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A Study on Extent of Utilization of Information and Communication Technology (Ict) among Farmers in Tirupathur District, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The growing complexity of agrarian challenges in India has exceeded the capacity of traditional public extension services, challenging the integration of Information and Communication Technology (ICT) to ground the knowledge gap. This study explores the extent of utilization of ICT tools among farmers in Tirupathur district of Tamil Nadu. A study was conducted across 10 villages using a proportionate random sampling method, with data collected from 120 respondents through a structured interview schedule. Findings indicates that major ICT tools included Television, Mobile phones, Agrisnet, TNAU AGRITECH portal, Paddy expert system, IFFCO Kisan, YouTube and WhatsApp which exhibited high engagement. Conversely, minor tools such as e-agricultural magazines, e-Krishi Kendra, AGMARKNET, Telegram and Twitter showed minimal usage

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highlighting the need for improved digital literacy and targeted awareness campaigns to enhance the adoption of underutilized ICT tools for effective knowledge dissemination in rural communities. Analyzing 13 personal, socio-economic, cognitive, behavioral, and skill-related factors that revealed farm size, information seeking behaviour, ownership of ICT gadgets, social participation and social media usage exhibit very strong positive correlations with ICT adoption, while occupational status shows a strong negative correlation underscoring the need for targeted interventions to improve digital engagement in agriculture and Education showed a very weak and non-significant relationship with ICT usage, indicating that formal education alone does not significantly influence the extent of ICT utilization among respondents. This study sheds light on the transformative eventuality of ICT in ultramodern extension services and its critical part in strengthening pastoral agrarian knowledge dispersion.

Keywords: ICT; agriculture; extent of utilization; farmers; ICT platforms.

1. INTRODUCTION

The agriculture is still the main stay of Indian economy with a share of about 17% in both National GDP and work force over half (World Bank, 2023). But even today, agriculture in India continues to suffer from innumerable problems like small and fragmented landholdings, lack of knowledge about modern agriculture technologies, poor market access and the like. These, in turn, have resulted in stagnating productivity and greater susceptibility, notably to smaller and marginal farmers. The growing importance of ICT for agricultural development with the advancement of digital technologies, the use of ICT has assumed a transformative role in agricultural development. ICTs—mobile phones, internet services, radio, television, and most recently artificial intelligence and data-empowered platforms—have the ability to transform information outreach, empower farmer choice making, and bridge the rural-urban divide.

ICT adoption and successful application in agriculture varies by location and community, despite its promise. Small and marginal farmers in India, who cultivate less than two hectares of land, own more than 81% of operational holdings (Government of India, 2020).

Determining the level of ICT use is crucial in areas like Tirupathur, where agriculture is a major source of rural livelihoods, in order to spot gaps and adjust extension tactics appropriately. This study examines the socioeconomic and behavioral aspects impacting adoption as well as the extent of ICT use among farmers in the Tirupathur district. It also seeks to clarify how beneficial ICTs are seen to be when making farming decisions. The research's conclusions will be useful to technology suppliers, agricultural extension programs, legislators and policy makers.

2. MATERIALS AND METHODS

2.1 Study Area and Sample Selection

The purpose of this study is to evaluate how much farmers in Tamil Nadu's Tirupathur district use information and communication technology (ICT). Ten villages in the Tirupathur block are the subject of the study, these were chosen for their agricultural activities and ease of access to ICT services. To provide varied representation from a range of farm sizes and socioeconomic backgrounds, 120 respondents were chosen using the proportionate random sampling technique.

2.2 Selection of Variables

The following factors were chosen to examine their effects on farmer's use of ICT based on expert assessment and research relevance:

- **Personal and Socio-Economic Variables:** Age, educational status, occupational status, farm size, farming experience, and annual income.
- **Cognitive and Behavioral Variables:** Digital literacy, information-seeking behavior, ownership of ICT gadgets, social participation, innovativeness, and social media usage.
- **Skill and Knowledge Variables:** Training undergone on ICT.

