Encouraging Kanpur's Rural Women Farmers: The Role of e-Mobile Technology in Bridging the Digital Divide

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Article

Encouraging Kanpur's Rural Women Farmers: The Role of e-Mobile Technology in Bridging the Digital Divide

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Abstract: This study looks at how well e-mobile technology empowers rural women, specifically focusing on women farmers in Kanpur, Uttar Pradesh, who work to advance agriculture. It further highlights how e-Mobile Technology becomes an asset for rural women farmers in self-sustaining farms, how they participate in the market, socializes, and finally how the rural life of the women improves economically. In addition, it looks at the aspect of sustainability and how these technologies help in practicing sustainable agriculture. The research also explains the demographic composition and its variables in terms of e-Mobile Technology by the Kanpur's rural women farmers. Information was gathered from a sample of 160 rural women farmers in Kanpur using semi-structured interviews and focus group discussions. Multiple statistical analyses, such as paired chi-square tests, t-tests and the Garratt ranking method, were employed to assess the impact of mobile technology applications on rural women's lives because this study examined several factors. The evidence indicates that e-Mobile Technology contributed positively to the enhancement of agricultural information access, enabling women farmers to participate more actively in markets and networking, which collectively leads to their empowerment. Nonetheless, the research noted remaining issues such as a huge digital divide and paramount issues of mobile technology and infrastructure in the periphery. Noto standing these constraints, the findings indicate the promise of mobile technology for closing the information wedge, increasing the participation of females in agriculture and the resultant fair agricultural growth. This research highlights the importance of implementing specific measures aimed at enhancement of digital skills and facilities to help the rural women embrace the e-mobile in agricultural practices.

Keywords: agricultural development; e-Mobile technology; mobile technology in agriculture; rural women's empowerment; sustainable agriculture development; women farmers

Introduction

The agricultural sector in India, which mainly consists of small and marginal farmers, is in dire need of several interventions aimed at improving productivity, overcoming market challenges, and incorporation of modern agriculture. In these households, women are the keystone, as in most societies they contribute highly to agriculture especially in the rural households but face social economic and or technological constraints. This is especially the case in states such as Uttar Pradesh, which is agrarian based and there is high involvement of women in agricultural production, only to marginalization in decision making and access to life enhancing resources. Though these women constitute a large labour force in the food chain, rural women in India must struggle to avail the necessary equipment needed to increase food production. The 'digital divide' is one of the core barriers where cess to tablets, smartphones, or other modern devices is nearly non-existent. E-Mobile Technology -mobile phones used to access information, markets, and services - in particular, ushered a new dawn in this regard. This is possible because of mobile phones since the women farmers can demand agricultural information, the prevailing prices in the markets, weather reports, and banking services, which have the power to enhance the agricultural sector and improve their lives on an

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economic level. Due to its agricultural background and the lifestyle of its inhabitants, Kanpur district which is one of the districts in Uttar Pradesh with rich black cotton soil and many agricultural activities, attracts the attention of mobile technology in a great extent. The black soil of Kanpur grows various crops including wheat, rice, sugarcane and green vegetables, of which many are the primary source of income for the women in the rural areas. Yet, in this region, the use of contemporary farming techniques is very low resulting in limited productivity and economic progress. Modern technological tools such as mobile applications for rural women farmers should be introduced to improve agricultural practices and pay social and economic equity as well as equality between Gender.

Even though studies worldwide have shown the benefits mobile technology brings to a good number of people, and how age or even other demographic factors contribute to mobile phone ownership and utilization among rural women farmers in Kanpur, there has been limited research in that regard. This will be the research gap this research endeavors to fill by establishing the extent to which age factors influence the use of mobile phones for agricultural practices with the aim of facilitating age-based strategies. Since the study will look at how various aged women involved in farming are able to incorporate mobile technology in their working practices, it will be beneficial in determining how best such technology can be integrated into the rural women farming undertaking in Kanpur so that the benefits are enjoyed by all.

