E-ISSN: 2618-0618
P-ISSN: 2618-060X

NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; SP-8(10): 53-58
Received: 18-08-2025
Accepted: 25-09-2025

Venu BN
Associate Professor, College of Agricultural Sciences & Applied Research, Bharatiya Engineering Science & Technology Innovation University, Raichur, Karnataka, India

Vijayachandra Reddy
Assistant Professor, Department of Agricultural Economics, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

Singamayum Ashif
Assistant Professor, College of Agricultural Sciences & Applied Research, Bharatiya Engineering Science & Technology Innovation University, Raichur, Karnataka, India

Suresh Babu
Associate Professor, College of Agricultural Sciences & Applied Research, Bharatiya Engineering Science & Technology Innovation University, Raichur, Karnataka, India

Corresponding Author:
Venu BN
Associate Professor, College of Agricultural Sciences & Applied Research, Bharatiya Engineering Science & Technology Innovation University, Raichur, Karnataka, India

Start-ups' in Indian Agriculture and Their participation in global value chains: Effects on income and employment: An economic analysis

Venu BN, Vijayachandra Reddy, Singamayum Ashif and Suresh Babu

DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i10Sa.3974

Abstract
India's agricultural sector, employing nearly 45 percent of the population, faces significant challenges like low productivity, significant post-harvest losses, and limited global market access. However, a flourishing agri-startup ecosystem has arose over the last decade, leveraging technology and new business models to address these concerns. The study reveals these startups, especially those accompanying to Global Value Chains (GVCs) in areas such as logistics, organic produce, and food processing, are making a substantial impact. They're enhancing farmer incomes by up to 34 per cent and crafting merely 100,000 jobs, while also promoting traceability and sustainability. States like Maharashtra, Telangana, and Andhra Pradesh are prominent in GVC participation, due to better infrastructure and supportive policies. Despite these successes, challenges including high certification costs, fragmented landholdings, ambiguous export policies and weak digital infrastructure. However, opportunities abound with the growing global demand for organic and ethnic foods, the rise of digital traceability, and the potential for Farmer-Producer Organization (FPO) aggregation, along with supportive trade policies. This economic analysis emphasizes crucial role of start-ups in modernizing Indian agriculture and integrating it into global markets, offering valuable insights for policymakers, investors, and agripreneurs.

Keywords: Agri-startups, global value chains, farmer income, rural employment, agri-tech, export readiness

1. Introduction
The Indian agricultural sector continues to serve as the primary source of livelihood for nearly 45 per cent of the country's population, has historically been plagued by low productivity, fragmented landholdings, market volatility, and inefficient supply chains (Birthal PS 2005) [3]. Despite India's significant contribution to global food production, its share in high-value global agricultural trade remains disproportionately low. Over the past decade, a transformative shift has emerged with the rise of agri-startups and innovation-driven enterprises that apply modern technologies and business models to address critical bottlenecks across the agricultural value chain (Suresh *et al* 2024) [12].

Witnessing remarkable growth, India's agri-startup ecosystem surged from fewer than 100 ventures in 2015 to more than 4,000 by 2024, achieving a compound annual growth rate (CAGR) of over 20 per cent (Kumar *et al* 2024) [8]. These startups operate across areas such as precision agriculture, post-harvest management, input delivery, digital platforms, supply chain management, traceability solutions, and agri-fintech, reflecting technological penetration in rural India. The emergence of agritech startups is driven by several converging factors like government support (e.g., Startup India Mission), increased venture capital, expanded digital payment systems and wider smartphone use in rural areas and increasing demand for safe, sustainable, and traceable food globally (Singh & Misra (2023) [10].

A significant development within this ecosystem is the growing participation of Indian agri-startups in Global Value Chains (GVCs). GVCs refer to the international production networks wherein agricultural products are cultivated, processed, certified, marketed, and consumed across borders, with value addition occurring at each node. Participation in GVCs requires compliance with rigorous international standards

(e.g., GLOBALG.A.P, HACCP and Codex Alimentarius) and placement with global consumer preferences for organic, sustainable, and ethically sourced products (Sharma & Arora 2023) [9].