2.3 Data Collection

The chosen farmer's primary data was gathered using a pre-tested interview schedule. The interview approach was chosen because it

allowed for direct communication and guaranteed replies that were accurate and clear. Based on the multidimensional approach, questions were formulated.

2.4 Data Processing and Analysis

Using the proper statistical methods, the gathered data was scored, tabulated, classified, and examined. Percentage analysis, frequency analysis, correlation, and multiple linear regression were used to evaluate the extent of utilization, enabling comparison of farmer's extent of use. To determine the main elements impacting the integration of digital technologies in agriculture, relationships between the degree of ICT use and a few chosen variables were also investigated.

3. RESULTS AND DISCUSSION

3.1 Distribution of Respondents according to Their Regressor Variables

3.1.1 Age

The distribution of respondents by age revealed that a majority (65%) belonged to the middle-aged group (36-45 years), followed by older respondents (25%) and younger respondents (10%). This indicates that the primary decision-makers in farming activities were predominantly middle-aged individuals, likely contributing to their extensive experience and established practices.

3.1.2 Educational status

Educational attainment varied significantly, with the highest proportion (29.16%) having higher secondary education, while 24.19% had collegiate education. A notable portion (13.33%) were illiterate. This educational disparity may impact their capacity to adopt modern agricultural technologies and practices.

3.1.3 Occupational status

The data showed that 78.33% of respondents were engaged in agriculture as their primary occupation, reflecting the region's agrarian economy. The remaining 21.67% considered agriculture as their secondary occupation, possibly supplementing other income sources.

3.1.4 Farm size

The majority (65%) were small farmers, indicating the prevalence of small-scale farming systems. Marginal farmers constituted 11.66%, while 23.34% were big farmers, underscoring the challenges smaller landholders may face in resource mobilization and sustainability.

3.1.5 Farming experience

Most respondents had medium (45%) or low (40.83%) experience, while only 14.17% had extensive experience (>20 years). This suggests that a significant portion of the population may still be developing advanced farming skills.

3.1.6 Digital literacy

Digital literacy was moderate for 37.5% of respondents, while 35% reported low literacy and 27.5% had high literacy. This suggests a need for targeted digital training initiatives to enhance farmers' technological capabilities, similar to approaches used in education where technology-enhanced learning has improved student engagement (Lewohl, 2023)." Similar patterns of digital skill development have been observed in the education sector, where foreign language teachers improved their competencies through the adoption of modern technologies (Biletska et al., 2021).

3.1.7 Annual income

Nearly half (46.66%) had low income, followed by 41.67% in the medium-income category and only 11.67% reporting high income. This income disparity highlights potential financial constraints in adopting advanced agricultural practices.

3.1.8 Information seeking behaviour

A significant proportion (45%) exhibited medium information-seeking behavior, while 34.17% showed high engagement. This suggests a positive inclination towards exploring new agricultural methods, echoing research that emphasizes communication development as a critical skill for knowledge acquisition and self-learning (Utkerovna, 2023)." The ability of individuals to regulate their own learning plays a critical role in technology adoption, as supported by findings in educational research on self-regulated learning in digital environments (Junaštíková, 2023).

3.1.9 Ownership of ICT gadgets

Mobile phones/smartphones were the most common ICT gadgets (35.83%), followed by televisions (27.5%). Limited ownership of computers/laptops (6.66%) suggests barriers to accessing advanced digital platforms.

3.1.10 Social participation

More than half (53.33%) exhibited medium social participation, while 25% had low participation. Enhanced social involvement could potentially improve knowledge exchange and adoption of new technologies, as seen in collaborative learning contexts that emphasize interpersonal development (Priyambodo & Wilujeng, 2023)." Similar to how collaborative communication positively affects student satisfaction and engagement in educational contexts (Estriegana et al., 2024), fostering strong social networks among farmers can enhance ICT adoption and learning in agriculture.

