Original Research Article

Evaluating the Impact of Agri-Startups on Technology Transfer: Insights from Farmers in Madurai and Dindigul Districts, Tamil Nadu, India

ABSTRACT

Agri-startups are emerging as transformative agents in the agricultural sector, particularly in developing regions. This study explores the critical role of Agri-Startups in facilitating technology transfer to farmers in the Madurai and Dindigul districts of Tamil Nadu, India. Through a survey of 150 farmers associated with five prominent Agri-Startups, the research delves into the financial, technological, and marketing contributions of these startups, as well as farmers' perspectives on their impact. The findings reveal that Agri-Startups significantly attract investment for agricultural innovation (72.7% agreement), promote the adoption of new technologies (81.3% agreement), and identify market opportunities (72% agreement). Despite these advancements, farmers' overall agreement on the role of Agri-Startups in technology transfer is varied, with 44% expressing low agreement, 43.33% medium agreement, and only 12.7% showing high agreement. This disparity underscores the need for Agri-Startups to strengthen their engagement with farmers, particularly in areas of education, after-sales support, and demonstrating the practical benefits of their innovations. The study offers valuable insights into the Agri-Startup ecosystem in rural India, highlighting both its potential and the challenges that must be addressed to enhance the effectiveness of technology transfer in agriculture.

Keywords: Agri-Startups, Technology Transfer, Farmers' Perspectives, Agricultural Innovation,

1. INTRODUCTION

Agri-startups have become important players in this changing field, bridging the gap between innovative ideas and real-world applications. These businesses are not only creating new technologies, but they are also essential in getting these advancements to farmers.The need for efficient, sustainable farming methods and the rapid advancement of technology are driving a massive transformation in the agricultural sector.There is a widespread belief, that startups must be located in industrialised nations with access to all resources. In reality, however, startups must be located in nations with higher requirements and better prospects [1]. Especially in developing nations, the convergence of agriculture and technology through startups is becoming a critical factor in increasing agricultural sustainability and production [2]. With a $10.6 billion worldwide investment in 2022, despite a decline in funding, Agri-tech startups continue to draw a significant 13% less than in 2011 [3]. This industry has grown by

an astounding 20 times in venture capital investments during the last ten years, indicating the increased significance of tackling food security in the face of a growing global population and climate-related challenges [4]. According to the economic survey 2021-22, the majority of India's 83 unicorns, have a combined worth of over $277.70 billion people and generate more than 50% of the country's Gross Domestic Product (GDP), are in the service industry, according to the economic report 2021-2022 [5] . To solve many of the major problems facing the agriculture industry, Agri-Startups have arisen as a "wind of change". Startups create a ripple effect on the socio-economic fabric of the demography in which they operate [6] With the use of cutting-edge concepts and contemporary technology, these startups aim to transform the agricultural environment in India. Startup companies, also known as Startups or Agri-startups, are entrepreneurial endeavours that are usually recently established, expanding quickly, and seeking to fill a market gap by creating or providing an exceptional and novel product, service, or method. Things have begun to change in India with the rise of Start-ups. There is no denying that Startups have revolutionized the agricultural sector and pushed for growth [7]. It's also important to note that the advent of free market economies around the world has led to the formation of a new entrepreneurial spirit known as "Agripreneurship" and an increase in the necessity for individuals to take responsibility for managing their enterprises [8].TheAgripreneurship programme is essential for producing managers and entrepreneurs to serve the global agriculture industry [9]. Infrastructure development, funding allocations, regulatory reforms, ease of doing business, and specialized strategies and activities have all contributed to the sector's increased profitability for aspirational business owners. An increasing number of individuals are showing interest in the sector and its various difficulties [10].A total of Rs. 3671.75 lakhs in investment is being given to 346 startups in the agricultural and associated sectors, providing opportunities that will both directly and indirectly assist farmers in growing their businesses and employing young people their income [11].

When an entity satisfies the requirements listed below, it will be considered as a "STARTUP":

- ✓ The startup has to file for registration as a limited liability partnership or private company.
- ✓ The startup cannot be the result of reorganisation.
- ✓ The Startup must not be older than 10 years
- ✓ Annual turnover of the start-up must not be more Rs. 100 crores [12].

This study aims to investigate how important a role agri-startups play in helping farmers in Tamil Nadu's southern districts,Madurai and Dindigul in particular transfer and embrace innovative agricultural technology. By looking at their effects on adoption rates, technological transfer, and the difficulties farmers have accepting these advances, this study seeks to

understand how these companies are changing the agricultural location and improving their production. This study aims to shed light on the current state of technology adoption in the research area and the efficacy of Agri-startups in bridging the innovation-to-practical application gap, given that technology adoption rates vary across regions and are crucial for advance agricultural practices.The study validates the necessity to look at how Agri-startups are influencing the direction of agriculture in these regions and due to this technology transfer and adoption farmers were able to improve their skills in improving their production level . By examining the Agri-Startups of their role in marketing, finance, technological and farmers perspectives, this study aims a thorough grasp of how these startups are influencing the agricultural environment.Therefore, present study was initiated with the following specific objective.