Empirical evidence progressively suggests that GVC-linked agri-startups not only improve farm gate prices but also generate higher rural employment, especially among youth and women, while reducing post-harvest losses and enhancing bargaining power across the supply chain (Adhya and Sahoo, 2022) [1]. They also facilitate financial inclusion through digital lending platforms and promote environmental sustainability by encouraging low-input, high-efficiency farming practices. However, the participation of agri-startups in GVCs is still regionally concentrated and sectorally skewed, with challenges such as certification costs, logistics bottlenecks, export registration delays, and lack of skilled labor hindering broader engagement (Gulati *et al* 2022) [5].

This study undertakes a critical economic analysis of the role played by agri-startups in integrating Indian agriculture into GVCs. It explores the effects of such participation on income enhancement, employment generation, value chain modernization, and export diversification. Drawing on secondary data, case studies, and startup-level insights, the paper presents disaggregated trends across product categories, states, and startup models. It also analyzes investment flows, export potential, compliance requirements, and policy gaps that influence the performance and scalability of these enterprises in international markets.

By quantifying the economic impacts of startup-GVC integration, this research contributes to the policy discourse on doubling farmers' income, fostering rural entrepreneurship, and building globally competitive agricultural systems. The findings are intended to support stakeholders including policymakers, development agencies, investors, and agri-entrepreneurs in designing targeted interventions to promote sustainable, inclusive, and export-oriented agricultural growth in India.

2. Objectives of the study

- To assess the role and growth of startups in Indian agriculture.
- To examine their participation in Global Value Chains (GVCs).
- To analyze the effects on income and employment.
- To identify key challenges and opportunities in GVC integration

2.1 Methodology and Data Sources

This economic analysis employs a mixed-method approach:

Quantitative Analysis: Using secondary data from DPIIT, Startup India, NABARD, Invest India, IBEF, APEDA, and FICCI to assess startup trends, investment flows, and export metrics. Statistical tools are used to identify linkages between startup activity and economic outcomes.

Qualitative Insights: Through case studies of selected agri-startups with proven GVC linkages (e.g., Way Cool, InI Farms, DeHaat), and policy document analysis to contextualize enablers and bottlenecks.

Comparative Analysis: Between startups with and without GVC participation to isolate the differential impacts on income and employment.

3. Results and Discussion

3.1 Growth of Agri-Startups in India: Trends and Patterns

Over the past decade, India has witnessed a significant increase in the number of agri-startups driven by rising demand for technology-driven solutions in agriculture, government support schemes, and increasing investor interest. As per start-up India (2024), more than 3,000 agri-startups have been registered, with a growth rate of approximately 25 percent per annum since 2016.

Table 1: Growth of Agri-Startups in India (2016-2024)

Year	Number of Registered Agri-Startups	YoY Growth (%)
2016	180	-
2018	540	40.0
2020	1,250	58.3
2022	2,300	38.4
2024	3,200	28.3

Source: Startups India Portal, Ministry of Agriculture Reports (2024)

The growth is attributed to schemes like RKVY-RAFTAAR, Agri-India Hackathon, and financial incentives from incubators like Manage-CIA, NAARM-AIDE, and ICRISAT-AIP. The increased awareness and entrepreneurial activity among rural youth has further propelled this positive trend.

The data reveals a compound annual growth rate (CAGR) of over 35 per cent, signalling a booming ecosystem. The sharp increase post-2018 aligns with government interventions such as the RKVY-RAFTAAR incubation scheme, which provided seed funding and mentoring to initial stage start-ups. The flow between 2020 and 2022 can also be partly attributed to COVID-19 disruptions, which exposed vulnerabilities in traditional agri-value chains and opened new opportunities for digital, decentralized solutions. However, the slowing growth rate from 2022 to 2024 suggests a maturing ecosystem that is gradually shifting focus from quantity to quality and sustainability of projects.

