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Determining Adoption of Agritech by Farmers in Rural Bangalore

SHWETHA KUMARI* and M VINEETH

Department of Economics, Christ (Deemed to be University), Bangalore Yeshwanthpur Campus, Nagasandra, Near Tumkur Road, Bangalore, Karnataka.

Abstract

The use and dissemination of agricultural technology has sparked widespread attention across disciplines since it is seen as a solution to food shortages, low productivity, income, and yields in farming, particularly in developing nations such as India. As of mid-2021, there are approximately 226 AgriTech startups in Bangalore, Karnataka, out of 700 in India. The purpose of this study is to examine the factors (age, educational level, economic status, farmer category) that influence the adoption of AgriTech startups services in Karnataka's rural Bangalore district. This study was conducted in Byrasandra and Byadarahalli in Namangala taluk of Rural Bangalore among farmers who had adopted AgriTech and who had not adopted agritech services provided by agritech startups. A descriptive analysis such as chi square and cross tab was used to examine the objectives using a random sample of 100 farmers. From the result it was evident that farmer's age, educational level, economic status and farmer category plays a significant role in the rural Bangalore uptake of AgriTech given by AgriTech startups. The study recommends the future studies on adoption of AgriTech in India to widen the range of variables used by researchers.

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Adoption of Technology;
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Introduction

Global food demand is rising, but there is a shortage of land and farming resources on the supply side. By the year 2050, the world's population is projected to be 9.7 billion, necessitating a 70% increase in the number of calories available for consumption, even as the price of the inputs required to produce those foods is rising.[1] However, India has 1.27 billion people, making it the second-most populous country in the world. With 3.288 million square kilometres of land, it is the seventh-largest nation in the world.[2] Agriculture plays an essential role to the Indian economy. The agriculture sector accounts for 19.9% of India's GDP and employs over 43% of the country's workers. However, various constraints, including insufficient capital inflow and operational inadequacies, were preventing the Indian agriculture sector from attaining its full potential.

CONTACT Shwetha Kumari shwetha.kumari@res.christuniversity.in Department of Economics, Christ (Deemed to be University), Bangalore Yeshwanthpur Campus, Nagasandra, Near Tumkur Road, Bangalore, Karnataka.

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The agriculture sector was being actively disrupted by India's booming start-up ecosystem. According to EY, 2020, India's AgriTech start-ups were working in an appealing industry with a potential value of US$24 billion by 2025.[3]

Various structural issues, with inadequate capital influx and operational inadequacies were hindering Indian agriculture sector from attaining its full potential ones.[44] Compared to nations like the US or China, yields on crops like cereals were 50% lower in India. Farmers' income decreased as a result of the value chain's extensive use of intermediaries. Several stakeholders were introducing various interventions in the form of AgriTech start-ups, also known as AgriTech start-ups.[5] In an era of globalization and technological advancements it was impossible to learn, earn knowledge and practice the benefits of applied sciences without the usage and application of Information and communication technologies (ICTs). ICT played important role in agricultural extension and advisory services. ICTs bridge the gap between agricultural researchers, extension agents, and farmers. As a result, agricultural production increases.[6]

The widespread adoption of technology through digital platforms, analytics, artificial intelligence (AI), machine learning (ML), and the Internet of Things (IoT) was primarily credited with the transformation of India's agriculture. The agriculture industry was being actively disrupted by India's developing start-up scene. AgriTech start-ups in India were competing in a lucrative sector with a predicted value of US$24 billion by 2025.7 An increasing amount of literature reviews has emphasised the significance of agricultural technologies and the factors that affected whether or not they were adopted.[7] In developing nations, acceptance of agritech was influenced by several economic, institutional, and human-specific variables. Numerous socioeconomic factors, particularly the literacy rate, showed a beneficial impact on the amount of AgriTech adoption.[8]

Lack of empirical studies on AgriTech adoption in India, particularly in Karnataka, has brought attention to the need for more comprehensive AgriTech adoption studies. In Karnataka, there was significant conceptual study done on AgriTech.

Materials and Methods

Research Objectives

Objective 1: To analyse the factors (age, educational level, economic status, farmer category) that determine the adoption of agriculture technology provided by AgriTech startups in Rural Bangalore.