In this research, apart from assessing the mobile technologies impact, the research will also investigate the aspects such as digital illiteracy or lack of infrastructure that impede the effective use of mobile technologies. This is because the information obtained from this study is intended to inform policy designing geared towards enhancing the role of mobile technologies in agriculture across age spectrum usage by women in India, irrespective of age. In this way, the study hopes to enhance ongoing efforts aimed at addressing the existent digital inequalities, especially in the circumstances of rural women farmers in Kanpur.

Problem Statement

It is the digital divide that is more prevalent in safe rural areas of India that enhances the challenges faced by the rural women farmers. While technology has improved most of the sectors, the sugarcane farming sector has inferior access of the technology. Most rural women do not have access to the tools due to cultural beliefs and practices. Other reasons range from lack of education, poor knowledge on the utilization of technology and the social amenities are also not available in the region. Thus, women farmers have difficulties in reaching out for essential resources and assistance that would enhance their agribusiness ventures, interaction in markets as well as the quality of life overall.

The issue of e-Mobile Technology overcoming existing limitations has hardly been documented especially for the case of rural women farmers. Although some research have targeted the use of mobile technology and its effect on the rural populace, very few have examined such tools and their implications on women in agriculture. The importance and the utilization of mobile phones in rural India increases day by day, all these, since change is bound to come; this penetrates the study of e-Mobile Technology among women farmers in Kanpur within the objectives of inclusiveness and sustainability in economic agricultural development of the region.

Literature Review

Much has been researched on the nexus between mobile technology and agricultural development in the rural context but the same on women farmers is concise. Research has shown that farmers' access to information and services, even in remote areas with little or no agricultural extension service, can be enhanced using mobile technology. For instance, farmers can receive information on weather patterns, pest control measures and the pricing of local goods and services, thereby aiding their decision-making capabilities. Such services prove to be vital to the women, who, due to prohibit social and cultural norms do not obtain formal agricultural extension services. It is from this that Udisha and Ambily Philomina (2024) argue that mobile devices in the sphere of

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agriculture can be of help to the poorest women – of course, provided there is access to appropriate mobile technology together with training support and other necessary means. Also, gender gaps can be minimized with the appropriate infrastructure so that rural women farmers do not miss out on agricultural benefits. The study then suggests policy recommendations which are intended to facilitate digital accessibility and further embed use of mobile devices for agriculture in rural areas.

Ismail and others (2023) examine the dynamics of customer ICT attraction in Klang, Selangor agriculture-based industries, published in the International Journal of Academic Research in Business and Social Sciences. Such study includes comprehensive statistics on the adoption of ICT in agriculture showing the critical aspects of ease of use, perceived usefulness, cost effectiveness and availability of the technology. Additionally, it looks at how these variables assist customer engagement and overall business performance in the agriculture industry. In today's world, the authors see ICT mainly as a means of conducting communication, marketing, and completion of tasks in a more efficient manner, therefore there is a call for developing policies and strategies geared towards digital agriculture to enhance competitiveness and sustainability.

Sani et al. (2023) investigate the effectiveness of agricultural extension services in supporting poultry farmers, focusing on areas such as training, advisory services, and the provision of relevant information. The findings indicate that while extension services have a positive impact on farmers' productivity, there are gaps in service delivery, including inadequate access to resources, poor communication, and insufficient technical support. The authors recommend improving extension services through better training for extension agents, enhanced communication strategies, and increased resource allocation to better meet the needs of poultry farmers.

In their research, Suri and Sharma (2023) delve into understanding the factors that widen the gender divide in digital access, consumption and control. These include negative socio-cultural factors; lower technological mobilization; less or no promotion of digital literacy strategies for women. The study notes that the women in this part of the world do not only face discrimination but also other structural challenges such as lack of mobility, social stereotypes and infrastructural limitations, which discourage them from engaging in the digital economy. The authors maintain that there is a need to bridge this digital gender gap for the sake of ensuring that women are empowered, and social and economic justice is realized. They suggest that effective measures should be taken towards expanding digital infrastructure, enhancing digital literacy and formulating measures to ensure women's access to technology, among other initiatives. Suri and Sharma explain digital tools usage in women gender perspectives and cultural beliefs and why such practices are dangerous for women. Finally, the research asserts that overcoming these constraints in gender inclusive economic growth will provide economic opportunities to women and will help the region to develop in a more inclusive manner.