1.2 Objective of the study

- ✓ To examine the role of Agri-Startups in facilitating the transfer of technology to farmers

2. MATERIAL AND METHODS

This study, conducted in the Tamil Nadu districts of Madurai and Dindigul during the period of 2023 to 2024, focused on Agri-Startups that have become important players in the growth of the agricultural industry. The sample data consists of entrepreneurs and founders who were involved in agro-based companies in Madurai and Dindigul districts of Tamil Nadu. Secondary data was used to build a list of Agri start-up sub-sectors.The Tamil Nadu region consists 137 Agri-start-ups distributed across 38 districts, making it one of the fastest-growing start-up ecosystems in the country (Startup India, 2020) [13]. A total of 150 farmers were selected as respondents using a purposive random sampling. For this study, a sample size of 5 Agri-startups were chosen using purposive sampling. Five Agri-Startups, each established more than 12 years, were identified and selected in the Madurai and Dindigul districts. Five blocks were selected for the study, and farmers who had adopted the technologies provided by the list of those startups. These districts were specifically chosen due to the higher number of developed Agri-Startups. These Agri-Startups operate in collaboration with farmers from various blocks, including Nilakottai and Vedasandur in Dindigul district, and Vadipatti, Usilampatti, and Alanganallur in Madurai district. The primary data was collected using an interview schedule designed according to the study's objectives, and the data was analyzed and tabulated using frequency and percentage.

Table 1. The distribution of Agri-Startups according to their technologies

S.No	Name of the Agri-Startups	Technologies provided
1.	Adish-technologies private limited	Web-services, Mobile

		Applications development
2.	Gusto-crop technologies private limited	Nano-based fertilizer and growth products
3.	RNR-Agri developers private limited	Agri-Consultant
4.	Infarmsys technologies private limited	Agritech solution and Soil NPK sensors
5.	BrainfarmsAgrotech private limited	Artificial neural networks (ANN) and Remote sensing

Different categories of role in facilitating the transfer of technologies in questionnaire schedule were developed and used in this study. In order to ascertain the perceived significance of the various functions performed by agri-startups, farmers' answers were recorded on a binary scale (Yes/No). Using SPSS software, descriptive statistics data was analyzed and tabulated.

Table 2. The distribution of Agri-Startups and selection of respondents.

S.No	Name of the Agri-Startups	No. of respondents selected
1.	Adish-technologies private limited	30
2.	Gusto-crop technologies private limited	30
3.	RNR-Agri developers private limited	30
4.	Infarmsys technologies private limited	30
5.	BrainfarmsAgrotech private limited	30
	Total	**150**

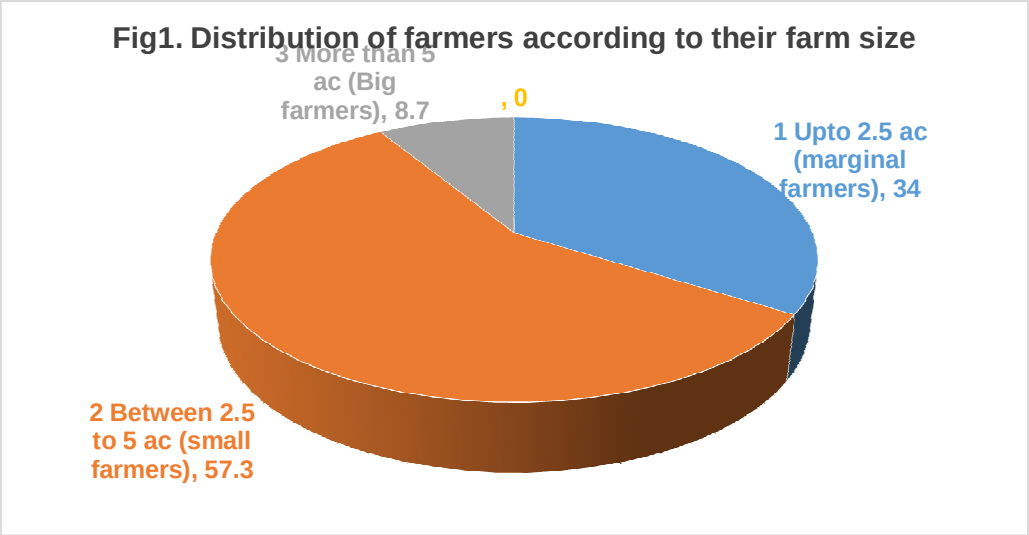
Table 3. The distribution of respondents according to their farm size

