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Barriers in adoption of social and digital media in agriculture: A multivariate analysis with policy insights from U.T. of Puducherry

¹Parthasarathi S, ²Pouchepparadjou A, ³Hemavathi M, ⁴Umamageswari M and ⁴Sivasakthi Devi T

¹Professor (Agricultural Extension) & Head, Department of Agricultural Economics and Extension, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal (U.T. of Puducherry), Puducherry, India

²Professor (Agricultural Economics), Department of Agricultural Economics and Extension, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal (U.T. of Puducherry), Puducherry, India

³Assistant Professor (Agricultural Statistics), Department of Agricultural Economics and Extension, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal (U.T. of Puducherry), Puducherry, India

⁴Assistant Professor (Agricultural Economics), Department of Agricultural Economics and Extension, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal (U.T. of Puducherry), Puducherry, India

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Corresponding Author: Umamageswari M

Abstract

The increasing adoption of Information and Communication Technology (ICTs) has transformed agricultural extension by improving timely access to the information through social and digital media platforms. However their effective utilization remains limited, particularly with small farmers. The research aims to analyse the barriers in accessing social and digital media from the farmers of Union Territory of Puducherry including 17 revenue villages, covering 275 farmers across all categories (Small, medium and large) selected through proportionate random sampling and suggesting policy recommendation for effective utilization. Constraints were grouped into socio-economic, knowledge/skill and technical categories and analysed using Garrett's ranking technique, Spearman correlation and principal component analysis (PCA). The result revealed that high cost of ICT tools, inadequate infrastructure, poor network connectivity, and lack of digital literacy were major barriers in adoption of social and digital media in agriculture. Further, identifying the more relevant and reliable content was emerged as most critical constraints across all category of farmers. Correlation analysis indicated strong interrelationships among constraints, specifically related to quality information and technical issues. PCA results showed there was no significant perceptual differences among small, medium and large farmers indicating the need for communication intervention strategies. Farmers suggested the provision of information in regional knowledge, affordable ICT devices, and conducting training programmes to enhance the effective usage of social and digital media. Providing validated digital advisory system can increase the agricultural productivity and rural livelihoods.

Keywords: Social and digital media, information communication technology, Principal Component Analysis (PCA)

Introduction

The adoption of Information and communication technologies (ICT) has opened new opportunities and ways for strengthening the dissemination of agricultural information and extension services. Social and digital media platforms such as mobile apps, Social networking websites, video sharing platforms, and web based advisory portals provide remarkable contribution in enhancing farmers' access to timely and location specific information on crop management, weather forecasts, pest and disease control, market prices, and government support programmes (Aker, 2011; World bank 2019) ^[1, 17]. These platforms are enhancing traditional extension systems, facilitate interactive and economical communication, promoting farm level decision making system with more specific information. Despite the huge transformation and enormous benefits, the adoption and effective use of these social and digital media in agriculture remain uneven and constrained, particularly the marginal and small farmers. Inadequate

rural digital infrastructure, unreliable internet connectivity, high cost of smartphones and data services and low levels digital literacy are continued as structural barriers which limit the farmers' engagement in these platforms (Mittal & Mehar, 2016; Rao, 2018) ^[10, 11]. Farmer specific characteristics such as age, education, income, gender and farm size are meant to be socio economic barriers which further influence the likelihood of adopting digital media tools for agricultural purposes (Mittal, Gandhi and Tripathi, 2010) ^[9]. In addition to the access related challenges, the issues related to the reliability, applicability and quality of digital information also pose certain limitations while adopting these platforms. The content which are unauthenticated, properly not verified, lack of evaluating or assessing the agricultural information mislead the farmers' decision and it negatively impact which erode the farmers' trust on digital information (Kietzmann *et al.*, 2011; Klerkx, Jakku & Labarthe, 2019) ^[6, 7]. The other parameters like language barriers, insufficient localization of content, and