As argued by Gevel et al. (2020), the use of citizen science allows local farmers and communities to take up the roles of data collectors, analysts, and decision makers which encourages the adoption of climate-smart agriculture. The review outlines how research and practice are two separate entities in agriculture, and that citizen science will facilitate research for specific solutions to be found in the farmers' contexts. In addition, the authors provide an insight on how combining local knowledge with scientific research will enhance agricultural productivity, resilience, and sustainability of the environment. In addition, the research benefits from the challenges of citizen science by addressing such concerns as maintaining the integrity of data produced, having skilled users on digital platforms, and coordinating such projects over wide geographical stretches. However, Gevel et al. are optimistic that with the right conditions, there is a potential for citizen science to revolutionary's agricultural research, making it inclusive of all stakeholders and the unique cultural context of its practice. Furthermore, the paper calls for the enhancement of citizen science initiatives by providing training, technology, and policy so that this approach is successfully adopted in agricultural research, leading to more productive and climate-smart agriculture systems.

In their research, Quandt et al. (2020) notes that women farmers can access such information as weather forecasts, market prices, agronomic advice and government services through mobile phones

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and tablets. Such access overcomes the disadvantages of geographical mobility of men and the few extension workers, thus enabling women to make better choices concerning their farming activities. The claim made by the authors is that farming technologies in this case mobile phones are not only useful in enhancing the efficiency in farming activities but also in increasing the agency of women by increasing their level's participation in decision-making and engaging them in income-generating activities. This in turn elevates one's economic status and social position in their society. Nevertheless, the study also points out the existence of some barriers that affect some women from taking advantages of these advances, for instance, the level of technology and the cost of mobile phones. Such factors may also inform the authors' contention that there is a need to pay attention to the issue of overcoming challenges associated with mobile phone use. In addition, the authors also recommend that resources be mobilized specifically to address the problems associated with the use of mobile phones. It will also be instrumental in alleviating the gender parity problem in agricultural productivity and promoting inclusive development that these capacity-building initiatives are extended to the most disadvantaged women.

In the journal article uploaded on Semantic Scholar by Nur-E-Alam, Ali, and Haque (2019), the authors investigate the use of cell phones as a means of agricultural information receptacle by farmers. In this perspective, the study looks at how other sectors are adapting to the new trends including but not limited to, the use of mobile phones by farmers to access vital information such as weather forecasts, market prices and farming methods. The research points out the benefits of mobile technology such as low cost, convenience and easiness to reach out to users irrespective of the distance thus enhancing agricultural activities. It is also observed by the authors that the use of mobile phones in agriculture is associated with high productivity and improved management skills. However, they also stress the importance of further mobile agricultural services and education incorporation to achieve their full potential.

The implications of the Fourth Industrial Revolution (4IR) on agricultural and rural innovation in India, as discussed by Lele and Goswami (2017) in Agricultural Economics. The article discusses the impact of automation and artificial intelligence coupled with data on development of agriculture and rural economies. They contend that the technologies of the 4IR allow for improvements in productivity, sustainability, and, of critical importance, the earnings of the rural populace. They also point out, however, the fears and concerns saying that not every other person has access to new technology or infrastructure and that policies need to come into play. The study calls for the introduction of specific policies and strategies so that 4IR can be enjoyed by all and that the smallholder farmers can also benefit from the digital economy.

The Broadband Commission Working Group on the Digital Gender Divide (2017) discusses a few fundamental aspects needed to address the gender disparities in internet and broadband access and utilization. The report points out that in many regions of the world, women are confronted with challenges in accessing and leveraging digital tools. Such challenges include cost implications, knowledge barriers, and socio-psychological factors that inhibit their involvement in the digital economy. Therefore, the working group enunciates strategies that refocus on the targeted gender. The report recommends, among other things, infrastructure development to provide women with affordable and reliable internet services, women's digital literacy programs, and the development of policies that will change the way of thinking that inhibits women from accessing the internet. Moreover, it suggests that women should play a greater role in the development of technology policy as well as in leadership positions within the digital industry. The working group, however, insists that addressing the digital gender divide as a development issue brings about great economic and social benefits to women, and enhances gender equality and the realization of the Sustainable Development Goals. It encourages the collective engagement of the state apparatus, the business community, and social stakeholders to mitigate the digital divide-related inequalities between genders.

