a transparency and traceability system, (c) adequate training and education for providers and farmers, (d) innovation through research and development and collaboration.

Recently, the Government of India has announced an accelerator programme of INR 500 crore to add impetus to successful initiatives in AgTech start-ups and a separate division is planned for agriculture start-ups in the Ministry of Agriculture. Support to tech-led start-ups by the Government of India is key and will help in increasing the number of AgTech start-ups in the country from a mere 80–100 in 2014 to 10,000 by 2025.[8]

7 https://aspirecircle.org/wp-content/uploads/2021/04/Praxis-global-report-on-agritech.pdf
8 https://pib.gov.in/PressReleseDetailm.aspx?PRID=1868565

02 Agriculture and sustainability

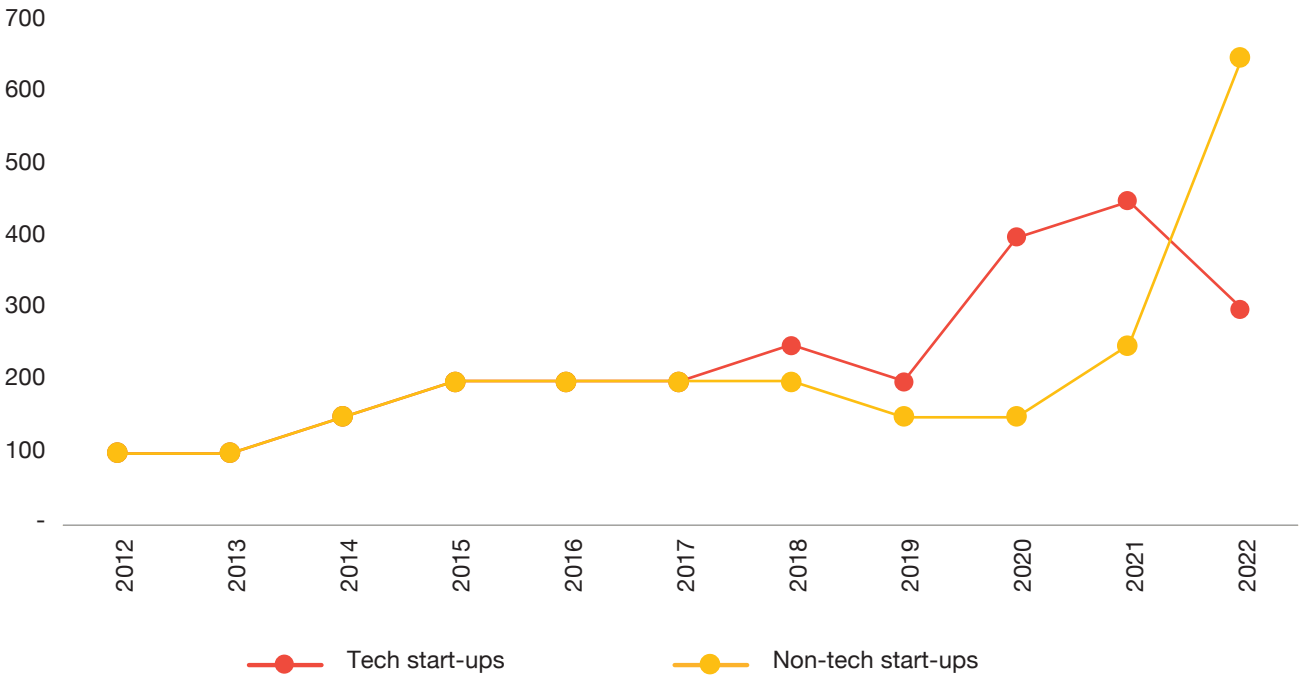
2.1. Sustainable agriculture: A global and Indian priority

2.1.1. Global priority

Agriculture is the backbone of any economy as it provides both food security and employment. Given the rising population, especially in developing countries, there is a need for impactful policies and schemes that will enable farmers to produce enough food to meet the requirements of 9.7 billion people by 2050. At the same time, climate change poses a severe threat to crop yield and thus ensuring food security is going to be a challenge in the near future.[12] As agriculture alone contributes to 25% of GHGs emissions, it becomes necessary to adopt and promote agricultural practices that ensure food security.

Internationally, sustainability of food production and related challenges have been raised at multiple forums. For instance, Sustainable Development Goal (SDG) 2 – 'End hunger, achieve food security and improved nutrition and promote sustainable agriculture' – identifies the need for sustainable agriculture practices, a healthy lifestyle, climate change measures, interventions for small and marginal farmers and other similar issues. Further, there is a growing need for research and development and use of

In the post-pandemic world, tech companies have grown 2.3 times compared to non-tech companies



Source: www.startupgenome.com and PwC analysis

12 https://www.worldbank.org/en/topic/agriculture/overview



technology to create a sustainable food system in the present situation of climate change and its impact.[13]

Building resilience of local food systems will be critical to averting large-scale future shortages and to ensuring food security and good nutrition for all.[14] Climate change is a serious threat to agricultural ecosystem in the world.

The challenges of climate change and its impact on agriculture has been also emphasised by the Intergovernmental Panel on Climate Change (IPCC). As per the Sixth Assessment Report of the IPCC, heat stress and a rise in floods and droughts will adversely affect the availability of food and thus lead to food inflation. As a result, cases of malnourishment may see a sharp rise, especially in South and Southeast Asia.[15]

Further, the Rome Declaration on Nutrition and the Framework for Action focuses on the development of rural regions through sustainable agriculture and fisheries, especially in the least developed economies of the world. Their productive capacities will be strengthened through structural transformation and development policies.[16]

Digital business models and start-ups hold promise in the current scenario. As estimated by the World Economic Forum, there is a rise in digital business models and these models will produce 70% of new value across the globe in coming decade. 'Digitally transformed' industries are likely to influence more than 50% of the global GDP by 2023.[17]

Insights from the Global Startup Ecosystem Report 2022[18]

Silicon Valley, New York, London, Boston and Beijing are the top five start-up ecosystems of the world.

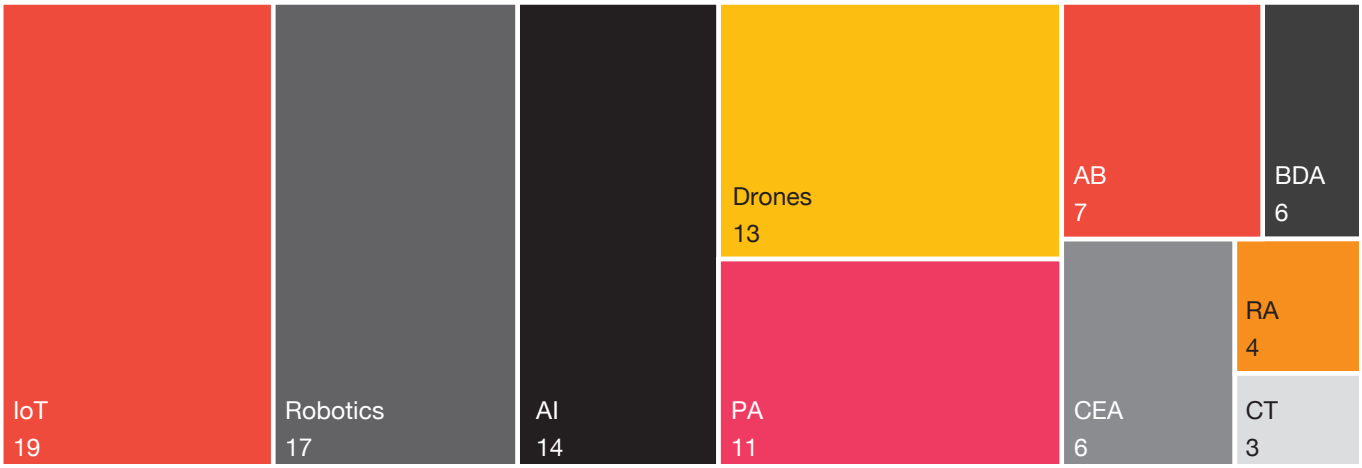
The start-up ecosystem in India is developing rapidly. Delhi (26) entered the top 30 for the first time, while Bengaluru stood at 22.