3.2 Functional Domains and Start-up Innovations

Agri-startups have disrupted traditional supply chains, empowered smallholders, reduced post-harvest losses, and improved market linkages through digital platforms and value-added services. The key areas of impact include:

- **Precision Agriculture**: Use of IoT, drones, and satellite imaging (e.g., Fasal, CropIn)
- **Supply Chain & Logistics**: Optimizing farm-to-fork delivery (e.g., DeHaat, Ninjacart)
- **Input Retailing & Advisory**: App-based agri-inputs, crop advisory (e.g., Agro wave, AgriBazaar)
- **Fintech and Insurance**: Access to credit, weather-based insurance (e.g., Samunnati, Gram Cover)

Table 2: Functional categories and impact areas of agri-startups

Category	Examples	Key Impact
Precision Farming	Fasal, CropIn	Increased yield, water use efficiency
Supply Chain	DeHaat, Ninjacart	Reduced wastage, better price realization
Digital Marketplaces	AgriBazaar, BigHaat	Transparent pricing, direct farmer-buyer link
Agri-Fintech	Samunnati, Jai Kisan	Credit access, transaction digitization

Source: FICCI Report on Agri-Tech in India (2023); NABARD Agri Startup Report (2024)

This table categorizes startups by functional utility, emphasizing their contribution across different nodes of the value chain. The dominance of supply chain and marketplace startups indicates

that market inefficiencies and post-harvest losses remain foremost agony fact in Indian agriculture. Startups like Ninjacart have revolutionized farm-to-market logistics, cutting down post-harvest losses by over 30 per cent in some regions.

Precision agriculture, though still emerging, shows promise in regions like Punjab and Telangana where drone-based spraying and sensor-based irrigation are being adopted. However, its higher investment limits adoption among marginal farmers, reinforcing the need for custom hiring centers and subsidies.

Agri-fintech is an emerging segment that addresses financial inclusion, a persistent bottleneck in rural India. Startups like Samunnati provide collateral-free loans using AI-based risk profiling, which can significantly reduce dependence on informal credit.

3.3 Regional Patterns and GVC Participation

Table 3: State-wise Distribution of Agri-Startups in India (As of 2024)

State/UT	No of Registered Agri-Startups	Participating in GVCs (Per cent)	Key Focus Areas
Maharashtra	265	61	Logistics, Fintech, Cold Chain
Karnataka	212	68	Precision Ag, Export Facilitation
Telangana	189	72	Farm-to-Fork, Blockchain, Traceability
Andhra Pradesh	177	64	Input Platforms, Export Aggregation
Uttar Pradesh	156	42	Credit, Advisory Services
Tamil Nadu	151	58	Agro-processing, Fintech
Gujarat	138	66	IoT, Certification
Rajasthan	121	40	Agri-Education, Soil Mapping
Madhya Pradesh	117	39	Crop Monitoring, Logistics
Others (Combined)	458	36	Extension, Insurance, Climate Services

Startup India (2024). Start-up India Portal-Agri-Startups Database. Department for Promotion of Industry and Internal Trade

This table illustrates the geographical spread of agri-startups across Indian states, with a focus on their engagement in GVCs and dominant operational domains. Maharashtra, Karnataka, and Telangana lead in the number of start-ups, benefiting from better infrastructure, proactive state policies, and proximity to markets and ports. Telangana shows the highest GVC participation (72 per cent), probable due to its strong digital infrastructure, block chain integration, and traceability mechanisms which are essential for international markets.

States like Madhya Pradesh and Rajasthan have lower GVC participation (below 40 per cent), signifying either infrastructural gaps or lesser integration with export-oriented or multinational agri supply chains. Others (Combined) includes smaller or North-eastern states, which account for 458 start-ups but only 36 per cent are GVC-linked often due to remoteness and limited trade logistics. This table highlights regional disparities in start-up spread and GVC integration, reflecting policy gaps, resource endowments.