limited alignment with farmers' agro-ecological and socio-cultural contexts further reduce the usefulness of digital information services (Faure *et al.*, 2018) [3]. From a policy perspective, removing these obstacles is essential to promoting inclusive and equitable digital transformation in agriculture. Policy interventions are required to facilitate the creation of localised and farmer-centric digital content, improve the digital literacy among farmers and extension staff, expand rural infrastructure and promote public private partnerships in digital extension (Swanson & Rajalahti, 2010; World Bank, 2019) [13, 17]. With this backdrop, the present article analyses the key barriers to the adoption of social and digital media in agriculture and discusses policy interventions aimed at addressing these constraints. By drawing empirical evidences, the research aims to give insights for policymakers, extension organizations and development practitioners to create inclusive and sustainable strategies that enhances the reach and impact of agricultural information services.

Methodology

The research was conducted in the union territory of Puducherry, which comprises four regions Puducherry, Karaikal districts along with Mahe and Yanam regions. The 17 revenue villages were selected with the help of Uzhavar Udaviyagam [Farmers Help Centers (FHC)]. Accordingly, out of 21 FHCs available in Puducherry district, 10 FHCs/villages were selected. In the case of Karaikal district, among 10 FHCs available 6 FHCs were selected for the study. Since, Mahe and Yanam regions were very small only one FHC was available in each region and it was studied as a whole. The list of farmers was collected from 18 Farmer Help Centers of the selected villages to ensure equal spatial distribution and diversity of crops included revenue villages Karayamputute, thirukanoor, Madagadipet, P.S. Palayam, Karikalampakkam, Kariyamanikkam, Ariyankuppam, Ketterikuppam, Seliyamedu and Thavalakuppam from Puducherry district; Kottucherry, Nedungadu, Ambagarathur, Surakudy, Vizhithiyur, and Thirunallar from Karaikal district; along with rural areas of Mahe and Yanam regions. A sample size of 275 farmers were considered from the selected villages by following proportionate random sampling method with due consideration of 75 farmers from three categories viz. Small, medium and large farmers.

Analytical tool

The purpose of using social and digital media and suggestions for better utilisation were prioritized using *Garrett's ranking technique*. This technique was applied to

know the major reasons for utilizing these media and how better these can be used to create impact over them. To study the constraints faced by the farmers in accessing social and digital media, 17 constraints were framed and grouped into three groups as socio-economic constraints, knowledge/skill constraints and technical constraints. The responses of the respondents about the constraints faced by them were collected on a three point continuum namely most severe, severe and least severe with a score of 3, 2 and 1 respectively. The farmers assigned the score based on the severity of constraints experiencing in usage of social and digital media. The scoring of one constraints may related with other constraints. *Spearman correlation analysis* is used to study is the severity of one constraints is interrelated with other constraints and to ascertain the degree of inter-association among 17 identified constraints. A Multivariate technique, Principle Component Analysis (PCA) is used to identify the constraints that are similarly scored by different category of farmers. The PCA Biplot is used to depict the group of constraints which explains the most variation among the farmer category. Spearman correlation analysis and Principle Component Analysis (PCA) were analysed using open source R studio.

Results

Constraints in accessing social and digital media

Socio - economic constraints in accessing social and digital media

The socio-economic constraints expressed by the farmers were tabulated and presented in the following table 1. It could be inferred from the above table that with respect to cost constraints majority of small farmers (54.66%) expressed it was most serious, medium farmers expressed it as serious constraint to the tune of 34.66% and in the case of large farmers it was least serious as expressed by 45.33%. Due to higher price of various gadgets such as smart phone, computers, internet services, recharge etc might have been influenced small farmer to a greater extent in accessing social and digital media. Diversion of work was the most serious constraint for the small (66.66%) and large farmers (41.33%). These categories of farmers were performing more of physical work, hence use of social and digital media was definitely a diversion for them. Irrespective of categories of farmers, all the respondents were expressed inadequacy of ICT tools was the most serious constraint. It might be due to the cost of gadgets, problem in updating the tools, insufficient storage capacity and poor speed of gadgets which prevented them in using ICT gadgets to the desirable extent.