540 companies achieved unicorn status in 2021 which is a new record. In 2020, this number was 150.

Globally, tech start-ups will be the key driver of industrial growth in all economies. They would also drive the agricultural ecosystem in developing economies by increasing food productivity through sustainable and innovative models.

13 https://sdgs.un.org/topics/food-security-and-nutrition-and-sustainable-agriculture
14 https://sdgs.un.org/2030agenda
15 https://www.ipcc.ch/report/ar6/wg2/downloads/outreach/IPCC_AR6_WGII_FactSheet_Asia.pdf
16 https://sdgs.un.org/2030agenda
17 https://startupgenome.com/article/the-state-of-the-global-startup-economy
18 https://startupgenome.com/report/gser2022

Trends and innovations in AgTech in 2022



IoT: Internet of things; AI: Artificial intelligence; AB: Agri biotech; BDA: Big data analytics; PA: Precision agriculture; CEA: Controlled environment agriculture; RA: Regenerative agriculture; CT: Connectivity technology

Source: https://www.startus-insights.com and PwC analysis

With Delhi and Bengaluru emerging as new global hubs for tech start-ups, AgTech start-ups would help in redefining India's new agricultural ecosystem through more environment- friendly and sustainable solutions.

2.1.2. Indian priority

AgTech market segmentation

Nature of services

Key services

- Input market linkage and farming as a service (FaaS)
- Supply chain, post-harvest management and output market linkage
- Precision farming, advisory and analytics
- Agri FinTech

Key regions

Karnataka	Maharashtra	Delhi NCR
Haryana	Tamil Nadu	Telangana
Gujarat	Others	

By region

Source: Department for Promotion of Industry and Internal Trade (DPIIT) and PwC Analysis



As per NASSCOM, AgTech start-ups have raised approximately USD 248 million in 2019, mainly through adoption of new technology.[19] The surge in AgTech start-ups has been due to the penetration of mobile technology in rural areas, i.e. affordable hardware such as smartphones and wireless mobile networking technology such as 4G and Long-Term Evolution (LTE) technology.

In India, as on July 2022, there are 1147.93 million wireless telephone connections, out of which 522.98 million subscribers are in rural India.[20] Moreover, the country had 750.5 million smartphone users in 2021. With a high number of smartphone users, the possibility of the adoption of AgTech (especially IT and ITeS) solutions and products would be easier and more effective.

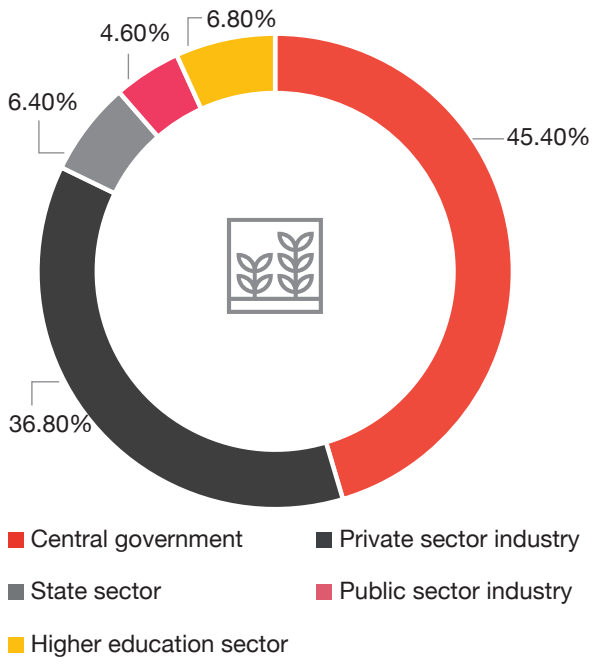
The Government of India is also placing emphasis R&D activities through grants. The gross expenditure on R&D (GERD) has increased year on year, and nearly tripled from INR 39,437.77 crore in 2007–08 to INR 1,13,825.03 crore in 2017–18. The GERD is estimated to be Rs. 1,23,847.70 crore in 2018–19.[21]

Central government and state government shares are highest as funds were provided to multiple organisation such as the Defence Research and Development Organisation (31.6%), Department of Space (19.0%), Indian Council of Agricultural Research (11.1%), Department of Atomic Energy (10.8%), Council for Scientific and Industrial Research (9.5%) and Department of Science and Technology (7.3%), Department of Biotechnology (3.7%) and Indian Council of Medical Research (3.1%), Ministry of Earth Sciences (2.3%), Ministry of Electronics and Information Technology (0.8%), Ministry of Environment,

Forest and Climate Change (0.5%), Ministry of New and Renewable Energy (0.1%) in 2017–18.[22]

Thus, India is progressively building a sound ecosystem for AgTech companies to flourish and develop pathbreaking and disruptive products and solutions that support sustainable agriculture. Further, the Government of India is also strengthening the country's AgTech start-up ecosystem through several policies.

National R&D expenditure by sector



19 https://www.ibef.org/blogs/agritech-start-ups-the-ray-of-hope-in-indian-agriculture
20 https://dot.gov.in/sites/default/files/MTS%20July%202022.pdf
21 https://dst.gov.in/sites/default/files/R%26D%20Statistics%20at%20a%20Glance%202019-20.pdf
22 https://dst.gov.in/sites/default/files/R%26D%20Statistics%20at%20a%20Glance%202019-20.

The National Mission on Sustainable Agriculture (NMSA) was implemented in 2014–15 to encourage sustainable agricultural practices. It also supports the creation of sustainable products and solution for realising sustainable agriculture.[23]

Key Government policies and initiatives supporting the AgTech start-up ecosystem

Department/Ministry	Name of the scheme	Key features
Ministry of Science and Technology	National Initiative for Developing and Harnessing Innovations (NIDHI)	The scheme aims to promote technology-driven start-ups to create innovations for sustainable solutions.
Biotechnology Industry Research Assistance Council (BIRAC)	• Bio incubators Nurturing Entrepreneurship for Scaling Technologies (BioNEST) Scheme • Biotechnology Ignition Grant (BIG), Promoting Academic Research Conversion to Enterprise (PACE), Small Business Innovation Research initiatives (SBIRI) • Biotechnology Industry Partnership Programme (BIPP).	Scheme aims to foster innovations for development of new technologies.
Scheme aims to foster innovations for development of new technologies.	• Rashtriya Krishi Vikas Yojana (RKVY)	• Agri-entrepreneurship for promoting innovation • Financial support for development of incubations such as agro processing, farm mechanization, AI, etc.
Ministry of Electronics and Information Technology (MEITY)	• MeitY Start-up Hub' (MSH)	• Fostering innovations by supporting creation of incubation centres
Ministry of Commerce and Industry	• Startup India	• Support for creation of start-ups for leading innovative solutions

Source: Websites of various Government ministries, Press Information Bureau and PwC analysis

New age start-ups are aiming to design and develop innovative products and solutions that will help in addressing the challenges posed by climate change and promote sustainable agriculture.

Countries around the world have raised the issue of sustainability on global platforms and proposed the development of polices around the future course of action. This discussion led to the implementation of the Sustainable Development Goals by the United Nations General Assembly in 2015. Among the 17 SDGs set under Agenda 2030, zero hunger and responsible consumption and production relate to sustainable agriculture.

India needs to improve its scores on sustainable agriculture

The Food Sustainability Index (FSI) is used to measure the sustainability of existing food systems in 78 countries. The FSI comprises 38 indicators and 95 sub-indicators that measure food loss and waste, agriculture and nutritional challenges. The scores on these indicators range from 0 to 100, where 100 = the highest sustainability and greatest progress towards meeting environmental, societal and economic key progress indicators (KPIs).