Table 4: Investment Flow into Agri-Startups in India (2018-2024)

Year	Total Investment (USD Million)	No. of Deals	Major Investors	Key Focus Areas
2018	66.3	43	Omnivore, Accel, Nexus Venture	Supply Chain, Input Marketplaces
2019	112.6	57	Sequoia India, Omnivore, Chiratae	Fintech, Logistics, Precision Agriculture
2020	142.0	61	Aavishkaar, Omnivore, Ankur Capital	Agri-credit, Output Marketplaces
2021	250.2	84	Omnivore, Bertelsmann, Tiger Global	Farm-to-Fork, Cold Chains, Traceability
2022	178.4	71	Omnivore, Nabventures, BEENEXT	Drone Tech, Ag-Biotech, Climate Smart Ag
2023	199.8	68	Omnivore, Lightspeed, Ankur Capital	Post-harvest Tech, Agronomy Services
2024*	~215.0 (Estimated)	70+	Omnivore, Avaana Capital, Blume VC	Digital Platforms, GVC Facilitation

Source: Invest India. (2024). Agriculture Sector Profile. Invest India.

The Indian agriculture sector witnessed a robust growth phase between 2018 and 2021, with investment surging nearly fourfold from USD 66.3 million to USD 250.2 million. This remarkable increase reflects delicate investor confidence, driven by extensive digital transformation, supportive government initiatives such as Start-up India and the Agri Infrastructure Fund, and the emergence of scalable agritech business models. Investor loyalty is evident through consistent participation from firms like Omnivore across multiple years, signalling sustained interest and faith in the Indian agritech landscape. Other repeat investors, including Ankur Capital, Sequoia, and Accel, further underscore deepening sectoral involvement.

The COVID-19 pandemic between 2020 and 2021 augmented existing vulnerabilities in traditional agricultural supply chains, making farm-to-fork models, cold chains, and digital traceability urgent focus areas by 2021. Investors responded tactically by backing startups that were developing resilient, tech-enabled systems, consequently pushing 2021 to become the highest investment year recorded thus far. Following this peak, the period from 2022 to 2024 saw a phase of stabilization. Although 2022 witnessed a drop in investment to USD 178.4 million, this shift indicated a transition towards high-risk, high-return innovation, with a pivot towards deep-tech applications such as drone technology, climate-smart agriculture, and AG-biotech. A slight rebound in 2023-2024, with investments hovering around USD 200-215 million, suggests market consolidation. This period also saw a notable shift towards post-harvest technology, agronomy services, and Global Value Chain (GVC) facilitation, aligning with India's increasing focus on export readiness and value chain integration.

3.4 Investment Patterns and Sectoral Allocation

Table 5: Sector-wise Investment (Cumulative 2018-2023)

Segment	Estimated Investment Share (percentage)
Supply Chain & Logistics	28
Market Linkages	22
Fintech for Farmers	18
Precision Agriculture/Drones	12
Climate Smart Technologies	10
Input/Advisory Platforms	10

Source: Invest India. (2024). *Agriculture Sector Profile*. Invest India

The agricultural tech (agri-tech) sector is seeing significant investment across several key areas. Supply Chain & Logistics (28 per cent of investment) leads the way, focusing on reducing post-harvest losses and improving efficiency through cold chains, storage, and transportation. Market Linkages (22 percent) are also attracting substantial funding, with platforms connecting farmers directly to buyers to ensure better prices and cut out middlemen. Fintech for Farmers (18 per cent) addresses the unmet financial needs of small-scale farmers by providing credit, insurance, and digital payment solutions. Emerging areas include Precision Agriculture/Drones (12 per cent), which leverages technology for farm monitoring and data-backed decisions, and Climate Smart Technologies (10 percent), which focuses on solutions for climate change adaptation.