Hypothesis of the Study

H01 - The use of AgriTech services is not significantly related with the farmer's age.

H11 - The use of AgriTech services and the farmer's age are significantly related.

H02 - The use of AgriTech services is not significantly related with the economic status.

H12- The use of AgriTech services are significantly related with the economic status

H03 - The use of AgriTech services is not significantly related with the educational qualification.

H13- The use of AgriTech services are significantly related with the educational qualification.

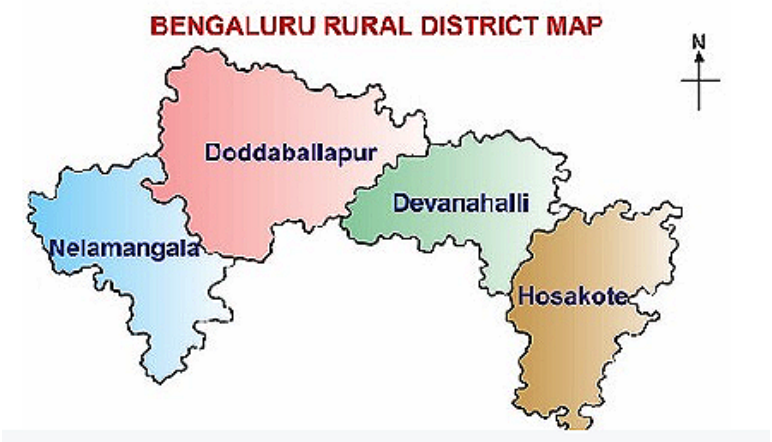
H04 - There is no significant relationship between farmer category of the farmer and adoption of AgriTech services.

H14- There is a significant relationship between farmer category of the farmer and adoption of AgriTech Services.

Study Area

The study was carried out in Nelmanagala Taluk, a remote area of India's Karnataka state's Rural Bangalore region. There are 229 villages total in this Taluka. According to the 2011 Indian census, there are 210,889 people living in Nelmanagala Taluk, 107,504 of them are men and 103,385 of whom are women. There are 148,770 persons who can read and write, including 66,422 women and 82,348 men. 22,701 people depend on agriculture cultivation, of which 17,655 are male cultivators and 5,046 are female. In Nelmanagala, 8,512 people are employed as agricultural labourers, 4,492 of whom are males and 4,020 of whom are women. The villages that were selected to conduct the study was Byrasandra and Byadarahalli in Namangala Taluk. The selection of this district was done on the basis that Nelmangala Taluk is closer to Urban Bangalore, which is the start-up hub of India. There are many AgriTech startups operating in the taluk providing their services to farmers.

Map Showing Bengaluru Rural's Nelmanagala Taluk



Source: E-KRISHI, University of Agricultural Sciences, Bangalore, HTTP://E-KRISHIUASB.KARNATAKA.GOV.IN/ITEMDETAILS.ASPX?DEPID=14&CROPID=0&SUBDEPID=21

Sample Selection

Given that this paper only concentrating on Nelmangala taluk in rural Bangalore, the firms in the AgriTech sector were first identified who were offer their AgriTech services in the Taluk using secondary data. The next step in this paper involved randomly selecting farmers who are using AgriTech and who are not using AgriTech. 100 samples are selected randomly for this study from Byrasandra and Srinivas Pura in Namangala Taluk, Rural Bangalore.

Research Design and Data Collection

A descriptive analysis such as Chi square and Cross tab was used to test the objectives and hypothesis using a random sample of 100 farmers who had adopted AgriTech and who had not adopted AgriTech services provided by AgriTech startups. The data were collected in mid-2022. The study developed questionnaire, which consisted of open and closed ended questions. In this study, descriptive research was used to analyse the results. The main selection criteria were that villages should be near the Nelmanagala Taluk. To collect the sample, the study developed questionnaire, which consisted of open and closed ended questions. The data set of complete responses was checked for answer consistency and total response time. The results were analysed with SPSS Statistics 26.o.