S.No	Category	Farm holding	Score
1.	Marginal farmer	Upto 2.5 acres	1
2.	Small farmer	Between 2.5 to 5 acres	2
3.	Big farmer	More than 5 acres	3

Farm Size:

Table 4. Distribution of respondents according to their farm size (n=150)

S. No	Category	Number	Per cent
1.	Upto 2.5 ac (marginal farmers)	51	34.0
2.	Between 2.5 to 5 ac (small farmers)	86	57.3
3.	More than 5 ac (Big farmers)	13	8.7
	Total	**150**	**100.00**



From the table 4, it os concluded that it provides insights into the landholding patterns. Notably, the majority of respondents (57.3%) identified as small farmers, followed by (34%) who consider themselves as marginal farmers. A smaller proportion , (8.7%) fall under the category of big farmers.

3. RESULT AND DISCUSSION

Table 5. The frequency and percent of farmers in the role of Agri-Startups in Facilitating Technology Transfer

(n=150)

S.No.	Statements	Frequency	Percentage
A.	**Financial role of Agri-startups in technology transfer**		

1.	Agri-startups attract investment for agricultural technology development	109	72.7
2.	Agri-startups sources of initial capital for innovative agricultural ideas	70	46.7
3.	Agri-startups invest in creating new markets for agricultural technologies	77	51.3
4.	Agri-startups aim to generate financial returns through successful technology commercialization	74	49.3
5.	Agri-startups willing to take on higher risks associated with technological development in agriculture	66	44.0
B.	**Technological role of Agri-startups in technology transfer**		
6.	Agri-startups demonstrate practical applications through field trials to enhance productivity and sustainability	122	81.3
7.	Agri-startups facilitate the adoption of new technologies by farmers	87	58.0
8.	Agri-startups operate demonstration farms to showcase new agricultural technologies	65	43.3
9.	Agri-startups provide educational programs to farmers regarding new technologies	57	38.0
10.	Agri-startups focus on increasing productivity and sustainability through technology transfer	80	53.3
C.	**Marketing role of Agri-startups in technology transfer**		
11.	Agri-Startups identify market needs and opportunities to help farmers access relevant technologies that improve their farming practices.	108	72.0
12.	Agri-startupsactively promote and market new agricultural	98	65.3

	technologies, ensuring that farmers are aware of and can adopt the latest innovations.		
13.	Agri-Startups provide targeted marketing channels that connect farmers with the right products and services to meet their specific needs.	58	38.7
14.	Agri-startupsoffer after-sales support and services to farmers, ensuring satisfaction and continued success with the adopted technologies.	82	54.7
15.	Agri-startupsassist farmers in differentiating their produce in the market by leveraging technology, enhancing competitiveness and profitability	62	41.3
D.	**Other role of Agri-startups in technology transfer**		
16.	Farmers examine the changes that Agri-startups bring to the agriculture industry.	105	70.0
17.	Farmers find agri-startups' technologies relevant and beneficial to their farming practices	70	46.7
18.	Farmers aware of the role of agri-startups in driving technological advancements in agriculture	59	39.3
19.	Farmers evaluate the effectiveness and practicality of technologies introduced by agri-startups	75	50.0
20.	Farmers view agri-startups as trustworthy resources for knowledge and encouragement when implementing new technology.	58	38.7

Table 6:Distribution of farmers according to the role of Agri-Startups

S.NO		Level	Frequency	Percentage
1.		Low	66	44.0
2.		Medium	65	43.3
3.		High	19	12.7
		Total	**150**	**100.00**