Table 1. Distribution of respondents according to their regressor variables

(N=120)

S.No	Category	Number of respondents	Per cent
Distribution of respondents according to their age			
1.	Young (Up to 35 years)	12	10.00
2.	Middle (36-45 years)	78	65.00
3.	Old (above 45 years)	30	25.00
Distribution of respondents according to their educational status			
1.	Illiterate	16	13.33
2.	Primary education	10	8.33
3.	Middle school education	16	13.33
4.	Secondary school education	14	11.66
5.	Higher secondary school education	35	29.16
6.	Collegiate education	29	24.19
Distribution of respondents according to their occupational status			
1.	Agriculture as primary occupation	94	78.33
2.	Agriculture as secondary occupation	26	21.67
Distribution of respondents according to their farm size			
1.	Marginal farmers(< 2.5 acres)	14	11.66
2.	Small farmers(2.51 to 5 acres)	78	65.00
3.	Big farmers(> 5 acres)	28	23.34
Distribution of respondents according to their farming experience			
1.	Low (<10 years)	49	40.83
2.	Medium (10-20 years)	54	45.00
3.	High (>20 years)	17	14.17
Distribution of respondents according to their digital literacy			
1.	Low	42	35.00
2.	Medium	45	37.50
3.	High	33	27.50
Distribution of respondents according to their annual income			
1.	Low	56	46.66
2.	Medium	50	41.67
3.	High	14	11.67
Distribution of respondents according to their information seeking behaviour			
1.	Low	25	20.83
2.	Medium	54	45.00
3.	High	41	34.17
Distribution of respondents according to Ownership of ICT gadgets			
1.	Computer/Laptops	08	6.66
2.	Mobilephones/Smartphones	43	35.83
3.	Television	33	27.50
4.	Radio	25	20.83
5.	Pendrive	11	9.18
Distribution of respondents according to their social participation			
1.	Low	30	25.00

S.No	Category	Number of respondents	Per cent
2.	Medium	64	53.33
3.	High	26	21.67
Distribution of respondents according to their innovativeness			
1.	As soon as a new technology is introduced	48	40.00
2.	After seeing the farmers have done it successfully	65	54.16
3.	I prefer to wait and take my own time	7	5.84
Distribution of respondents according to their social media usage			
1.	Low	18	15.00
2.	Medium	86	71.67
3.	High	16	13.33
Distribution of respondents according to their training undergone on ICT			
1.	No training	85	70.83
2.	Attended one training	20	16.67
3.	Attended two training or more	15	12.50
	Total	120	100.00

Table 2. Distribution of respondents according to their regressed variables

(N=120)

S. No	Services	Frequently		Sometimes		Rarely		Never	
Distribution of respondents according to their Extent of utilization of ICT gadgets									
		No	%	No	%	No	%	No	%
1	Radio	42	35.00	45	37.50	21	17.5	17	14.16
2	Television	75	62.50	45	37.50	0	0.00	0	0.00
3	Mobile phone	50	41.66	41	34.16	26	21.66	8	6.66
4	Pendrive	25	20.83	12	10.00	32	26.66	32	26.66
5	e-Agricultural magazine	20	16.67	18	15.00	30	25.00	37	30.83
Distribution of respondents according to their Extent of utilization of Agricultural portals									
1	TNAU AGRITECH portal	47	39.16	31	25.83	41	34.16	22	18.33
2	AGRISNET	48	40.00	29	24.16	21	17.50	17	14.16
3	e-Krishi Kendra	0	0.00	0	0.00	48	40.00	68	56.66
4	AGMARKNET	0	0.00	0	0.00	39	32.50	76	63.33
5	IFFCO Agri portal	21	17.50	25	20.83	32	26.66	10	8.33
Distribution of respondents according to their Extent of utilization of VKC's and Telephony									
1	Village Knowledge Centres (VKCs)	30	25.00	24	20.00	35	29.16	27	22.5
2	Village Resource Centres (VRCs) –	21	17.5	25	20.83	45	37.50	24	20.00
3	Farmers Call Centre	25	20.83	8	6.66	27	22.50	59	49.16
4	Mobile Advisory Services by KVKs	27	22.5	45	37.50	24	20.00	22	18.33
Distribution of respondents according to their Extent of utilization of Mobile apps									
1	Paddy Expert System (TNAU)	49	40.83	32	26.67	28	23.33	11	9.16
2	SugarcaneExpert System Tamil (TNAU)	0	0	0	0	54	45.00	66	55.00
3.	Banana Expert System Tamil (TNAU)	0	0	13	10.83	47	39.17	60	50.00
4	Uzhavan app	47	37.50	31	25.83	23	19.17	19	15.83
5	IFFCO Kisan	45	36.67	31	26.67	26	21.66	18	15.00
6	KisanSuvidha	12	10.0	26	21.67	32	26.67	50	41.67
7.	TNAU app	45	37.50	34	28.33	29	24.17	12	10.00
8.	M-Kisan	12	10.0	26	21.67	51	42.50	31	25.83
9	Crop Insurance app	0	0.0	13	10.83	41	34.85	60	50.00
10	AgriMarket	18	15.00	11	9.17	40	33.33	51	42.50