Table 1: Distribution of respondents according to their socio-economic constraints (SEC)

Sl. No.	Constraints	Small Farmer (n=75)			Medium Farmer (n=75)			Large Farmer (n=75)		
		Most serious	Serious	Least serious	Most serious	Serious	Least serious	Most serious	Serious	Least serious
SEC1	Cost	54.6	26.6	18.6	32.0	34.6	33.3	13.3	41.3	45.3
SEC2	Waste of time	29.3	36.0	34.6	20.0	24.0	56.0	34.6	30.6	34.6
SEC3	Diversion of work	66.6	28.0	5.3	25.3	33.3	41.3	32.0	41.3	26.6
SEC4	Inadequacy of tools	61.3	28.0	10.6	49.3	37.3	13.3	54.6	38.6	9.3
SEC5	Social Inhibition	58.0	3.3	38.6	20.0	12.0	68.0	37.3	24.0	38.6

Knowledge/Skill constraints in accessing Social and Digital Media

The Knowledge/Skill level constraints were tabulated and

presented in the following table 2 and it could be inferred that, difficulty in finding relevant information was the most serious problem expressed by all the category of farmers. In

the case of small farmer their serious problems includes inadequate technical knowledge and skill (61.33%), difficulty in understanding of the message (52.00%) posted in the media. In most of the case the language of message, difficulty in handling the gadget, unable to copeup with new

information, readability of the content, lengthiness of content and non-credible source of information were the prohibitory reasons for such an poor impact in technological/knowledge utlilation in social and digital media.

Table 2: Distribution of respondents according to their Knowledge/Skill constraints (KSC)

SI. No.	Constraints	Small Farmer (n=75)			Medium Farmer (n=75)			Large Farmer (n=75)		
		Most serious	Serious	Least serious	Most serious	Serious	Least serious	Most serious	Serious	Least serious
KSC1	Difficulty in understanding	52.0	32.0	16.0	48.0	37.3	14.6	38.6	38.6	12.6
KSC2	Difficulty in handling	49.3	36.0	14.6	50.6	33.3	16.0	46.6	24.6	28.6
KSC3	Difficulty to find relevant information	66.6	28.0	5.3	57.3	36.0	6.6	62.6	29.3	8.0
KSC4	Inadequate technical knowledge/skill	61.3	28.0	10.6	46.6	42.6	10.6	54.6	38.6	6.6

Technical constraints in accessing social and digital Media

The technical constraints were tabulated and presented in the following table 3 and concludes that network coverage was the most serious problem faced by majority of small (42.66%) and medium (37.33%) farmers. The small and medium farmers opined inadequate service by the service providers (66.66% & 56.00%), unsuitable and incomprehensive information (60.00%& 52.00%) were the

major constraints experienced by them. Whereas, irrelevant information (58.66%) and inadequate response (57.33%) were the major constraints experienced by the large farmers. The poor network, outdated gadgets, posting of many messages from various sources, unwanted or irrelevant messages were the factors which reduce the focus of messages from these media, hence the constraints are expressed by the farmers.