3.5 Export Orientation and Certification Barriers

Table 6: Export-oriented agri-startups product categories and major destinations

Product Category	Leading Startups	Export Destinations	Compliance Required
Fresh Fruits	InI Farms, Farmley	EU, UAE, Singapore	GLOBALG.A.P, HACCP
Spices & Condiments	Agrowave, Arya.ag	UK, Germany, US	FSSAI, ISO 22000
Processed Pulses & Grains	WayCool, KrishiHub	Middle East, ASEAN	FDA, Codex
Organic Vegetables	NatureBio Foods, Satvikk	EU, Japan, Australia	India Organic, USDA Organic
Smart Farming Services	DeHaat, Fasal, CropIn	Africa, SEA, LatAm	SaaS Certification, GDPR
Agri-inputs (Biofertilizers)	AgNext, BharatAgri	Africa, South Asia	REACH (EU), UN FAO Codex

Anonymous 2024. Agricultural and Processed Food Products Export Development Authority (N.D.). Agri export compliance guidelines.

India's agri-startup sector is flourishing, with companies actively engaged in exporting various agricultural products and services. Key categories include Fresh Fruits (e.g., InI Farms, Farmley exporting to EU, UAE, Singapore, requiring GLOBALG.A.P, HACCP), Spices & Condiments (e.g., Agrowave, Arya.ag to UK, Germany, US, requiring FSSAI, ISO 22000), Processed Pulses & Grains (e.g., WayCool, KrishiHub to Middle East, ASEAN, requiring FDA, Codex), and Organic Vegetables (e.g., NatureBio Foods, Satvikk to EU, Japan, Australia, requiring India Organic, USDA Organic).

Overall, the sector is driven by government support, technological adoption (AI, ML, IoT), and a focus on improving efficiency and market access for farmers, with a growing international presence. Obtaining necessary certifications (like IEC, RCMC, and product-specific quality standards) is crucial for successful agri-exports from India.

3.6 Income and Employment Impact

Table 7: Participation of agri-startups in global value chains in India (2024)

State/UT	No of Agri-Startups	GVCs (Percentage)	Avg. Annual Farmer Income (₹ lakh)	Avg. Direct Jobs Created	Avg. Indirect Jobs Created
Maharashtra	410	52	2.85	4,200	8,600
Karnataka	330	47	2.43	3,600	7,100
Telangana	260	39	2.68	3,200	6,400
Andhra Pradesh	310	44	2.75	3,800	7,900
Uttar Pradesh	290	30	1.95	2,900	6,000
Gujarat	270	36	2.56	3,100	6,500
Punjab	200	41	3.05	2,600	5,200
Rest of India	1140	28	1.88	11,000	23,000
Total	3,210	~37	—	33,400	70,700

Source: ICAR-NAARM. (2023). *Agri Innovation and Startup Ecosystem in India: Status, Trends, and Opportunities*. National Academy of Agricultural Research Management, Indian Council of Agricultural Research.

- **Startup Concentration and GVC Participation:** Maharashtra, Karnataka, and Andhra Pradesh are leaders, contributing approximately 33% of all agri-startups. Maharashtra stands out with 410 startups and a 52 per cent GVC integration, highlighting its strong export infrastructure. In contrast, Uttar Pradesh and the Rest of India show weaker GVC participation (30 and 28 per cent respectively), possibly due to poorer infrastructure and limited export linkages. Overall, around 37 per cent of Indian agri-startups are involved in GVCs.
- **Farmer Income:** States with higher GVC participation, such as Maharashtra, Punjab, and Andhra Pradesh, also report higher average farmer incomes. Punjab leads with ₹3.05 lakh, potentially due to high-value crops and export-focused start-ups. Uttar Pradesh and the Rest of India have lower incomes (less than ₹2 lakh), correlating with their limited GVC integration. This suggests a positive link between start-ups, GVCs, and improved farmer income through better pricing and market access.
- **Employment Generation:** Agri-startups create significant employment. Maharashtra alone accounts for 12.6 per cent of direct jobs (around 4,200). Rest of India contributes the most indirect jobs (23,000), likely due to a wider distribution of start-ups. On average, each agri-startup generates 10-11 direct jobs and 22-23 indirect jobs, demonstrating their substantial employment elasticity. In total, agri-startups have created 33,400 direct jobs and 70,700 indirect jobs.
- **Regional Disparities:** Southern states (Karnataka, Andhra Pradesh, and Telangana) generally outperform Northern and Eastern states in GVC participation and income impact. Uttar Pradesh, despite its agricultural output, lags in startup quality and GVC integration, indicating a need for policy interventions focused on incubation, digital platforms, and export readiness in such regions.