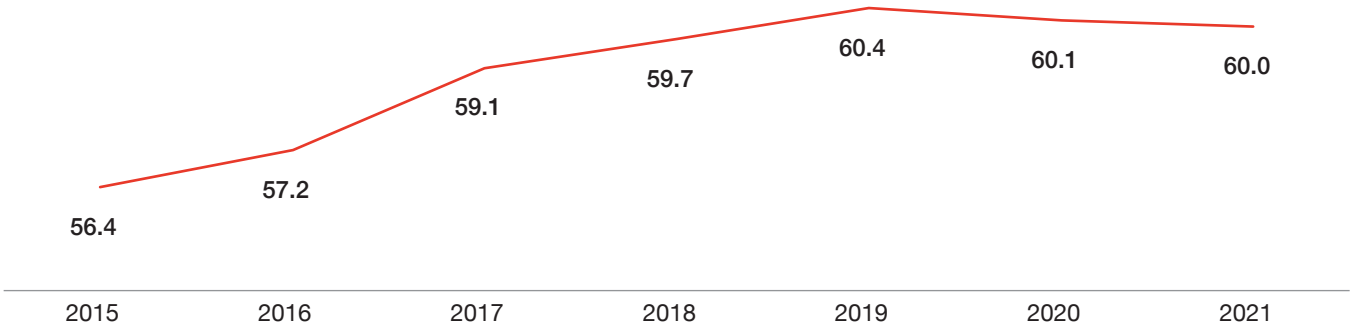
23 https://nmsa.dac.gov.in/

Agricultural Sustainability Index[24]



As per the FSI developed by Economist Impact with the support of the Barilla Centre for Food and Nutrition Foundation (BCFN), India scored 56 points and ranked 71 among 78 countries on the sustainable agriculture component in 2021. However, overall, India scored 62 points on the FSI and ranked 39.

India SDG score year on year



Source: SDG Index Dashboard and PwC analysis

India needs to make concerted efforts to achieve the following key SDGs:

Zero hunger: Major challenges remain

Responsible consumption and production: SDG achieved

Climate action: SDG achieved

Life on land: Major challenges remain

There is a need for further work and actions to be taken on 'life on land' and 'zero hunger'. Sustainable agriculture will play a very important role in achieving these SDGs.[25]

24 https://impact.economist.com/projects/foodsustainability/interactive-world-map/
25 https://dashboards.sdgindex.org/map

2.2. Sustainable agriculture practices

Sustainable agriculture practices are an alternative to existing age-old practices and also help in achieving energy efficiency, addressing climate change, and reducing waste and soil and water depletion.[26] As per the FAO, sustainable agriculture revolves around five principles.

FAO's five principles on sustainable food and agriculture



Source: FAO

Sustainable agriculture is based on agricultural operations that do not deplete existing resources so that they remain available to future generations. A sustainable food system is part of a sustainable agricultural system, which encompasses wider concepts like encouraging vegan food, decreasing food mileage (sustainable food distribution), promotion of local food, sustainable gardening and rooftop gardening.[27]



26 dex.org/map" https://dashboards.sdgindex.org/map and PwC analysis
27 dex.org/map and PwC analysis

Areas of opportunity for AgTech start-ups

1. Food security
2. Agritourism
3. Agroforestry
4. Biofuels
5. Conservation tillage
6. Controlled environment agriculture (CEA)
7. Cover crops
8. Dairy waste management
9. Direct marketing
10. Energy efficiency and conservation
11. Food labelling/certifications
12. Food waste management
13. Global sustainable sourcing of commodities
14. Institutional sustainable food procurement
15. Biologically integrated farming systems
16. Integrated pest management (IPM)
17. Nutrition and food systems education
18. Organic farming
19. Precision agriculture
20. Soil nutrient management
21. Post-harvest management practices
22. Technological innovation in agriculture
23. Urban agriculture
24. Value-based supply chains
25. Water use efficiency
26. Water quality management
27. Zero-emissions freight transport

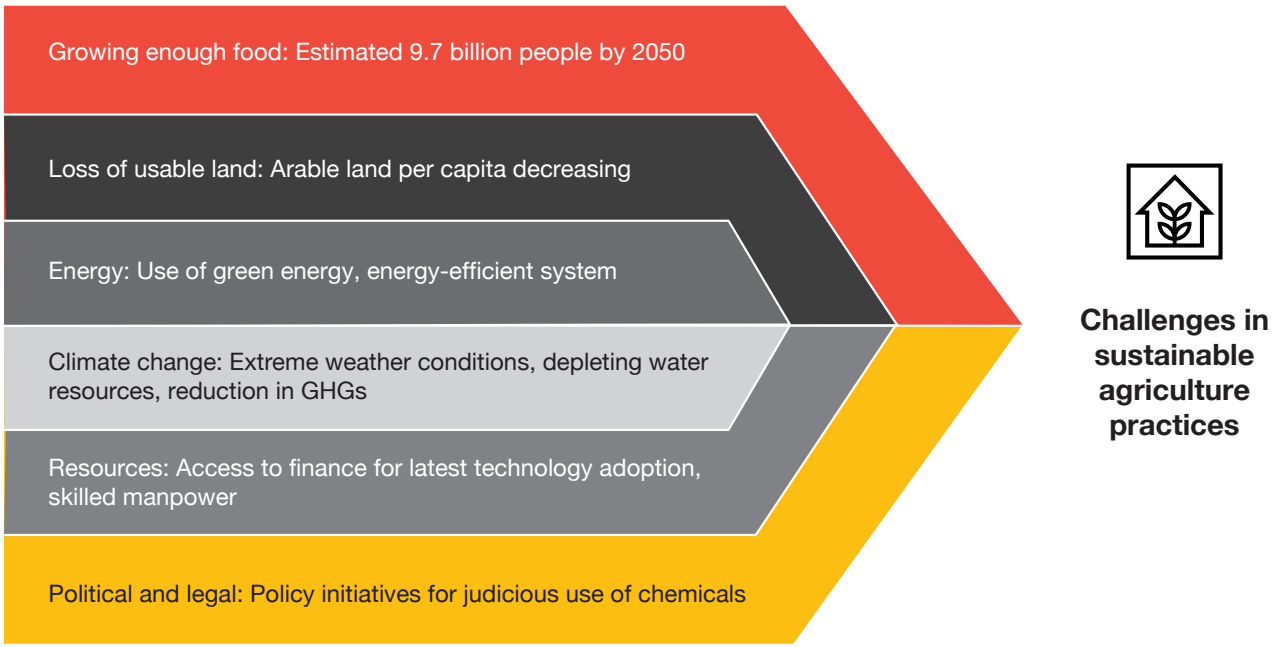
Source: United States Department of Agriculture stats and PwC analysis

In addition, there are many other factors which directly or indirectly minimise resource utilisation and maximise output realisation, leading to sustainable agricultural practices. With their innovative ideas and solutions across the entire gamut of agricultural value chain, start-ups development has been contributing and delivering product and services that promote sustainable agriculture worldwide.

2.3. Assessing sustainability issues in the agricultural ecosystem

While sustainable agriculture mainly focuses on cultivation and practices, it also includes all interrelated systems such as pre-production and post-production agri ecosystems that expand the scope of sustainability.

Challenges in the sustainable agriculture ecosystem



Source: https://amazone.net/en/company/sustainability/1-1-sustainable-agriculture-the-challenges-571926 and PwC analysis

It is important to understand the issues in adopting sustainable agriculture in order to devise strategies and plan long term.

2.3.1. Areas where AgTech start-ups can contribute

2.3.1.1. Sustainable inputs

Indiscriminate use of chemical fertilisers and pesticides has resulted in loss of soil fertility, pests developing resistance against pesticides and hazardous impacts on the entire agri and bio-ecosystem. The world has witnessed loss of biodiversity, including insects and algal blooms, and nitrate pollution in not only sub-surface aquifers but also ground aquifers, loss of soil micro biodiversity, etc.

Alternative pesticides have begun to be used in many parts of the world and have also been documented in the Traditional Knowledge Database. Further, biotechnological research on biopesticides and biofertilisers has resulted in the development of sustainable products that are recommended in the package of practices under Integrated Nutrient and Pest Management. Increasing the efficiency of chemicals by using technology such as fertigation through a drip system and informed application of pesticides in the right doses or as per requirement or advisories can help in reducing pollution.