Table 3: Distribution of respondents according to their Technical Constraints (TC)

SI. No.	Constraints	Small Farmer (n=75)			Medium Farmer (n=75)			Large Farmer (n=75)		
		Most serious	Serious	Least serious	Most serious	Serious	Least serious	Most serious	Serious	Least serious
TC1	Network coverage	42.66	41.33	16.00	37.33	30.66	32.00	24.00	36.00	40.00
TC2	Unreliable sources of information	41.33	41.33	17.33	37.33	46.66	16.00	50.66	36.00	13.33
TC3	Irrelevant information	48.00	41.33	10.66	37.33	45.33	17.33	58.66	32.00	9.33
TC4	Inadequate information	49.33	40.00	10.66	45.33	36.00	18.66	52.00	38.66	9.33
TC5	Inadequate service	66.66	28.00	5.33	56.00	37.33	6.66	41.33	45.33	13.33
TC6	Unsuitable and incomprehensible information	60.00	28.00	12.00	52.00	34.66	13.33	54.66	36.00	9.33
TC7	Inadequate response	56.00	30.66	13.33	50.66	36.00	13.33	57.33	34.66	8.00

Spearman correlation Analysis between constraints

To identify the constraints bundles that act as root cause in usage of social and digital media spearman correlation analysis was used. The correlation heatmap of constraints scoring are shown in Fig.1. The heatmap shows, there was very strong positive correlation between TC3 and TC2 ($r=0.83$), TC3 and TC4 ($r=0.82$), TC6 and TC7 ($r=0.84$) which depicts the farmers finds unreliable sources of information (TC3) to be a most severe constraints also certainly finds irrelevant (TC2) and inadequate information (TC4) as equally severe. Similarly with the constraints unsuitable and incomprehensible information (TC6) and Inadequate response (TC7) were interrater. These correlation suggest, these five constraints need to be addressed as in bundle instead of considering as separate issue. The constraint SEC2 and SEC3 shows strong correlation ($r=0.75$) indicated the farmers who had diversion of work feels the usage of social and digital media as waste of time.

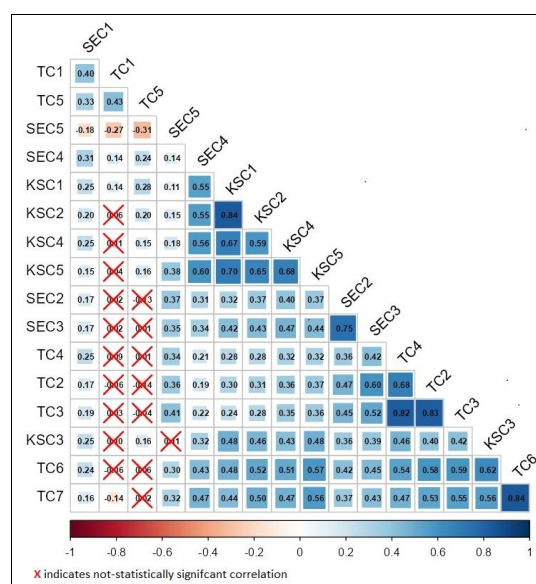


Fig 1: Correlation heatmap of farmers score with constraints.

The another bundle of constraints involving KSC1, KSC2, KSC4 and KSC5 shows moderate to strong positive correlations (ranges from 0.55 to 0.84) which represents the knowledge gap. The farmers who feels difficulty in understanding (KSC1) also feels difficult in handling social and digital media (KSC2). The farmers who has digital illiteracy (KSC5) also face inadequate technical knowledge/skills as more severe constraints. These bundle of constraints shows, the technical knowledge is not reaching the farmers effectively which suggest extension service must disseminate technical knowledge which is a key among farmers community in this AI era. In contrast, SEC5 shows weak negative correlation with SEC1 (cost), TC1 (Network coverage) and TC5 (Inadequate service, speed) which implies farmers who faces economic and technical barrier (high cost, poor network) do not see social media as having less social value. The farmer who face struggle with access may actually feel the importance of sharing and gaining information through social and digital media platform as high.