Aker (2011) emphasizes the importance of ICTs in agricultural extension services in the Third World. This article published in Agricultural Economics discusses the impacts of agricultural

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information technologies like cellular phones and the internet in transforming the practices of agriculture that allows farmers to access crucial information. For instance, market and weather information as well as farming practices is readily available for the farmers. Aker argues that the adoption of ICTs will result in improvement in productivity, resource access, and markets, especially so for smallholder farmers. The review also highlights some shortcomings such as inadequate Infrastructure, lack of digital skills, and the problem of localization, which must be tackled to enhance the effect of communication technologies in rural and agricultural areas.

Research conducted by Aker (2011) and Jensen (2007) reveals that mobile devices can enhance the efficiency of rural markets because farmers are able to know current market prices, and therefore able to bargain for better prices for their produce. Moreover, mobile phones are used by women to reach out to microbanks for mobile banking and micro loans. This is crucial to their economies. There are geographical regions where women are socially disadvantaged and do not have access to formal financial services such as banks. Nonetheless, mobile devices have the capacity to alleviate these challenges by making it easier for women to access such services.

The Review of Associated Literature on Technology Acceptance, Its Effects and Extension Service in Agriculture in Developing Countries by Takahashi, Muraoka and Otsuka (2019) studies these three phenomena to date. Published in Agricultural Economics, the article assesses the impact of technological changes such as machinery, digitalization and new agricultural methods on the farmers in developing countries. The authors note the benefits of technology around production, income levels, and agriculture. However, they also point out the problems including technology access, knowledge and capacity challenges, among others. The paper under review presents extension services as an integral part of technology transfer and highlights the need for ensuring technology use among smallholder farmers.

Numerous studies have also emphasized how mobile technology might advance gender equity. In poor nations, women are fewer likely than men to own mobile phones or use mobile services, according to the International Telecommunication Union (ITU). Their access to mobile-based agriculture services is restricted by this gender divide in digital technology.

Dey et al. (2010) explore the effects of integrated aquaculture–agriculture (IAA) systems on small-scale farmers in Southern Malawi, seeking publication in Agricultural Economics. The focus of the paper is on the impact that aquaculture combined with existing farming practices has on the farmers' productivity, earnings, and food insecurity. They conclude that the integrated agriculture and aquaculture system helps to provide various earning opportunities, encourages the use of more nutrients, and enhances soil quality thus, encouraging better economic returns to the household's systems and their sustainability. The research, however, also pinpoints some barriers like the need for improvement on quality of inputs, educating the farmers, and specialized extension services necessary to achieve full potential of the practices, IAA. This study illustrates the opportunities provided by integrated farming systems in addressing the challenges faced by rural communities in improving their livelihoods.

However, despite the potential of mobile technology, the digital divide remains a significant challenge in rural India. Several studies, including those by Khandelwal (2019), have pointed out that rural women face significant barriers to adopting mobile technology, including low levels of digital literacy, inadequate infrastructure, and socio-cultural constraints. In addition, limited access to affordable mobile phones and internet services exacerbates the digital divide, leaving rural women farmers at a disadvantage.

Objectives of the Study

The objectives of this research are as follows:

1. Evaluating the influence of e-Mobile Technology on the rural women farmers of Kanpur.
2. To explore how mobile technology advances inclusive development in agriculture.
3. To explore the demographic differences concerning the adoption of e-Mobile Technology against rural women farmers.

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4. To examine different barriers and challenges women experience in using the mobile technology for agricultural purposes.
5. To offer advocacy measures to the policymakers and other concerned parties with a view to ensure greater effectiveness of mobile technology on rural women farmers.