2.3.1.2. Optimisation of agricultural output

The main objective of research conducted in the field of plant breeding and development of new varieties is increasing yield to meet the growing demands of the rising population through the limited land available for cultivation.

Further, to enhance the yield, technology has been developed and deployed that optimises the growth conditions to realise the maximum/optimum yield. Such technologies are controlled environment agriculture, hydroponics and aeroponics. Many companies have standardised the protocols, which has resulted in the production of crops, especially vegetables, on an unprecedented scale in terms of yield and quality.[28]

2.3.1.3. Sustainable food supply chain/ distribution system

Increase in food mileage has increased the cost of transportation and distribution, so reduction in food mileage would decrease the cost of food as well as its wastage. Technology can be built which allows users to select the minimum distance from which commodities/food products are delivered. Further, there is a need to promote local food produce, which would help in decreasing food mileage. This can be achieved with the large-scale adoption of backyard/terrace and kitchen gardening, and encouraging local foods. Start-ups are also addressing such issues and have combined plant aesthetics and horticulture to bring solutions such as rooftop gardening.

There is also a need for technological interventions to reduce food loss in the entire supply chain system. Better and efficient post-harvest management with the aid of technology can help in reducing wastage of food and hence meeting the rising demand for food.

India ranks 121 on the Global Hunger Index out of 121 countries. India's score is 29.1, indicating a high level of hunger. At the same time, food wastage are also very high. As per the United Nations Environment Programme (UNEP) Food Index, the per capita food loss is around 50 kg per person per year.[29]

Proper cold storage management and better purchase, use and disposal, especially of used cooking oils (UCOs), are important. There is also a need for tech-based sensitisation services that can teach people judicious purchasing and consuming habits such as app-based need assessment and purchase management, especially for fruits and vegetables.



28 https://birac.nic.in/webcontent/75_Biotech_Startup_Products_2022.pdf
29 https://www.unep.org/resources/report/unep-food-waste-index-report-2021



2.3.2. Ecological impact

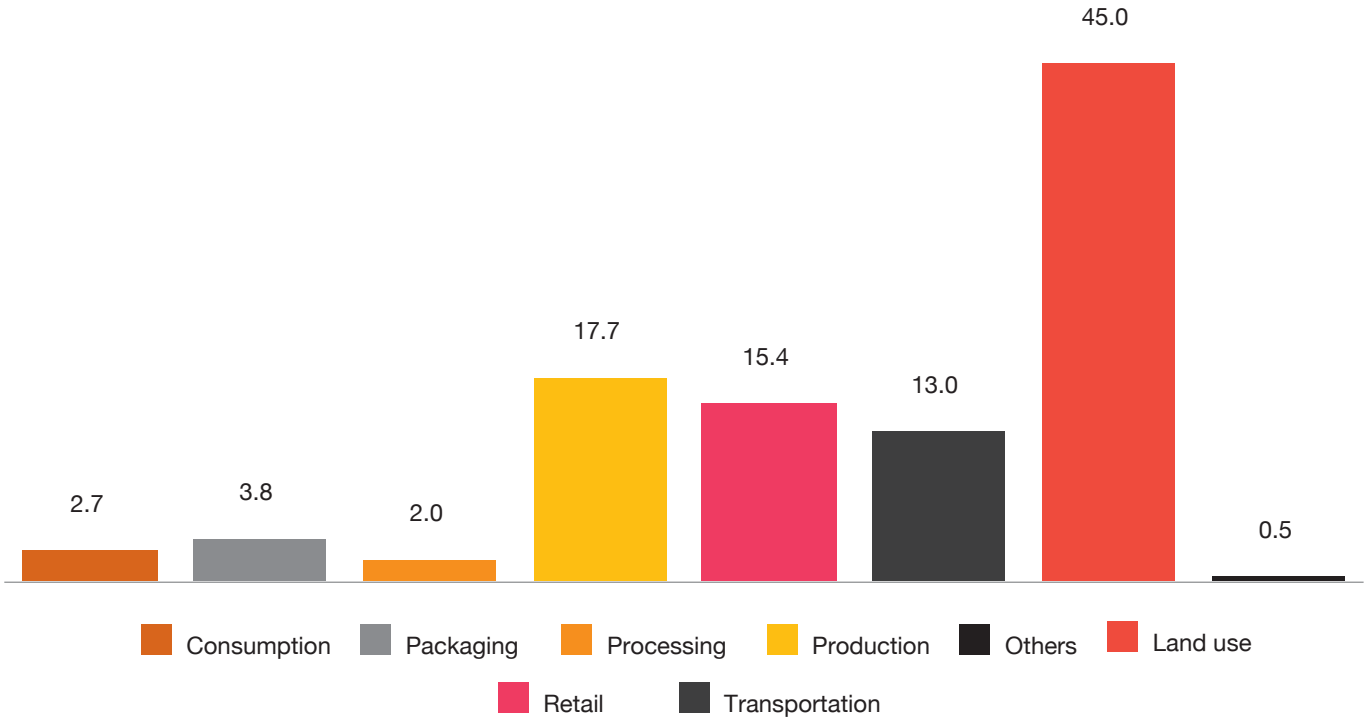
Agriculture has a significant impact on the ecology as it leads to air and water pollution and soil degradation. Paddy production and livestock farming, fertiliser run-off and biomagnification are some of the main factors. Sustainable agriculture practices have the potential to reduce GHG emissions and the threat of floods.[30]

Assessing the ecological impact of agriculture is important to devise innovative models for AgTech start-ups.

2.3.2.1. GHG emissions from agriculture

The food system, including change in land use and the agricultural production system, accounts for one-third of the total global GHG emissions. GHG emissions from the food system in India stood at 34% in 2018 as per datasets of the Emissions Database for Global Atmospheric Research (EDGAR). The total emissions in 2018 were 1.248 billion tonnes of CO2 equivalent, Global Warming Potential (GWP) – 100 ARS. GWP is a common unit of measurement that allows analysts to add up emissions estimates of various types of gases and helps policymakers to understand and establish a comparison of emissions reduction opportunities.

GHG emission at different stages of the food system in India



Source: Emissions Database for Global Atmospheric Research (EDGAR)

2.3.2.2. Maintaining biodiversity along with agriculture

To improve quality and standardise agricultural produce, only a few varieties of crops have been cultivated. This has led to genetic uniformity and thus loss of varietal and biodiversity. Biodiversity is the main foundation for agriculture; it helps in preservation and enhancement of agricultural systems. It is the main reason for the origin of crop species and livestock development, and hence plays a pivotal role in sustaining agricultural practices and quality of life for people. Better maintenance of biodiversity through sustainable agricultural practices would help in achieving food security, better nutrition and creation of livelihood opportunities. This would in turn preserve soil fertility and control pests and pollination.[31]

30 https://www.oecd.org/agriculture/topics/agriculture-and-the-environment/#:~:text=While%20negative%20impacts%20are%20serious,adoption%20of%20certain%20farming%20practices

31 https://www.cbd.int/article/biodiversityforfood-2

A successful example of using sustainable agriculture practices and biodiversity maintenance is discussed below:

Cocoa farming while preserving biodiversity[32]

Background

Nicaragua is the one of the poorest countries of Latin America known for its 'fine flavoured cocoa'. Cocoa cultivation faced a threat due to ageing of cocoa trees which are sensitive to diseases and low productivity.

The challenges

- Ageing population:
- Access to land
- Access to credit
- Curbing migration

Transformation: Cocoa cultivation while adopting agroforestry systems through a cooperative model with support from development agencies, government bodies and private industry

Interventions:

- Catch them young and educate: Youth were selected by local producer organisations to participate in cocoa production in agroforestry systems.
- Exchange of knowledge: Technicians organised training for other youth in their community.
- Theory to practice and learning by seeing: Graduates returned home to their cooperatives and replicated knowledge from field schools.
- Networking: A regional network of cocoa education was established in Central America.