S. No	Services	Frequently		Sometimes		Rarely		Never	
Distribution of respondents according to their Extent of utilization of social media									
1.	Youtube	50	41.67	40	33.33	17	14.16	13	10.83
2.	Whatsapp	34	28.33	40	33.33	32	26.67	14	11.67
3.	Telegram	12	10.0	28	23.33	49	40.83	31	25.83
4.	Facebook	27	22.50	44	36.67	24	20.00	25	20.83
5.	Twitter	0	0.0	0	0.0	67	55.83	53	41.67
6.	Instagram	20	16.67	11	9.17	38	31.67	51	42.50

3.1.11 Innovativeness

Only 5.84% delayed adoption, indicating a generally receptive attitude towards innovation, aligning with trends in 21st-century cognitive adaptability and creative thinking skills observed in other sectors (Nazhifah et al., 2023)." Similar to patterns observed in academic contexts, where innovation is influenced by self-efficacy and research engagement (Han et al., 2023), farmers' innovativeness in adopting ICT tools may also be shaped by their confidence and exposure to successful practices. "This is in line with studies highlighting that foundational ICT competence is crucial for building adaptive and innovative skills in the 21st century (Weber & Greiff, 2023)."

3.1.12 Social media usage

Medium social media usage dominated (71.67%), indicating that social platforms are emerging as key information channels for farmers.

3.1.13 Training on ICT

A large proportion (70.83%) had no ICT training, underscoring the need for improved access to digital learning programs.

3.2 Distribution of Respondents According to Their Regressed Variables

3.2.1 Utilization of ICT gadgets

Television (62.5%) and mobile phones (41.66%) were the most frequently used gadgets, highlighting their role in information dissemination. In contrast, tools like pendrives (20.83%) and e-agricultural magazines (16.67%) had lower adoption, indicating limited digital literacy.

3.2.2 Utilization of agricultural portals

Portals such as TNAU AGRITECH (39.16%) and AGRISNET (40%) were widely used, while e-Krishi Kendra (56.66%) and AGMARKNET (63.33%) saw minimal engagement, reflecting awareness gaps.

3.2.3 Utilization of VKCs and telephony services

Village Knowledge Centres (VKCs) had moderate usage (25%), while services like the Farmers Call Centre had low adoption (49.16% never), emphasizing the need for improved outreach.

3.2.4 Utilization of mobile apps

Popular apps like the Paddy Expert System (40.83%) and Uzhavan app (37.5%) showed strong engagement. Conversely, crop-specific apps such as the Sugarcane Expert System (55% never) had low usage, indicating limited awareness.

3.2.5 Utilization of social media

YouTube (41.67%) and WhatsApp (28.33%) were prominent, while platforms like Twitter (55.83% rarely) and Instagram (42.5% never) saw minimal engagement.

3.2.6 Key findings

The findings highlight that while several socio-economic and behavioral factors correlate with ICT utilization, social media usage emerges as the most significant predictor. This emphasizes its crucial role in modern agricultural practices by enhancing information access, knowledge sharing, and technology adoption. Additionally, improving digital literacy, encouraging social participation, and expanding ICT training can further strengthen ICT adoption.