Significance of the Research Work

This research work is important for many reasons. First, it adds to the existing scholarly literature on the topics of gender, technology and agriculture in India. Narrowing the argument to examine rural women farmers of Kanpur, the research exposes the potential of this segment as a catalyst of agricultural and rural transformation which remains untapped. Second, this study sheds light on the e-Mobile Technology as a tool that can enhance social and economic empowerment especially that of women in the rural areas where the gender equity situation is dire. With the increased ubiquity of mobile technology, there is a compelling need to understand and analyse how such technological changes affect women's engagement and status in agriculture, to inform policy and program interventions that aim to bridge the gender gap in agriculture. As such, the findings of this research also help to understand more deeply the extent of the challenges that rural women encounter in the use of technology as well as the extent of technology in mitigating such challenges. The findings also point out the emphasis that should be given on efforts to improve digital literacy, enhance access to mobile services as well as mobile infrastructure in rural areas. Moreover, in approaching issues of rural women agriculture, it is essential that policy makers, development agencies and technology providers seek to understand the needs and experiences of rural women farmers so as to comprehend the factors that will make their interventions and solutions more effective, sustainable and gender responsive.

Research Questions

The study will address the following key research questions:

1. How do rural women farmers in Kanpur, Uttar Pradesh, benefit from the adoption of e-mobile technology?
2. What are the impacts of mobile technology on agricultural productivity, market access, and income generation for rural women?
3. What effects do demographic variables like age, household income, and education have on rural women farmers' adoption and use of mobile technology?
4. What are the major barriers to the adoption of e-Mobile Technology among rural women in Kanpur, and how can they be overcome?
5. How does mobile technology foster social connectivity, empowerment, and socio-economic integration for rural women farmers in Kanpur?

Methodology

The research employs the combination of qualitative and quantitative data in the investigation. A survey questionnaire is to be given to 160 rural women farmers in Kanpur, which were sampled through stratified random sampling so that different agricultural sub-groups are well represented. The survey will seek to find out demographic, mobile phone usage and the influence mobile technology on farming activities, market participation and social networking.

Qualitative data collection will also include semi-structured interviews and focus group discussions (FGDs) to explore better the usage of mobile phones and other mobile related technologies by rural women farmers. This qualitative information will serve to enhance the quantitative findings and further elaborate on the constraints and the potential of e-Mobile Technology embracing e-activities.

Statistical calculations such as paired chi-square tests, t-tests and the Garratt ranking method will be used to analyze the data. The findings will be presented in both qualitative and quantitative formats to clearly show the effects of e- Mobile Technology on the Kanpur's rural women farmers.

Data Collection and Participants

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Data collection for this study on the role of e-mobile technology in bridging the digital divide for rural women farmers in Kanpur, Uttar Pradesh, was conducted between July and October 2024. The research aimed to explore the extent to which mobile-based technology can empower rural women in the agricultural sector, enhancing their access to information and improving productivity. A total of 160 participants were selected for the study, all of whom were rural women farmers residing in different villages across the Kanpur district.

The selection of participants was based on specific criteria to ensure a representative sample. These criteria included women actively involved in farming, with varying levels of exposure to digital technology, and those who had access to mobile phones. The participants were divided into two groups: one group had prior experience using mobile technology for agricultural purposes, while the other had little to no exposure.

The study by Table 1 provides information on demographic profile and its observable and expected frequencies, their difference, their square differences, chi-square values, and critical values for rural women farmers in Kanpur, describing also draws a table. The purpose of the chi-square analysis is to test how much the collected data differ from the expected data and is used here to look for determinants of mobile technology use by women farmers in the rural setting.

Table 1. Socio-Demographic Profile of Respondents (n=160).

S. No.	Category	Frequency (f) or (O)	Percentage (%)	Expected (E)	$(O-E)^2$	$(O-E)^2/E$	Chi-Square Value	df-Value	α - Value	critical value
1.	**Age**									
	Less than 25	16	10.00	38.4	522.24	13.58	52.47	4	0.05	9.488
	25-35	27	18.18	38.4	131.04	3.41				
	36-45	44	27.50	38.4	31.36	0.82				
	46-55	31	20.62	38.4	54.76	1.43				
	More than 55	74	46.25	38.4	1276.96	33.23				
2.	**Religion**									
	Hindu	56	35.00	80	576	7.2	14.4	1	0.05	3.841
	Muslim	104	65.00	80	576	7.2				
3.	**Educational Qualifications**									
	Less than High School	54	33.75	40	196	4.9	7.85	3	0.05	7.815
	High School	41	25.63	40	1	0.025				