Table 8: Sector-wise income & employment effects from GVC-linked startups

Startup Domain	GVC Exposure (Percentages)	Avg. Income Growth for Farmers (percentages)	Direct Employment Increase (percentages)	Export Contribution (percentages)
Organic & Natural Foods	62	34	45	51
Agri-Logistics & Exports	55	28	38	63
Digital Marketplaces	47	24	41	18
Precision Agri-Tech	39	19	33	12
Food Processing	58	26	36	47

Source: Compiled by the author based on data from DPIIT (2024), NABARD (2018), NSO (2021), FICCI & PwC (2022), ICAR-NAARM (2023), and Dalwai Committee Reports (2018)

Different types of agricultural startups in India contribute in unique ways to Global Value Chain (GVC) participation, farmer income, employment, and exports. Organic & Natural Foods are highly integrated into GVCs (62 percent exposure) and show the most significant farmer income growth (34 percent) and a strong export contribution (51 percent). This is largely due to the global demand for certified organic products. Agri-Logistics & Exports startups are the biggest drivers of exports (63% contribution), with 55percent GVC integration. They help reduce post-harvest losses, leading to improved farmer earnings (28 percent) and notable job creation (38 percent).

Food processing start-ups also have a strong GVC presence (58 percent) and a significant share in exports (47 percent). They are particularly effective at creating rural employment (36 percent) and adding value to farm produce. Digital Marketplaces have moderate GVC exposure (47 percent) and primarily impact domestic trade. While they improve market access and generate employment (41 percent), their contribution to exports (18 percent) is lower.

Finally, Precision Agri-Tech start-ups currently have low GVC exposure (39 percent) and a limited export contribution (12 percent) due to high costs and slow adoption. However, they do support income and employment through technology-driven solutions.

3.7 Key Challenges in GVC Integration

- **Infrastructure and Logistics Bottlenecks:** Inadequate rural road networks, storage facilities, and cold chains hinder smooth flow of agri-products. High post-harvest losses (15-25% for perishables) due to lack of proper warehousing and transport. Port inefficiencies and high turnaround time reduce export competitiveness.
- **Compliance with International Standards:** GVCs demand certifications like GLOBALG.A.P, HACCP, ISO 22000 and organic certifications. Most small and medium agri-enterprises lack the financial and technical resources to comply. Traceability and food safety norms (e.g., in EU, US) are strict and continuously evolving.
- **Fragmented Landholding and Low Productivity:** Small and marginal farmers (86% of India's farmers) face barriers to scale and mechanization. Inconsistent quality, volumes, and reliability of supply limit startup integration with GVCs.
- d. Financial Constraints and Limited Risk Capital: Startups and FPOs lack access to patient capital and export finance. Venture capitalists prefer low-risk sectors, deterring funding for agri-export initiatives.
- **Policy Uncertainty and Trade Restrictions:** Export bans, Minimum Export Prices (MEPs), and sudden changes in trade policy (e.g., rice, onion bans) disrupt long-term planning. Lack of coordination between central and state trade/agriculture policies.
- **Digital Divide and Capacity Constraints:** Poor digital literacy and limited tech penetration in rural areas affect traceability and logistics tracking. Many GVCs now require digital platforms for real-time monitoring and quality assurance.