1. **Extent and Patterns of ICT Utilization**

The findings show that television (62.5%) and mobile phones (41.66%) remain the most frequently used ICT tools—reflecting their established relevance and accessibility in rural contexts. Similarly, a study by Singh

(2023) found that mobile phones were the most frequently used ICT tool among farmers in Haridwar district, while usage and awareness of advanced technologies like GPS and drones remained relatively low. Measuring the effectiveness of such emerging technologies is essential for planning and implementation, as highlighted in broader educational studies (Cukurova & Luckin, 2018).

Table 3. Correlation of characteristics of the respondents with their extent of utilization of ICT services

(N=120)

-	p-	Pearson's r	(R^2)	Correlation strength
Age	<0.001	0.589***	0.347	Strong
Education	0.191	-0.120	0.014	Very weak
Occupational Status	<0.001	-0.663***	0.439	Strong (Negative)
Farm Size	<0.001	0.809***	0.655	Very Strong
Farming Experience	<0.001	0.746***	0.557	Strong
Digital Literacy	<0.001	0.707***	0.500	Strong
Annual Income	<0.001	0.727***	0.529	Strong
Information Seeking Behaviour	<0.001	0.777***	0.604	Very Strong
Ownership of ICT Gadgets	<0.001	0.771***	0.595	Very Strong
Social Participation	<0.001	0.824***	0.679	Very Strong
Innovativeness	<0.001	0.667***	0.445	Strong
Social Media Usage	<0.001	0.946***	0.895	Very Strong
Training Undergone on ICT	<0.001	0.714***	0.510	Strong

** (Single asterisk) → p < 0.05 (Significant)*
*** (Double asterisk) → p < 0.01 (Moderately significant)*
**** (Triple asterisk) → p < 0.001 (Highly significant)*

Table 4. Multiple regression analysis of contribution of characteristics towards their extent of utilization of ICT services

Model Fit Measures							
				Overall Model Test			
Model	R	R^2	Adjusted R^2	F	df1	df2	p
1	0.958	0.919	0.909	92.1	13	106	<.001

Note: Models estimated using sample size of N=120

Table 5. Model Coefficients - Extent of Utilization of ICT

Predictor	Estimate	SE	t	p	Stand. Estimate
Intercept	0.45795	0.32573	1.4059	0.163	
Age	-0.00621	0.00345	-1.7996	0.075	-0.10577
Education	-0.00905	0.02945	-0.3072	0.759	-0.02748
Occupation status	-0.12622	0.12184	-1.0360	0.303	-0.09245
Farm size	0.08370	0.09054	0.9245	0.357	0.08790
Farming experience	-0.01164	0.10817	-0.1076	0.914	-0.01373
Digital literacy	-0.00332	0.07181	-0.0462	0.963	-0.00468
Annual income	-0.01263	0.07441	-0.1697	0.866	-0.01524
Information seeking behaviour	0.10566	0.06831	1.5468	0.125	0.13704
Ownership of ict gadgets	-0.01043	0.06077	-0.1716	0.864	-0.02023
Social participation	0.11328	0.07742	1.4632	0.146	0.13742
Innovativeness	0.01689	0.08387	0.2014	0.841	0.01755
Social media usage	0.78612	0.07953	9.8847	<.001	0.74356
Training undergone on ICT	-0.05517	0.10511	-0.5249	0.601	-0.06888

Modern digital tools such as the AGMARKNET portal (63.33% never used), e-Krishi Kendra (56.66% never used), and specific mobile apps like the Banana Expert System and Crop Insurance App (50% non-usage) exhibited minimal adoption. This pattern mirrors broader national trends where farmers face barriers like lack of training, awareness, and perceived complexity (Kumar & Alamgir, 2024).

Social media platforms—YouTube (41.67%) and WhatsApp (28.33%)—showed the highest frequent usage among respondents. In Uttarakhand, research found that younger and more educated farmers used social media more actively, whereas older farmers faced notable constraints such as low digital literacy and lack of awareness of useful platforms (Malik & Ansari, 2024). Similarly, a Telangana study reported that 78% of farmers used messaging platforms like WhatsApp and 61.7% accessed YouTube and Twitter for agriculture-related information (MadhuShekar et al., 2023).