Results and Discussion

Education Qualification and Adoption of AgriTech

To analysis the relationship between educational qualification of the farmers and adoption of AgriTech services provided by AgriTech start-ups, the study used crosstab, chi square test and bivariate pearson relation method. To analyse the objective respondents were asked whether they used AgriTech or not. Those who used marked 1 as their response used AgriTech and those who did not use AgriTech responded No (0) as their answer. Further there were five options given to the farmers in the questionnaire to choose their education qualification which included Illiterate (1), Primary (2), Secondary (3), Higher Secondary (4), Graduation+ (5). Descriptive statistics for the variable are presented in (Table 1).

According to Table 1, out of 50 farmers who are not using AgriTech 21.0% are illiterate, 26.0% completed primary educations, 1.0% completed their secondary education, 2.0% have higher secondary qualification and no farmers in this group have completed graduation degree. On the other hand out of 50 farmers who are using AgriTech only 6.0% is illiterate, 8.0% have completed primary education, 7.0% have completed secondary education. Out of 50 farmers who are using AgriTech 22.0% farmers

have completed higher secondary education and 7.0% have completed graduation. Therefore, it is apparent from Table 1 that AgriTech services adoption among farmers who have completed higher secondary education is higher compared to famers who are not using it. Farmers who have completed graduation are also influenced to use AgriTech services.

Table 1: Sample statistics of education qualification and adoption of AgriTech

User- Non-User- AgriTech * Education Cross tabulation						
	Illiterate	**Primary**	**Secondary**	**Higher Sec**	**Graduation**	**Total**
No	Count	21	26	1	2	0 50
	%within User- Non-User- AgriTech	21	26	1	2	0 50
Yes	Count	6	8	7	22	7 50
	%within User- Non-User- AgriTech	6	8	7	22	7 50
Total	Count	27	34	8	24	7 50
	%within User- Non-User- AgriTech	27	34	8	24	7 50

Source: Primary data

Table 2: Sample statistics of Chi Square test on education qualification and adoption of AgriTech

	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	46.029[a]	4	.000
Likelihood Ratio	53.128	4	.000
Linear-by-Linear Association	39.389	1	.000
N of Valid Cases	100		

a. 4 cells (40.0%) have expected count less than 5. The minimum expected count is 3.50.

Source: Primary data

The value of the Chi Square statistic was 46.029a. The result found is significant as the value arrived was much below the designated alpha level (normally .05). Therefore, it can be concluded that there is a high level of relation between economic status and adoption of AgriTech services among farmers. Therefore, it can be concluded that farmers who are modestly educated tend to adopt AgriTech services. According to the outcome, farmers' low levels of education have an impact on whether they accept AgriTech offered by AgriTech startups.

This means that the farmers who have completed their secondary, higher secondary and graduation are more likely to use AgriTech than compared to farmers who are illiterate. This indicates that the study's findings support the alternative hypothesis—that there is a significant, moderate association

between the farmer's educational background and the use of AgriTech services—and reject the null hypothesis. According to Lavison (2013) education level of a farmers increases his ability to obtain; process and use information relevant to adoption of a new technology.[9]

Economic Status and Adoption of AgriTech

To analyse the relationship between economic status of the farmers and adoption of AgriTech services provided by AgriTech start-ups, the study used crosstab and chi square test. To analyse the objective respondents were asked whether they used AgriTech or not. Those who used marked 1 as their response used AgriTech and those who did not use AgriTech responded No (0) as their answer. Further, there were five options given to the farmers in the questionnaire to choose their economic qualification, which included APL (1)/ BPL (2)/ Antyodaya (3)/ others (4). Descriptive statistics for the variable are presented in Table 3.

Table 3: Sample Statistics of economic status and adoption of AgriTech

Economic status Cross tabulation						
Economic Status			**APL**	**BPL**	**Antyodaya**	**Total**
User-Nonuser-AgriTech	No	Count	7	23	20	50
		% of Total	7	23	20	50
	Yes	Count	43	7	0	50
		% of Total	43	7	0	50
Total	Count	50	30	20	100	
	% of Total	50	30	20	100	

Source: Primary data

Table 3 demonstrates that, of the 50 farmers who do not use AgriTech 7.0% were from APL, 23.0% farmers were from BPL, 20.0% were from Antyodaya. Whereas out of 50 farmers who were using AgriTech 43.0% farmers were from APL economic category, 7.0% were from BPL, 0.0% from Antyodaya. In terms of economic status, the existing literature offers strong support for the influence of economic status on adoption and non-adoption of AgriTech services.