Principle Component Analysis (PCA)

The result of spearman correlation analysis (Fig 2) depicts the most of the constraints were interrelated with one another among the farmers category. The most similar constraints scored by different farmer category are identified using PCA. It is technique which reduced the 17 constraints into few principle components that explains the most variation among the farmers group. The PCA biplot (Fig.2) depicts, the first two principle component explains 55.6% of the total variation (PC1 is 41.3% and PC2 is 14.3%). The three ellipse of farmer category are almost overlap which clearly shows there is no perceptual gap between marginal, small and large farmers. The overlap ellipse showed the regardless of size of land holdings, farmers generally perceive and score the constraints in a very similar manner. This suggest the technical and knowledge support and policy intervention need not to be addressed differently for different farmers group. Therefore a common technical and knowledge training can be framed to address all the farmers. The constraints are grouped into three distinct groups based on the direction of arrows (Fig.2). Cluster I has the constraints KSC1, KSC2, KSC4, KSC5, SEC4 and SEC1 are highly correlated and inter-associated with one another which implies the farmers who struggle with socio-economic constraint (inadequacy of tools and usage cost) also gets struggle with knowledge/skill constraints such as difficulty in understanding, handling, Inadequate technical knowledge/ skill and digital illiteracy. The Cluster II involves TC2, TC3, TC4, SEC2, SEC3 and SEC5 which all farmers score in similar manner on the technical constraints and socio economic constraints. The inadequate service (TC5) and network coverage (TC1) are pointing in different direction indicates the severity of this constraints is scored by the farmers considering it as independent problem.

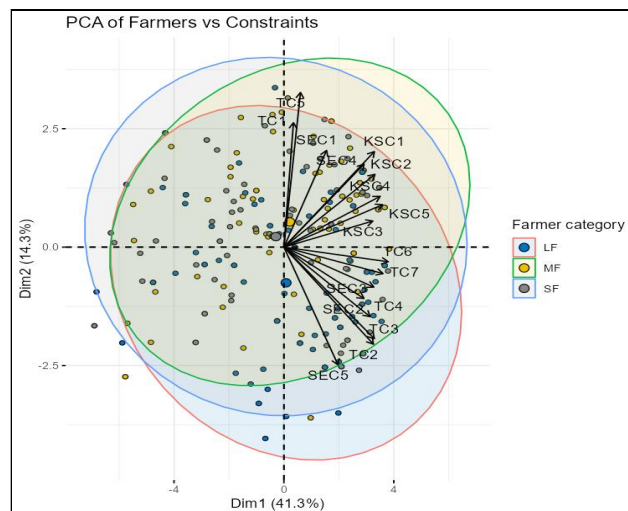


Fig 2: The Biplot of Principle Component Analysis of farmers score and constraints

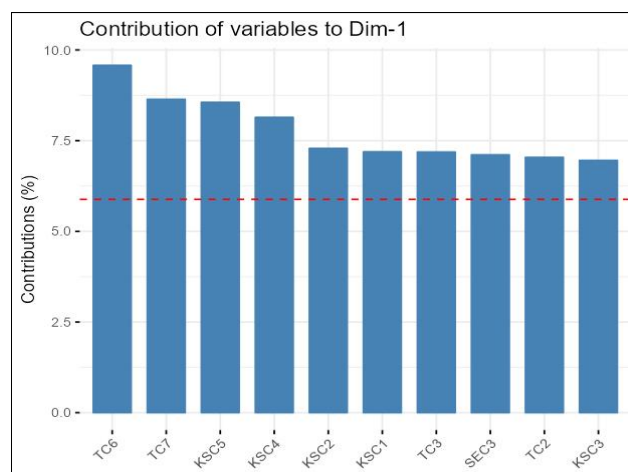


Fig 3: Constraints contribution Plot

The constraint contribution plot (Fig 3) shows the top 10 constraints that cause variation among the farmers that contributes to first Principle component (PC1) and all the constraints above the redline indicates all the constraints are statistically significant. The Unsuitable and incomprehensible information (TC6) and inadequate response (TC7) are the two most influential constraints contributing nearly 10% and 8.8% respectively to PC1 followed by group of Knowledge/skill constraints viz., digital illiteracy (KSC5), inadequate technical knowledge/skill (KSC4), difficulty in handling (KSC2), difficulty in understanding (KSC1). This suggest that, technical (TC6, TC7) and Knowledge constraints (KSC5, KSC4, KSC2, KSC1) are the primary factors that distinguish farmers in perceiving the social and digital media usage followed. Therefore knowledge and technical gap are the fundamental component that need to address for the farmers struggle in usage of social and digital media. The formation of programmes, training, extension service

that reduce the information gap will increase the usage of social and digital media.