Impact

- Productivity of cocoa increased by 10%
- Participation by the youth increased by 20%
- Cocoa cultivation helped in reforestation of tree cover in the agricultural landscape

Sustainable foods

The concept of sustainable foods has gained prominence in the past decade, with emphasis on what a person eat. There is a growing shift towards vegan diets, especially given the environmental cost of meat production and the challenges in supply chain management and distribution. This has resulted in the introduction of meat substitutes made of soybean and pea which resemble meat in terms of texture and taste.

Further, there has been development and commercialisation of food products that were being wasted in large quantities, such as jackfruit. Multiple food processing technologies are seeing greater acceptance, and the problem of food wastages is thus being addressed with support from and adoption by entrepreneurs.



32 https://www.rikolto.org/nl/node/2781#tab-results and https://www.frontiersin.org/articles/10.3389/fsufs.2021.635779/full

03 AgTech as an agent of sustainability in agriculture

Climate-related challenges loom large over the agriculture sector. As per a study under National Innovations in Climate Resilient Agriculture (NICRA), it is estimated that irrigated rice yields are likely to reduce by 7% in 2050, while yield of wheat is projected to decline by 6–25% and yield of maize is likely to reduce by 18–23% in 2100.[33]

3.1. Emerging presence of AgTech at different stages of the agri value chain

In recent years, technology-based start-ups have established their presence in the agriculture sector by providing relevant, innovative and affordable solutions to address the challenges across the value chain. They have revolutionised the age-old agricultural system with disruptive ideas and solutions.

3.1.1. The agriculture value chain

With technology interventions in agriculture, agri-based start-ups are bringing about a paradigm shift in the traditional agricultural value chain. Coordination among stakeholders is important for enriching of the supply side and promotion of processing, preservation and storage infrastructure in the agri and allied sector. Above all, maintaining quality standards, certification and traceability through use of technology is key.

'A "value chain" in agriculture identifies the set of actors and activities that bring a basic agricultural product from production in the field to final consumption, where at each stage value is added to the product. A value chain can be a vertical linking or a network between various independent business organizations and can involve processing, packaging, storage, transport and distribution of an agricultural product.' - FAO

The issues and challenges in the agricultural value chain can be addressed through the use of technology advances and sustainable practices. Interventions by AgTech start-ups across different stages of the agriculture value chain. including ICT-based applications, farm automation, weather forecasting, drones, input retailing and equipment renting, online agri-produce marketing, protected cultivation, innovative food processing, packaging and marketing, have yielded significant benefits and paved the path for agri-based technology in the future.



33 https://pib.gov.in/Pressreleaseshare.aspx?PRID=1696468

Agri-based technology at different stages of the agri value chain

Stages	Inputs / supply	Farming/ production/ harvesting	Storage/ distribution/ marketing	Processing/ retailing	
Technology intervention in agriculture	Mobile applications for access to real-time data related to weather forecasts, crop characteristics, soil health monitoring and restoration, diseases or pests, and telemetry	Use of IoT, drones, mobility, cloud computing, big data, remote sensing, AI, ML, image analytics and processing, blockchain, etc., for data-driven precision farming	Development of hi-tech storage and solar-based cold chain infrastructure E-monitoring of storage atmosphere to keep quality of stored produces intact	Use of advance technology for processing Processing automation	**Market/end consumers**
	Development of weather-resistant, disease/pest-resistant, higher nutritional value and high-yield varieties of seeds	Farm mechanisation and farm automation for improving utilisation and efficiency of farm machinery, weed removal, early disease identification, produce harvesting and grading	Predictive analytics using AI tools for providing accurate supply and demand information to farmers, and thereby increasing the share of price realisation to them		
	Training of farmers through e-modules, online meeting platforms on various updates and advancements in agricultural practices – Agri FinTech	Monitoring crop health and providing real-time action advisories to farmers Crop and livestock sensing	Agri e-procurement, e-marketing and e-trading platforms	Mobile and e-retailing applications	
Supporting institutions	Government policies and schemes, government and private stakeholders, FIs and investors, innovators and R&D, food processing industries, online and offline marketing, and trading channels				

Source: PwC analysis

3.2. Addressing the traceability system in agriculture

Traceability helps in tracking the origin of food and ingredients across the entire supply chain. It helps users to locate a certain product at any stage from production to consumption using a system of recorded identifications.

As per an estimate, about one person out of ten falls sick globally because of food contamination. Food companies directly bear a cost of USD 10 million due to food recall. Apart from this, non-compliance related fines are also very high. This ultimately also affects brand image.

Uses of the traceability system in agriculture[34]
Leads to transparency and thus helps in winning the consumer's trust.
Helps in reducing food wastage through timely identification of problems and recalling of products.
Helps in identifying food contamination which maintains food safety.
Increases farmers' productivity by providing better market visibility, increasing income and standard of living.
Helps in complying with quality standards and certifications
Satisfies sustainability claims in the food supply chain

3.3. Sustainability contribution of existing AgTech players

Agricultural innovations and technology interventions have been gaining momentum globally in the past few years, with agri-based technology start-ups presenting unique ideas and products for sustainable agricultural practice across the agricultural and allied value chain. In India, measures such as Startup India, Stand Up India and Make in India have created an enabling environment for the development of innovative solutions to challenges in the agricultural sector and other sectors. The COVID-19 pandemic provided further impetus to the exploration and adoption of relevant technological interventions to address issues related to sustainability.

The customised solutions and products offered by agri-based technology start-ups are helping to transform the agricultural value chain by increasing agricultural production to meet the rising demand for food, helping farmers to deal with various challenges, making agriculture more profitable, creating employment opportunities and having a larger socioeconomic impact on lives of rural households.

Globally, policymakers and the private sector have emphasised the need for integrating scientific data and technology in the farming system. New-age agri-based technology start-ups are supporting these efforts by undertaking research on agricultural inputs, and providing training and capacity building to farmers on advanced agricultural practices. Some of the other technological solutions include mobile application-based crop advisory, crop and livestock sensors, farm machinery automation and rental services, drones and agri-based FinTech.

Types of solutions offered by AgTech start-ups to promote sustainability in agriculture[35]

Sr. no.	Theme	Products and solutions developed	Sustainability relevance
1	Agri inputs	Decision support system (DSS) which provides hyper-local information on farms in real-time, such as: • crop water stress and requirement • crop health • warning signals in case of drought and flood situation • pests/diseases in crops	High-tech farm management optimisation of agri input application
2	Agri inputs	Technology-assisted software and hardware developed for preventive protection against pests and diseases in crops to reduce losses and increase yields. Provides predictive advisory for occurrence of diseases based on weather and other conditions.	Timely application of agri inputs supported by predicted advisory

34 https://tracextech.com/food-traceability-transforming-food-and-agriculture-industry/
35 https://pib.gov.in/PressReleasePage.aspx?PRID=1643788
https://www.birac.nic.in/webcontent/75_Biotech_Startup_Products_2022.pdf
http://online.anyflip.com/sruan/nisq/mobile/