Table 4:Sample Statistics of Chi Square test on economic status and adoption of AgriTech

	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	54.453a	2	.000
Likelihood Ratio	65.537	2	.000
Linear-by-Linear Association	50.896	1	.000
N of Valid Cases	100		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.00.

Source: Primary data

The chi square value is 54.453a. The p-value appears in the same row in the "Asymptotic Significance (2-sided)" column (.00). The result found is significant. As a result, the study accepts the alternative hypothesis that there is a strong relation between farmers' economic condition and their adoption of AgriTech services.

Age and Adoption of AgriTech

To analyse the relationship between age of the farmers and adoption of AgriTech services provided by AgriTech start-ups, the study used crosstab, and chi square test. To analyse the objective respondents were asked whether they used AgriTech or not. Those who used marked 1 as their response used AgriTech and those who did not use AgriTech responded No (0) as their answer. Further there were five option given to the farmers in the questionnaire to choose their economic qualification which included 20-30 (1)/ 30-40 (2)/ 40-50 (3)/ 50-60(4)/ 60+ (5). Descriptive statistics for the variable is presented in Table 5.

Table 5 depicts age of the farmers who were doing farming. From Table 5 it is evident that out of 50 farmers who were not using AgriTech 3.0% were from the age group 20-30, 1.0% from 30-40 age group, 16.0% from 40-50 age, 23.0% from 50-60 age group and 7.0% from 60+ age group. This means that 40-50 and 50-60 age group were strongly represented in the famrers list who were using AgriTech startips. It is also evident from the result that out of total 50 farmers who were using AgriTech 42.0% farmers belonged to 20-30, 6% from 30-40, 1.0% from 40-50 age group and 50-60 age group and 0.0% from 60+age. The highest age class (20-30) was more strongly represented in this sample. Further, it is also evident from the sample response that farmers belonging to older age 40-50, 50- 60 and 60+ used AgriTech services nominally.

Table 6: Sample Statistics of Pearson Chi Square test on age and adoption of AgriTech

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	77.773a	4	.000
Likelihood Ratio	94.924	4	.000
Linear-by-Linear Association	68.659	1	.000
N of Valid Cases	100		

a. 4 cells (40.0%) have expected count less than 5. The minimum expected count is 3.50.

Source: Primary data

The chi square value is 77.773a. The result found was significant as the value arrived was much below the designated alpha level (normally .05). Therefore, it can be concluded that there is a high level of relation between age and adoption of AgriTech services among farmers.This means that the famers who are younger are more likely to use AgriTech than compared to farmers who were older. The study's findings thus support rejecting the null hypothesis and accepting the alternative one, according to which there is a strong relation between age and AgriTech adoption.

Farmer Category and Adoption of Technology

To analysis the relationship between farmer category of the farmers and adoption of AgriTech services provided by AgriTech start-ups, the study used crosstab and chi square test. To analyse the

objective respondents were asked whether they used AgriTech or not. Those who used marked 1 as their response used AgriTech and those who did not use AgriTech responded No (0) as their answer. Further there were three option given to the farmers in the questionnaire to choose their economic qualification which included small farmers (1)/ medium farmer (2)/ large farmers (3). Descriptive statistics for the variable is presented in Table 7.

Table 7: Sample statistics of farmer category and adoption of AgriTech

			Farmer Category			
			Small	**Medium**	**Large**	**Total**
User-Nonuser-AgriTech	No	Count	32	10	8	50
		% of Total	32	10	8	50.0
	Yes	Count	8	21	21	50
		% of Total	8.0	21	21	50
Total	Count	40	31	29	100	
	% of Total	40	31	29	100	

Farmer category depicts the size of the farming land the farmer has. From the above it is evident that four of 50 farmers 32.0% were from small farmers' category, 10.0% who were not using technology were medium size farmers and 8.0% were from large farmers' category. Out of 50 farmers who were using AgriTech 8.0% were small farmers 21.0% were medium farmers and large farmers respectively. Farmers belonging to medium and large category were more likely to use AgriTech services.