Suggestions for better utilization of social and digital media

The suggestions given by farmers were tabulated and presented in the table 4 and it could be concluded that, content in regional language was given first by medium farmers (65.33%) and large farmers (58.66%) whereas cost effective ICT gadgets expressed as first suggestion by small farmers (50.66%). The training in how to use the social and digital media was ranked second by medium farmers whereas, exclusive TV channel for agricultural technology and allied activities was the suggestion given by small

farmers (53.33%) and big farmers (54.66%).

If the contents were in regional language the readers get enthused and read/watch and thus understand the intended meaning of the content. The cost of gadgets also plays a major role in access of social media. The higher the cost the more will be clarity, storage, speed which are not affordable by the resource poor farmers. These parameters are vital for social and digital media usage. Training in social and digital media is need of the hour. Even though, the farmers can learn the application of gadgets by themselves, the appropriate use can be recaped only they trained in aspects like developing content, inculcating responsibility among the users, sharing, taking photos and videos, attending conference calls etc.

Table 4: Distribution of respondents according to their suggestions towards better utilizing social and digital media

Suggestions	Small farmers (n=75)		Medium farmers (n=75)		Large Farmers (n=75)	
	Percent	Rank	Percent	Rank	Percent	Rank
User-friendly ICT tools	40.00	IV	32.00	V	41.33	V
Training in social and digital media usage	49.33	II	42.66	IV	46.66	IV
Exclusive channel for agricultural technology and allied activities	45.33	III	53.33	II	54.66	II
Content in regional language	65.33	I	50.66	III	58.66	I
Effective network coverage	28.00	VI	30.66	VI	25.33	VI
Cost effective ICT gadgets to access information	40.00	V	54.66	I	50.66	III

Conclusion

Despite social and digital media have emerged as powerful tools for disseminating agricultural information, their effective utilization among farmers remains constrained by multiple interrelated factors. The most critical barrier faced by all categories of farmers in the study area was identifying relevant and need based information. It reflects the issue of information overload and lack of content filtering mechanisms in digital platforms, which reduces their practical utility of social and digital media in farm decision making. Further, the research identified inadequate technical knowledge, difficult in understanding the messages, and challenges in handling digital devices were the major issues under the category of technical and cognitive constraints. These findings were consistent with the earlier studies emphasizing the role of digital literacy and user capability in determining technology adoption. The study identified poor network connectivity, inadequate service provision, and use of outdated low quality digital devices were limitations under infrastructure related constraints faced by the farmers. These challenges underline the persistent digital divide in rural areas, which restricts equitable digital extension services. The barriers like content related barriers like language mismatch, lack of localization and poor understanding of comprehensive information, lengthy unreliable and unrelated information led farmers in confusion state in decision making. Farmers strongly suggested that digital information should be based on their need focusing regional language content and further suggested for cost effective ICT devices and capacity building initiatives.

The research study can be concluded that while social and digital media hold immense potential to complement conventional extension system addressing key barriers related to access, affordability, literacy, content quality and institutional support. Moreover, there is a need to develop farmer centric, localized and region wise specific validated

content supported by institutional mechanism for quality assurance, achieving an inclusive and sustainable digital information in agriculture requires a holistic approach that combines technological innovation and infrastructure development. By addressing the identified barriers and implementing appropriate interventions, social and digital media can play a vital role in improving productivity, enhancing farmers' livelihoods and strengthening the overall agricultural extension systems.

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