Sr. no.	Theme	Products and solutions developed	Sustainability relevance
3	Soil health	Point-of-use rapid nutrients testing and soil health analyser	On-the-spot soil health testing which would help in minimising GHG emissions due to decrease in transportation of soil samples
4	Aquaculture	Veterinary drug used with feed supplements for controlling infections in shrimp	Timely application of agri inputs supported by predicted advisory
5	Soil health	ICT- and AI-based soil nutrient management	Soil health management and reducing GHG emissions
6	Pest management	Forest plant extract oil-based insecticide	Potential reduction in the use of chemical pesticides
7	Sustainable energy	Rice straw/biowaste-based sodium ion batteries	Waste to wealth, sustainable energy solution
8	Veterinary	Teleconsultation platform for veterinary doctors	Easy access to animal health services
9	Food wastage	On-farm fruit processing platform with traceability	Reduction in food wastage and reducing GHG emissions
10	Water use efficiency	Eco-friendly water retention polymer for irrigation	Increases water use efficiency
11	Biofuels	AI-based technology to track and collect biomass from farmers and convert into next gen biofuels	Biofuels from agricultural waste
12	Precision irrigation	Precision irrigation and disease management technology using AI and IoT	Efficient IT-enabled farm management solution
13	Water use efficiency	Technology-based sensor data and satellite imagery for precision irrigation	Increases water use efficiency in agriculture
14	Agri waste management	Flower waste based leather as an alternative to conventional leather	Waste to wealth
15	Animal feed	Technology-based single cell protein from methane for animal feed	Alternative animal feed
16	Waste to wealth	Technology-based use of silkworm pupa in the silk extraction process	The de-oiled cake is a rich source of protein and can be used as a raw material for an alternative to soya protein in the poultry and aqua industries.
17	Climate-resilient agriculture	A technology platform for bio stimulants for drone-based spraying	Climate-resilient crop



Sr. no.	Theme	Products and solutions developed	Sustainability relevance
18	Packaging	Biodegradable packaging material to increase the shelf life of fruits and vegetables	Decreasing wastages in the supply chain
19	Water use efficiency	Automated farm irrigation with the ability to respond to power and water disruptions without human intervention	Increases water use efficiency
20	Agri input	Technology that produces naturally coloured silk by incorporating natural pigments of plant origin	Environment-friendly solution which also act as a plant silkworm growth promoter
21	Pest management	Fruit fly trap to control damage to fruits and vegetables by fruit flies. It is a smart gravity-controlled release mechanism with high energy efficiency and high target specificity.	Potential reduction in the use of chemical pesticides
22	Water use efficiency	Solar-powered, sensor-based technology to provide optimum irrigation based on IoT	Water use efficiency
23	Post-harvest management	Fast-freezing cooling solution	Significant reduction in post-harvest losses and reduction in air pollution
24	Egg substitute	Plant-based egg without use of any synthetic agents and additives and having the texture and taste of egg	Food/protein security with low carbon footprint
25	Water use efficiency	A soil sensor for hydrology and land application for soil and crop-related stresses	Increases water and nutrient use efficiency

Source: Press Information Bureau, Government of India, BIRAC and PwC analysis

Source: https://pib.gov.in/PressReleasePage.aspx?PRID=1643788

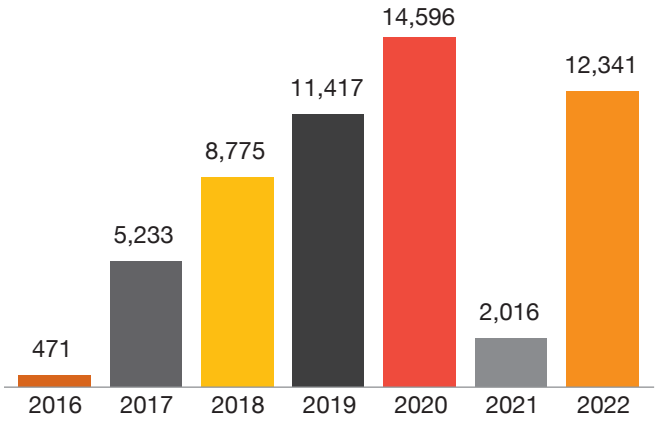
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04 Status of AgTech start-ups

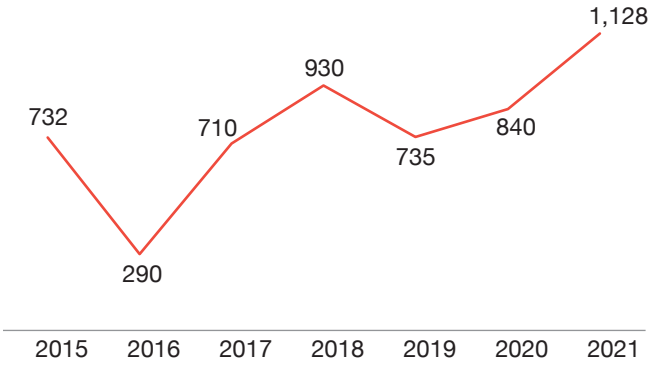
India has witnessed a marked increase in the number of start-ups recognised by the Department for Promotion of Industry and Internal Trade (DPIIT). In 2022, 12,341 start-ups have been recognised so far. Due to the pandemic, this figure stood at only 2,016 in 2021. These numbers are a good indicator that the start-up ecosystem is shaping up very fast.

Number of start-ups recognised by DPIIT



Source: DPIIT

Registration of biotech start-ups under BIRAC



Source: BIRAC

Biotechnology-based start-ups are also witnessing rapid growth. In 2021, 1,128 start-ups were registered under BIRAC and are availing support through various schemes. Further, 846 start-ups are being supported by 125 Technology Business Incubators (TBIs) of BIRAC and interestingly, 40 out of these are AgTech start-ups.

Biotechnology has a key role to play especially in sub-sectors of agricultural biotechnology that have the potential to address sustainability issues with products under the categories of biopesticides, biofertilisers, production of bioactive compounds, biologicals, etc.

The number of AgTech companies in India is growing at a rapid pace. In India, AgTech start-ups would create opportunities to develop innovative and environmentally friendly products which would help in achieving sustainable agricultural productivity.

4.1. Sustainability issues addressed by AgTechs

AgTech start-ups are working to address three broad areas of sustainability:

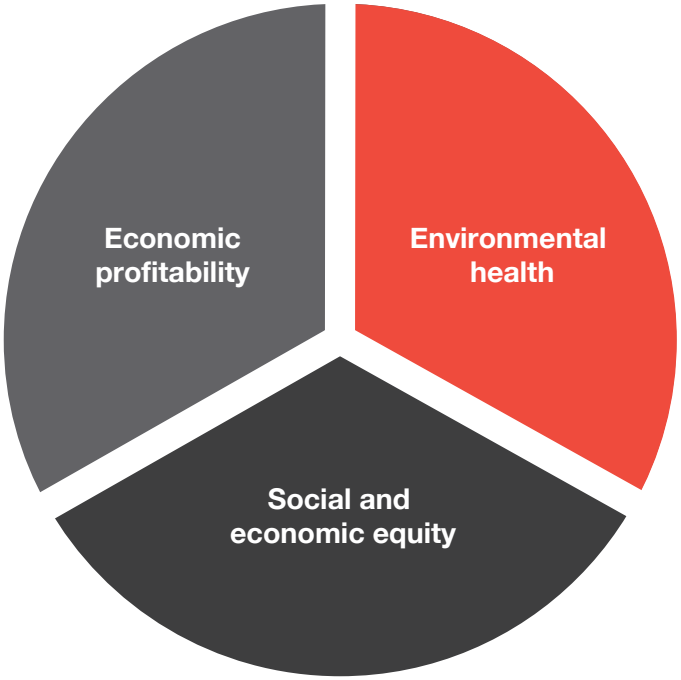
Environmental health: Products and solutions that decrease the environmental impact of agriculture on the environment

Economic profitability: Products and solutions that increase the efficiency of the agricultural production system with limited negative impact

Social and economic equity: Products and solutions that raise the quality of life where farming society have equitable status

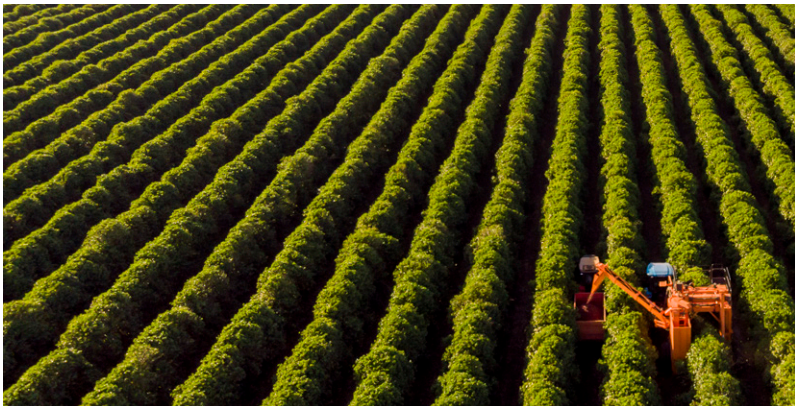
As agrarian society shifts from subsistence to commercial agriculture, there is a need to rediscover traditional practices aided by modern technological advancements and research. This could offer sustainable solutions to the problem of feeding billions.