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	Intermediate	34	21.25	40	36	0.9				
	More than Intermediate	31	19.37	40	81	2.025				
4.	**Yearly Family Income (Rs.)**									
	< 100,000	67	41.88	53.33	186.91	3.5	8.63	2	0.05	5.991
	100,001 - 200,000	37	23.12	53.33	266.74	5.0				
	> 200,000	56	35.00	53.33	7.13	0.13				
5.	**Spouse's Job**									
	Retired Employee	35	21.87	40	25	0.625	17.05	3	0.05	7.815
	Government Employee	41	25.63	40	1	0.025				
	Private Job	24	15.00	40	256	6.4				
	Business	60	37.50	40	400	10				
6.	**Family Type**									
	Nuclear	74	46.25	80	36	0.45	0.9	1	0.05	3.841
	Joint	86	53.75	80	36	0.45				

With respect to the age category, the widest deviation seems to be noted in the "less than 25" category where the number of females in the sample is 16 while the expected number was 38.4 thereby giving a very high chi square value of 52.47. This suggests that there are very few younger female farmer respondents incorporated into the study. On the contrary, 'more than 55 categories" has, a high observed figure of 74 as opposed to the expected 38.4 and thus a chi square value of 33.23 which shows that there is favouritism or upside in older women respondents than what is practical. These disparities further suggest how age plays an important role in the inclusion of mobile technologies within agricultural activities; more older women farm while the younger women are active in farming.

Using the chi-square analysis to examine the relationship between farming and religion, the observed and expected frequencies of Hindu and Muslim women farmers are significantly imbalanced. The sample contained 56 Hindus (35%) and 104 Muslims (65%). There is a significant difference between the observed and expected frequencies, giving a chi-square value of 14.4 which is greater than the critical value of 3.841. This would imply that the women farmers in the region are not composed of a random demographic but are influenced by the religious affiliation of the person

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in question. In the educational qualification category there exists a clear pattern in which rural women farmer possess lower levels of education. "Less than High School" contains 33.75% of the sample and possesses a chi-square value of 7.85 which is higher than the critical value of 7.815. It follows that level of education has a substantial effect on the extent to which rural women engage in farming and technology use. The other educational categories exhibit smaller departures indicating that the educational qualifications determine the access to the information and technology. The yearly family income category reveals that most women farmers belong to the income bracket of less than Rs. 100,000. However, the chi-square value for the income category " Rs. 100,001 - 200,000" (5.0) suggests a moderate deviation from expected frequencies, while the income group "More than 200,000" shows the smallest deviation (0.13). These results emphasize how income differences influence the use of mobile technology, as lower classes may have more obstacles for utilization of such technology.

Focusing specifically on the spouses' occupation this time, it is interesting to note how business women are overrepresented here – this included 37.5% of the studied subjects and the chi-square value was 10 hence a significant difference. On the contrary, employees of the public service (25.63%) and those in white-collar jobs (15%) have their differences comparatively reduced. These results indicate that the wives of the businessmen are more likely to adopt mobile technology among woman farmers because of the access to greater economic resources or wider market networks.

Lastly, within the context of family type, the ratio between nuclear families and joint families is even and there is no appreciable difference between the observed and expected frequencies. The chi-square value is also quite low (0.9) which means family arrangement does not play an important role towards the engagement of women farmers from the rural areas in farming activities or in the use of mobile technology. This means one structure of a family as a nuclear family or as a joint family will not be a major element to consider when looking at the use of technology with farming activities.

Accordingly, if the Chi-square statistic is greater than the tabulated value, the null hypothesis (HO1) is no longer valid. This shows that the need for information using mobile phones in agriculture is not the same in all age categories. Age is an important factor that predicts the extent of the use of mobile phones as younger adults are generally more open to new technologies.