Table 8: Sample Statistics of Pearson Chi Square test on farmer category and adoption of AgriTech

	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	24.131a	2	.000
Likelihood Ratio	25.450	2	.000
Linear-by-Linear Association	19.993	1	.000
N of Valid Cases	100		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 14.50.

Source: Primary data

The chi square value is 24.131[a]. The result was significant as the value arrived was much below the designated alpha level (normally .05). Thus, it can be said that there is a strong rrelation between farmer category and farmers' adoption of AgriTech services. Admassie and Ayele (2010) conducted a study on increased technology adoption in Ethiopia using 1920 agricultural family heads from four national regional states. The logit and probit model findings revealed that farm size and extension service influenced AgriTech adoption favorably, but distance to market and household head age influenced it negatively.[10]

Conclusion

The study found that there is significant relationship between age, educational level, economic status, farmer category and adoption of AgriTech. Age, education, size of the land operated, asset ownership, and several other farm and household characteristics have an impact on the decision to adopt AgriTech services as per Rajkhowa and Qaim, 2021.11 The research presents recommendations for further research on AgriTech adoption in India, such as farmer attitudes towards new technology and motivational factors in AgriTech adoption. As a result, policymakers, academics, and AgriTech startups may profit greatly from the findings of this study.

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Conflict of Interest

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References

1. The World Population Prospects: 2015 Revision, United Nations, Department of Economic and Social Affairs, Population Division. Available at: https://population.un.org/wpp/publications/files/key_findings_wpp_2015.pdf, 2015
2. World Resources Report: Creating a Sustainable Food Future, United Nations, World Resources Institute, and the World Bank, 2013.
3. EY. Agritech - towards transforming Indian agriculture. https://assets.ey.com/content/dam/ey-sites/ey-com/en_in/topics/start-ups/2020/09/ey-agritech-towards-transforming-indian-agriculture.pdf?, P. 9, 2020
4. India at a glance, FAO in India. Available at: https://www.fao.org/india/fao-in-india/india-at-a-glance/en/. 2017
5. Agriculture in India: Information about Indian Agriculture & Its Importance. IBEF. Available at: https://www.ibef.org/industry/agriculture-india.aspx. May 7, 2021
6. Chowhan, S., & Ghosh, S. R. Role of ICT on Agriculture and Its Future Scope in Bangladesh. *Journal of Scientific Research and Reports,* 26(5), 20–35. https://doi.org/10.9734/jsrr/2020/v26i530257]https://www.researchgate.net/profile/Sushan-Chowhan/publication/342288581_Role_of_ICT_on_Agriculture_and_Its_Future_Scope_in_Bangladesh/links/5eecfab0299bf1faac645a18/Role-of-ICT-on-Agriculture-and-Its-Future-Scope-in-Bangladesh.pdf . 2020
7. IBEF. Agriculture in India: Information about Indian Agriculture & Its Importance. Available at: https://www.ibef.org/industry/agriculture-india.aspx.March 2020
8. How agritech start-ups are changing the face of Indian agriculture. EY. Available at: https://www.ey.com/en_in/start-ups/how-agritech-start-ups-are-changing-the-face-of-indian-agriculture. 2020
9. Lavison, R. . Factors Influencing the Adoption of Organic Fertilizers in Vegetable Production in Accra, Msc Thesis, Accra Ghana. Department of Agricultural Economics and Agribusiness [119]. Retrieved from http://ugspace.ug.edu.gh/bitstream/handle/123456789/5410/Robert%20Kofi%20Lavison_Factors%20Influencing%20the%20Adoption%20of%20Organic%20Fertilizers%20in%20Vegetable%20Production%20in%20Accra_2013.pdf?sequence=1&isAllowed=y.2013
10. Admassie A. and Ayele G. . Adoption of Improved Technology in Ethiopia. Ethiopian

Journal of Economics, 19(1), 155-180.2010

11. Rajkhowa P, Qaim M. Personalized digital extension services and agricultural performance: Evidence from smallholder farmers in India. PLoS ONE 16(10): e0259319. https://doi.org/10.1371/journal.pone.0259319, 2021