2. Determinants of ICT Utilization

The correlation analysis identified social media usage ($r = 0.946$, $R^2 = 0.895$) as the strongest predictor of ICT engagement. Other strong correlates included social participation ($r = 0.824$), information-seeking behavior ($r = 0.777$), ICT gadget ownership ($r = 0.771$), digital literacy ($r = 0.707$), annual income ($r = 0.727$), and farming experience ($r = 0.746$).

These results align with findings from Telangana and Uttarakhand studies that confirm positive associations between education, digital literacy, social participation, and social media engagement (MadhuShekar et al., 2023; Malik & Ansari, 2024; Shehrawat et al., 2024). MadhuShekar et al. (2023) emphasized that education, income, and social orientation significantly influence social media use among farmers, although age and farming experience showed negative associations. In the Uttarakhand study, older farmers and those with lower digital literacy faced significant hurdles in adopting social media for agricultural information (Malik & Ansari, 2024).

3. Predictive Power of Variables

The multiple regression model—explaining 91.9% ($R^2 = 0.919$) of variance in ICT utilization—found social media usage ($\beta = 0.743$, $p < 0.001$) as the only statistically significant predictor. This reflects similar observations in global ICT-extension literature indicating social media as central to digital information pathways in rural agriculture (Mukherjee et al., 2025).

Other variables like education, income, occupation, and digital literacy lost statistical significance in the multivariate model, likely due to inter-relations among predictors or mediation by social media engagement—suggesting it functions as a gateway for using digital tools. The Uttarakhand study underlined the mediating role of digital literacy and information-seeking behavior in enabling social media adoption (Malik & Ansari, 2024).

4. CONCLUSION

The study enhances the significant role of Information and Communication Technology (ICT) in enhancing agricultural extension services and improving farmer's knowledge, decision-making, and productivity. Similar to its documented effects in educational settings, ICT integration in agriculture can enhance learning, engagement, and outcomes among rural populations (Toma et al., 2023)." Similar impacts of emerging technologies on knowledge and skill development have also been observed in the education sector, notably among K12 students in the Philippines (Dublar, 2023), reinforcing the transformative potential of ICT when effectively integrated. The findings reveal that socio-economic variables such as education level, digital literacy, social participation, and information-seeking behaviour significantly influence ICT adoption among farmers. While platforms like YouTube, WhatsApp, and Facebook are widely used for agricultural information, the adoption of advanced digital tools such as e-agricultural magazines, crop insurance apps, and Kisan Suvidha remains limited, highlighting a crucial awareness gap. Educational technologies have shown potential not only in technical skills development but also in improving communication competencies, such as public speaking (Ivanova et al., 2020), which can be critical when farmers engage in knowledge sharing within communities or extension events.

Key barriers to ICT adoption include limited access to digital gadgets like computers and low participation in ICT training programs. The prevalence of small-scale farming systems and financial constraints further impede farmer's ability to leverage digital advancements

effectively. To address these challenges, targeted interventions such as enhanced ICT training, improved digital infrastructure, and customized information services are essential. Aligning with Education 4.0 principles, equipping farmers with 21st-century digital skills is vital for adapting to the evolving demands of agriculture and sustainability (González-Pérez & Ramírez-Montoya, 2022).

Policymakers, extension organizations, and agricultural stakeholders must collaborate to design inclusive and farmer-centric digital solutions that pave way to diverse socio-economic profiles. Amponsah (2022) found a significant impact of internet usage on students' success in Ghana, emphasizing how digital access enhances learning outcomes even in non-agricultural contexts. Such evidence supports the argument that improving internet access in rural areas can have parallel benefits in agricultural education and extension.

In conclusion, strengthening ICT integration in agriculture is vital for empowering farmers in Tirupathur district to overcome socio-economic challenges, increase productivity, and achieving integrated development and holistic approach.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

During the preparation of this work, the author used ChatGPT (developed by OpenAI), Scholarly AI, and Review Management AI in order to assist with formatting references, managing the review process, and improving language clarity. After using these tools, the author reviewed and edited the content as needed and takes full responsibility for the content of the publication.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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