Key Opportunities in GVC Integration

- **Rising Global Demand for Organic and Ethnic Foods:** Indian spices, millets, pulses, and organic produce are in growing demand globally. Indian startups can leverage branding of traditional and GI-tagged products (e.g., Basmati rice, Darjeeling tea).
- **Digital Platforms and Agri-Tech Innovations:** Startups like DeHaat, AgNext, and Arya.ag enable traceability, real-time monitoring, and data-based quality grading. Blockchain and IoT facilitate transparent, trust-based integration into global chains.
- **Government Support and Trade Agreements:** Initiatives like APEDA, Agri-Export Policy and FTA negotiations (e.g., India-UAE CEPA) create more export pathways. Export facilitation centres, testing labs, and subsidies on certification reduce entry barriers.
- **Value Addition and Processing:** Processing startups (e.g., WayCool, Freshokartz) tap into value-added segments like ready-to-eat, frozen, dehydrated products.
- **Integration of Farmer Producer Organisations (FPOs):** FPOs can act as aggregators, standardizing quality and quantity for GVC contracts. Linkage with startups and exporters gives bargaining power to smallholders.
- **Climate-Resilient Practices and Certifications:** Sustainable agriculture practices enhance GVC competitiveness. Carbon credits, sustainable sourcing labels (e.g., Rainforest Alliance) open premium markets.

4. Conclusions

The analysis reveals that agri-startups are a transformative force in Indian agriculture, significantly contributing to its integration into Global Value Chains (GVCs). Their growth, exceeding a 20 percent CAGR since 2015, has been fuelled by government support and increased investment, leading to innovations across precision agriculture, supply chain, and agri-fintech.

Crucially, participation in GVCs through these start-ups directly correlates with higher farmer incomes and substantial employment generation. States with strong GVC integration, such as Maharashtra and Punjab, show higher average farmer incomes. Nationally, agri-startups have generated an estimated 33,400 direct and 70,700 indirect jobs.

However, scaling this integration faces persistent challenges, including inadequate infrastructure, stringent international compliance, fragmented landholdings, and limited access to finance. Despite these hurdles, the rising global demand for organic produce and the increasing adoption of digital technologies present significant opportunities for future growth. Targeted policy interventions are essential to address existing

bottlenecks and fully leverage the potential of agri-startups in driving sustainable and export-oriented agricultural growth in India.

5. Acknowledgements
The author(s) express sincere gratitude to the management of Bharatiya Engineering Science and Technology Innovation University (BESTIU) for their continuous encouragement, support, and facilitation in carrying out this research work. Their commitment to promoting academic excellence and innovation provided the necessary resources and environment for successfully preparing this paper.

6. Competing interests: No

7. Authors' Contributions
All authors are equally contributed in preparation of this paper. All authors are read and approved the final manuscript.

References
1. Adhya PS, Sahoo SK. Agritech startups in India: A revolutionary idea giving birth to agripreneurs. Int J Innov Res Technol. 2022;9(5):687-702.
2. Anonymous. APEDA-Agricultural and Processed Food Products Export Development Authority: Agri export compliance guidelines. Government of India; 2024.
3. Birthal PS, Joshi PK, Gulati A. Vertical coordination in high-value commodities: Implications for smallholders. Int Food Policy Res Inst. 2005;85.
4. DPIIT. Startup India Dashboard-Agri Startup Overview. Department for Promotion of Industry and Internal Trade, Government of India; 2024.
5. Gulati A, Sharma P, Ganguly K. Further strengthening agri-value chains in India Way forward. In: Agricultural Value Chains in India; 2022, p. 287.
6. ICAR-NAARM. Agri Innovation and Startup Ecosystem in India: Status, Trends, and Opportunities. National Academy of Agricultural Research Management, Indian Council of Agricultural Research, Hyderabad; 2023.
7. Invest India. Agriculture Sector Profile. Invest India; 2024.
8. Kumar RKN, Babu TR, Deshmukh SS. Nurturing growth: Agri startup landscape in India and the challenges ahead. Res World Agric Econ. 2024;5(2):131-149.
9. Sharma S, Arora R. Macroeconomic determinants of India's participation in global value chains: An empirical evidence. J Asian Econ Integr. 2023;5(1).
10. Singh RK, Misra N. Driving transformation in Indian agriculture through startups: An ecosystem analysis. J Rural Stud. 2023;101:175-185.
11. Start-up India. Agri-Startups Database and Trends. Department for Promotion of Industry and Internal Trade; 2024.
12. Suresh D, Choudhury A, Zhang Y, Zhao Z, Shaw R. The role of data-driven agritech start-ups: The case of India and Japan. Sustainability. 2024;16(11).