The start-up boom has led to the introduction of multiple operational, strategic, regulatory and statutory guidelines and policies by the Central and state governments. The Department of Science and Technology (DST), Department of Biotechnology (DBT), Indian Council of Agriculture research (ICAR), Ministry of Electronics and Information Technology (MEITY) and DPIIT have announced various schemes such as financial assistance for conducting R&D and providing seed capital funds, training and awards. However, there is a need for greater emphasis on sustainability and, specifically, sustainable agriculture. This is especially critical due to the threat of climate change and the possibility of the COP 26 target not being achieved if large-scale measures are not taken.



4.2. Focus on secondary agriculture

Secondary agriculture refers to new ways of improving farm income that supplement as well as complement primary agriculture. It involves post-harvest technologies and value addition to primary agriculture produce. Secondary agriculture is producing many innovative solutions for sustainable agriculture, and requires greater focus from the government, private sector and development agencies needs to drive focus exclusively on this.



4.3. Start-up system for sustainable agriculture

While many incubators are supporting start-ups in various fields such as biotechnology, electronics, information technology, agriculture, commerce and industry, an exclusive incubator for start-ups for sustainable solutions is inadequate. There is a need for a system comprising sustainability counsellors, promoters and subject matter experts who work across disciplines.

This system would have a deeper impact on the agricultural value chain, benefiting both academicians as well farmers in the start-up ecosystem of India which is based on traditional knowledge and indigenous technology. Mapping of the sustainable agricultural system and creation of databases, information centres and libraries need to be undertaken on a larger scale to address the sustainability issue. The Traditional Knowledge Database must be expanded to cover sustainable agriculture. Policy reforms with focused incentives for AgTech start-ups need to be implemented.

05 Key recommendations and way forward

AgTechs have immense potential to drive sustainable agriculture solutions and provide growth opportunities to farmers.

Multiple segments of AgTech offering better opportunities

Segments	No. of industries		Investment (USD billion)	
	Global	India	Global	India
Marketplace and e-distributors	2,000–2200	400–500	1,300	310
Farm inputs	1,000–1,200	250–300	3,300	36
Crop quality assessment	300-500	30–50	900	10
Precision agriculture and farm management	1,500–2,000	75–100	600	24
Finance and insurance	150–200	20–40	300	7
Farmer advisory/ content	300–500	75–100	400	1
Hyrdroponics	800–1,000	50–75	400	1

Source: Overview of Agritech Sector in India, 2020 by Praxis Global Alliance and PwC analysis

India is producing a considerable number of AgTech industries against the total number of AgTech industries globally. The country's AgTech start-ups could a greater ripple effect due to high opportunities in addressing the demand towards achieving sustainable agricultural productivity and value-chain. However, a strategy needs to be defined to address these challenges.

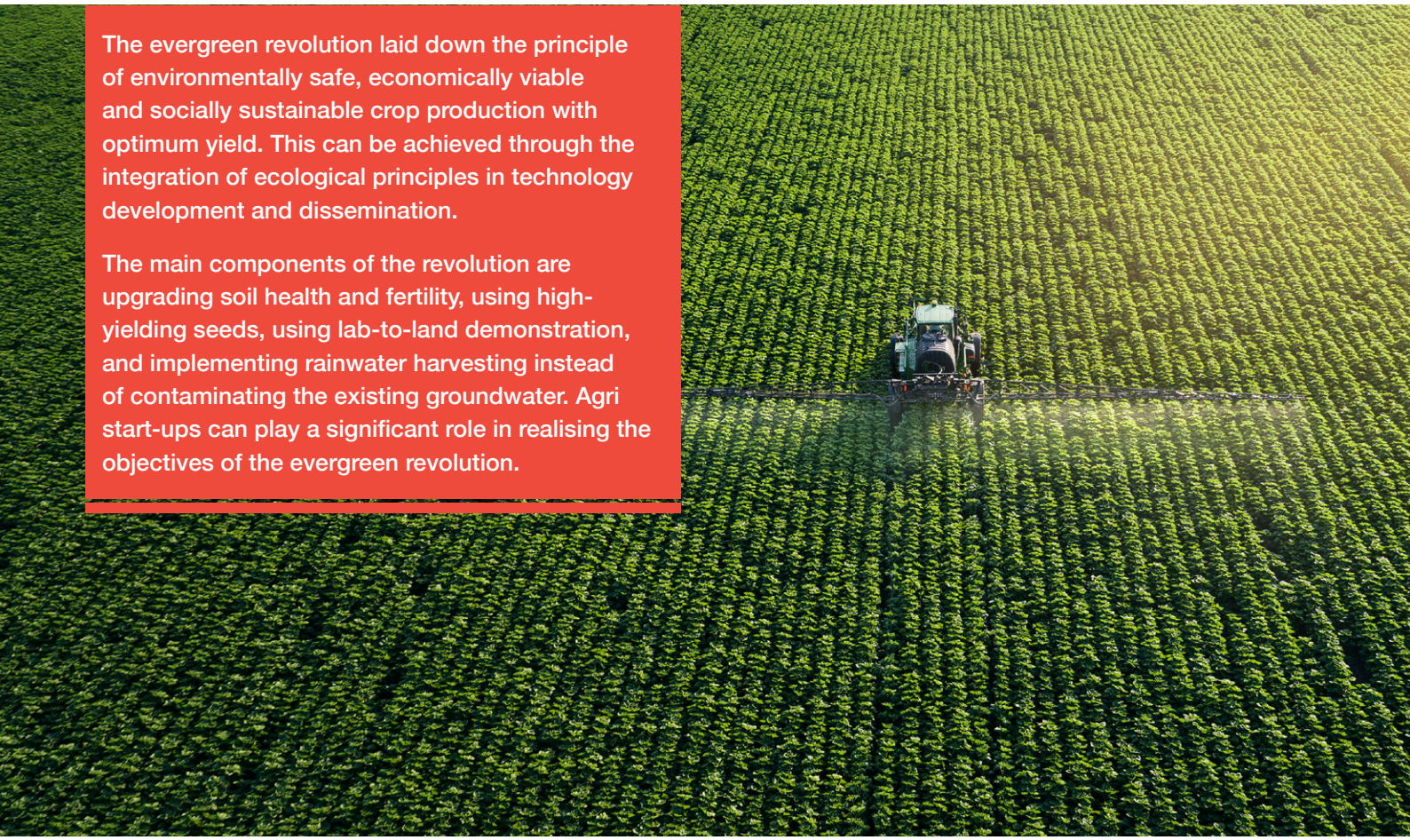
5.1. Key gaps identified[36]

Promotion of sustainable agriculture on the national scale requires the participation of multiple stakeholders. NITI Aayog needs to organise multiple deliberations to roll out an agriculture sustainability framework that involves active participation from AgTech start-ups. This will help in meeting the SDGs and commitments towards United Nations Framework Convention on Climate Change (UNFCCC) COP27. In this context, the gaps that AgTech start-ups can address are as follows:

High ● medium ◔ low ◔

Sr. no.	Gap area	Range of gap	Sustainability relevance
1	Agriculture sustainability framework	●	The sustainability agenda is still at a nascent stage among industries.
2	Research and development	◔	An ecosystem fostering research and development needs to be created.
3	Networking for agricultural sustainability	◔	Though start-up programmes are enabling networking, there is a needs for greater collaboration for R&D, sustainability, extension services, etc.
4	Capacity building/skill development	◔	To address agricultural sustainability, skill development of the existing workforce and awareness creation are important.
5	Incentivising prospective agri start-ups and prioritising their funding/financing	◔	Funding of agri start-ups focusing on agricultural sustainability should be given priority, including additional incentives.