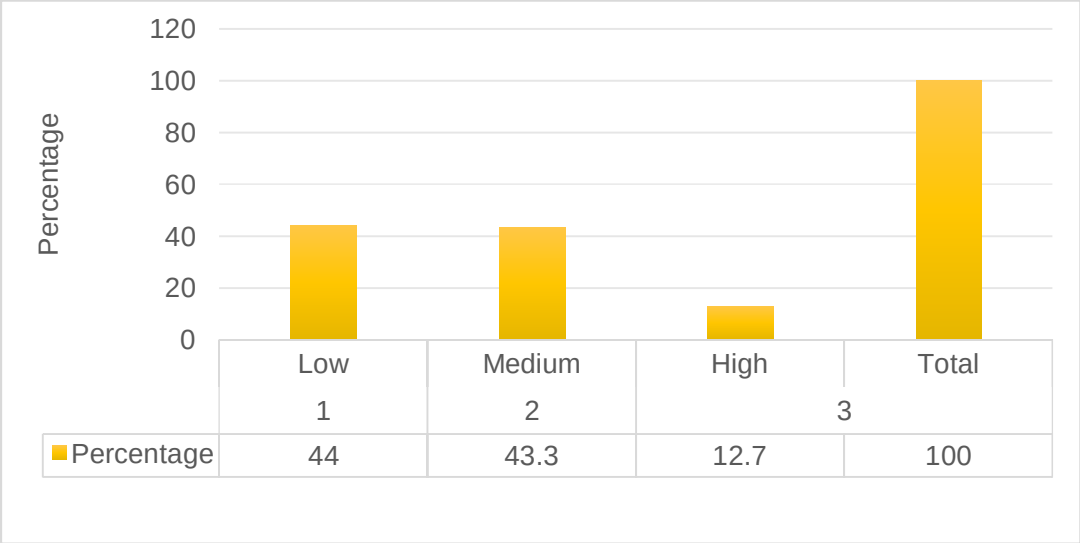


Fig. 2. Comparison of farmers according to their overall response towards the role of Agri-startups

Interpretation

From fig 2, a majority of farmers (44%) indicate a low level of agreement regarding the roles and impacts of agri-startups in technology transfer and adoption. Agri-startups have made significant contributions to the agricultural industry this is evident from the small percentage of farmers (43.33%) who indicate moderate levels of agreement. In contrast, only a small percentage of farmers (12.7%) strongly agree, demonstrating their great awareness and adoption of the technologies transferred by agri-startups. These findings are consistent with previous studies by Kakara Aneesha [14] and Vipin Kumar [15], lending further validity to the current study's conclusions.This suggests a consistent pattern in several research studies addressing the importance of agri-startups in supporting technology transfer to farmers

Financial Role

The data reveals that 72.7% of farmers recognize Agri-startups' ability to attract investment for agricultural technology development. However, only 46.7% view them as sources of initial capital for innovative ideas. This discrepancy suggests that while Agri-startups are perceived as capable of attracting larger investments, there's a gap in early-stage funding perception. This aligns with findings by Accenture (2017) [16], highlighting the critical need for early-stage funding in agricultural innovation.

Technological Role

A significant 81.3% of farmers acknowledge Agri-startups' role in demonstrating practical applications through field trials. This high percentage underscores the importance of tangible demonstrations in technology adoption, supporting Rogers' (2003) [17] Diffusion of Innovations theory. However, only 38% recognize their educational role, indicating a need for enhanced farmer training programs, as emphasized by Mwangi and Kariuki (2015) [18] in their study on factors affecting technology adoption.

Marketing Role

While 72% of farmers acknowledge that agri-startups can spot market opportunities and demands, only 38.7% think they offer focused marketing channels. This gap implies that although agri-startups are skilled at conducting market research, their customised marketing strategies could use some work. These results are consistent with the focus Goyal and Kumar (2021) [19] placed on the function of Agri-startups in filling knowledge gaps in the agricultural markets.

Other Roles

Agri-startups are recognised by 70% of farmers as bringing innovations to the agriculture industry, yet only 38.7% consider them to be reliable providers of information and support. This worrying lack of trust is consistent with Aker's (2011) [20] research, which emphasises the importance of confidence in the adoption of new technologies.

4.CONCLUSION

This study provides valuable insights into the role of Agri-Startups in facilitating technology transfer to farmers in the Madurai and Dindigul districts of Tamil Nadu, revealing a complex landscape of farmer perceptions and experiences. While Agri-Startups show promise in attracting investments and demonstrating new technologies, there is a clear need to bridge the gap between innovation and practical adoption, particularly for small and marginal farmers. Future research should focus on developing tailored strategies for technology dissemination, investigating long-term impacts of Agri-Startup interventions, examining supportive policy frameworks, exploring innovative farmer engagement models, and assessing collaborative ecosystems. By addressing these areas, future studies can contribute to the development of more effective and sustainable Agri-Startup ecosystems, ultimately enhancing agricultural productivity and rural livelihoods in developing regions. This research serves as a foundation for policymakers, agricultural extension agencies, and Agri-Startups to refine their approaches and maximize their impact on the agricultural sector, paving the way for more targeted

interventions and policy formulations that can accelerate the adoption of agricultural innovations and improve farmers' livelihoods.

5. LIMITATIONS

This study was limited to the Madurai and Dindigul districts of Tamil Nadu. It is recommended to exercise caution when extrapolating the findings to other fields. The dependence on vocal responses may have contributed to some discrimination. However, the findings of this work may aid future research in areas with similar conditions. It will also inspire scholars to learn more about Agri-startups.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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