Agricultural sustainability is still not a priority, and it is at a nascent stage. The inclusion of agriculture sustainability as a priority would create a more robust structure for the development of start-ups and sustainable agriculture.



The evergreen revolution laid down the principle of environmentally safe, economically viable and socially sustainable crop production with optimum yield. This can be achieved through the integration of ecological principles in technology development and dissemination.

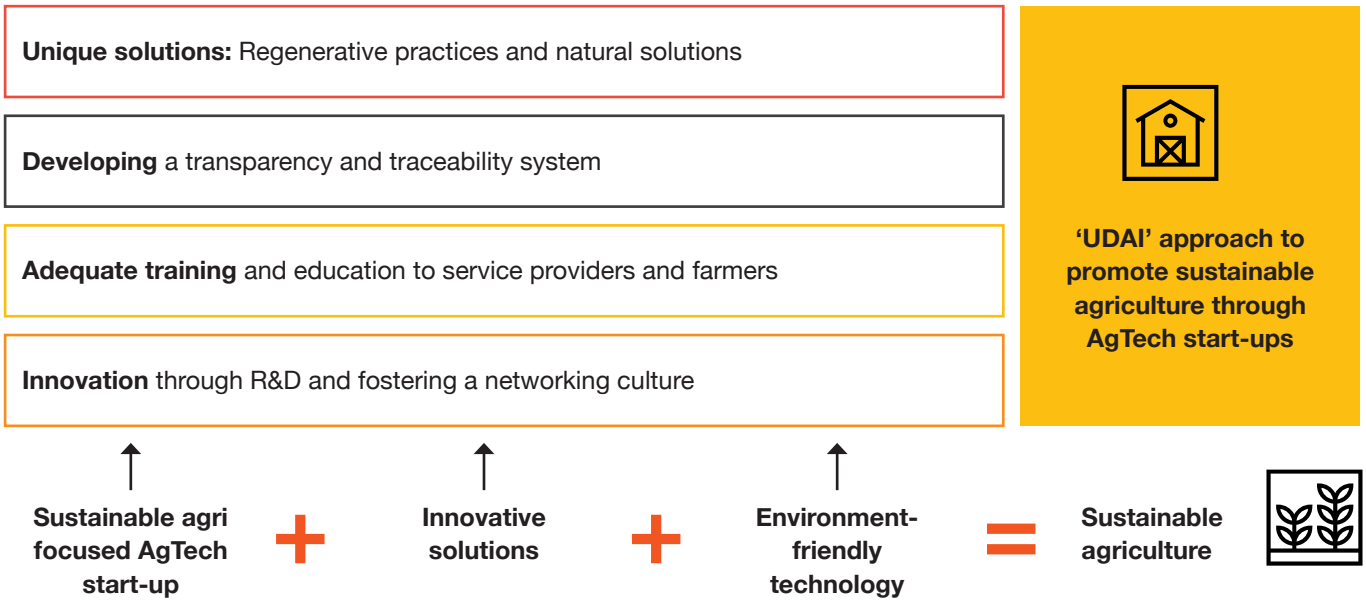
The main components of the revolution are upgrading soil health and fertility, using high-yielding seeds, using lab-to-land demonstration, and implementing rainwater harvesting instead of contaminating the existing groundwater. Agri start-ups can play a significant role in realising the objectives of the evergreen revolution.

36 PwC analysis

5.2. Recommendations

To bring about a sustainable and evergreen revolution, it is important to create a sustainable framework that focuses not only on agriculture but also on the environment. One approach that may be proposed keeping in view the long-term results and integrated sustainable solutions is given below:

UDAI approach for sustainable agriculture through AgTech start-ups[37]



Source: PwC analysis

Unique solutions: Regenerative practices and natural solutions

AgTech solutions would focus on natural ways and regenerative practices that enable resources to regain their original status. As per the European Commission, natural solutions are not only cost-effective but also help in building resilience through environmental, social and economic benefits. These solutions would ultimately lead to low GHG emissions, efficient use of water and food security. Regenerative and natural solutions may focus on the following:

- minimising soil disturbance
- efforts to minimise chemical based inputs
- maximising biodiversity
- keeping soil covered for longer duration
- adaptation to local environment.

AgTech start-ups focusing on innovative technological solutions related to soil health management and data analytics would support farmers in timely decision making. AgTech start-ups that are already providing services in the social and environmental sectors may also include such sustainable agriculture solutions.

37 https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1845114
https://pib.gov.in/PressReleasePage.aspx?PRID=1777684

Developing a transparency and traceability system

A sustainable agriculture system requires transparency, which depends on the use of data at every stage of the supply chain. Traceability supports tracking of products, including inputs in the whole supply chain process. Industries, including AgTech, are now acknowledging and inculcating responsible business culture in their core values either proactively or based on government rules and regulations. The Securities and Exchange Board of India (SEBI) has mandated that all the top 1,000 listed companies adhere to the Responsible Business Report from FY 2019–20.

However, post COVID-19, stakeholder awareness on sustainability is increasing and traceability system need to be developed to ensure transparency, especially in agriculture and allied activities.

Understanding the need for transparency and traceability in a sustainable agriculture system

Industry priority

- More accurate information to customers
- Reputation and risk management
- Efficient resource management
- Enhanced communication with business partners

Envisaged challenges

- Complex business network
- Data privacy
- Cost-effectiveness
- Technological barriers
- Product segregation
- Sustainability

Source: https://unece.org/fileadmin/DAM/uncefact/OECD_Feb2019.pdf

Agri produce reaches consumers after traveling great distances and undergoing various process. Thus, traceability is very important for ensuring quality. Post the COVID-19 pandemic, there has been a steep rise in the demand for branded and quality groceries, so an efficient traceability system would help in creating a sustainable solution for consumers. Further, in terms of input usage, especially in the case of fertilisers (mined or synthetic), the existing supply chain is long with thousands of kilometres of haulage before it reaches the field.

Indian AgTech start-ups now have to focus on creating a cost-effective traceability system and efforts would be required to mobilise resources, facilitate AgTech start-ups, favourable policies for development of products such as green fertilisers, biofertilisers and biopesticides.





Adequate training and education for service providers and farmers

With extreme weather events becoming more frequent due to climate change, countries are devising strategies to address the new normal and adhere to the commitments prescribed under the Intergovernmental Panel on Climate Change. Since agriculture solely contributes around one-third of GHG emissions globally, large-scale training and education on sustainable agriculture practices are essential.

India is seeing sporadic interventions through its growing start-up ecosystem. However, without training and education, the roll-out of these interventions would be a challenge. Collaboration between government and private institutions would not only help in creating more robust and innovative AgTech start-ups but also lead to a more concerted and conscious effort by existing AgTech start-ups to reduce the country's carbon footprint.

There is a need for training across the entire gamut of sustainable agriculture practices such as soil management, crop nutrient management, energy efficiency use, integrated pest management and irrigation.

Innovation and collaboration

Research and innovation in sustainable agriculture can be in terms of adoption of sustainable agricultural practices and development of innovative products and solutions. These solutions can have a direct or indirect impact based on the area of application in the agriculture chain – i.e. upstream or downstream. India has immense potential to develop multiple and diversified solutions that help in meeting sustainability goals. The country has a large traditional knowledge base which is in the process of being identified, scaled up and commercialised.

India has been making significant strides in R&D conducted at universities and by private institutes and corporations. The Department of Science and Technology, MeitY and Ministry of Agriculture and Farmers' Welfare are supporting R&D. In addition, the Government is building a Traditional Knowledge Digital Library and facilitating agripreneurship for the development of sustainable products and solutions.

Cross-sector collaboration in terms of economic, technical and consultative support is required to foster start-ups, and Government ministries have rolled out multiple schemes. However, since most of the sustainable products and solutions are multidisciplinary in nature, there is a need for robust and collaborative efforts. AgTech start-ups can collaborate with each other or with existing players in the agriculture ecosystem.

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