Moreover, a t-test is also used to examine the level of involvement in agricultural undertakings before the use of mobile phones and after. The t-test is useful in finding out if two different groups' means are significantly different. The statistics indicate the extent of engagement in agricultural endeavors before and after the integration of mobile phones into the activities as well; the metrics being provided in terms of percentage for each level of access such as: No Use, Less Use, Average Use and High Use, as depicted in Tables 2 and 3 respectively.

Table 2. Access Rates to Different Agricultural Activities Following the Pre & Post Mobile Phone Adoption.

Sl. No.	Activities	Integration of mobile phones							
		Pre-Mobile Phone Adoption				Post-Mobile Phone Adoption			
		No Use	Less Use	Average Use	High Use	No Use	Less Use	Average Use	High Use
1	How easy is it for you to get price information	51	53	26	30	9	28	32	91

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	for agricultural products and inputs?								
2	How accessible is the market for you to buy and sell agricultural products?	41	62	32	25	11	23	55	71
3	How comfortable are you with voicing your opinions and suggestions regarding farming practices?	54	45	32	28	12	11	74	63
4	How often do you attend classes or training related to new cultivation methods or the use of new machinery?	53	40	32	35	15	21	45	79

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5	How easily can you access finance options like loans, insurance, and payments?	48	59	25	28	11	19	55	75
6	How well-connected are you to other farmers and community organizations for information sharing and support?	47	57	43	13	19	26	43	72
7	How well do you receive updates about government schemes and services available for farming?	56	68	12	24	12	22	32	94
8	How easy is it for you to purchase agricultural	86	52	10	12	11	19	45	85

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	machinery, pesticides, and other inputs online?								
9	How often do you access farming-related information without the need for physical travel?	74	63	10	13	18	22	56	64

3. Assign Numeric Values:

To prepare the data for statistical analysis, we will convert the categorical responses into numeric values. This will allow us to compute an average score for each activity, both pre- and post-adoption.

For each activity, the average score is calculated as:

$$\text{Mean}=(\sum(\text{Response Category}\times\text{Percentage}))/100$$

Table 3. Analysis of t-test.

	No Use	**Less Use**	**Average Use**	**High Use**
t-values	11.21	8.63	-7.33	-10.87
Critical t-values	3.182	3.182	3.182	3.182
Degree of Freedom (n-1)	8			

The absolute comparisons showed that, at a 93% confidence level, 11.21, 8.63, -7.33, and -10.87 all exceeded the widely accepted critical t-value of 3.182 for a particular t-distribution with any apparent degrees of freedom. The null was ignored for each group since there were notable differences in access levels and all calculated t-values were statistically significant. It recognizes that mobile phone users are more able to access agricultural operations than their rivals. A substantial increase in access is routinely shown in most comparisons of pre- and post-mobile usage. According to the poll, mobile phone users can locate relatives at home, contact people in migratory areas, and obtain information for both agricultural and non-agricultural purposes (Rahman, 2023). Mobile data suggest a great deal by which mobile phone usage enhanced farmers' access to information, market involvement, education, and general information retrieval.

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Building mobile access especially at affordable rates can be much faster in developing women in rural areas as it translates to many necessary details from healthcare, agriculture, finance to education. It brings women to understand the decision-making processes; having sufficient information is likely to assist them in becoming entrepreneurs and raising their income while promoting equality between genders and possible community development. Farmers will always want to hear many kinds of information about agricultural inputs, local agro-meteorological forecasts, market characters, and practices of efficient farming for better farm management. The increased use of mobile phones ensures this information exchange through enabling farmers to receive near real-time updates on prices, demand trends, and logistics, all of which are very important for their decision-making.

Garrett Ranking Test:

Garrett Ranking Test is a test of variables that ranks and assesses the value respondents attributed to them. In this instance, the use of the method made it possible to probe the issues emanating from mobile phone use in rural areas. This analysis was targeted to rank the various factors on the negative impact on mobile phone usages in these areas and ultimately derive meaningful insights.

Higher ratings indicated more substantial issues in the impact evaluation, which was conducted using a scaling system. The average score for each problem would be determined by adding up all of the ratings that the respondents provided. According to their scores, the difficulties were prioritized, and the one with the highest score was deemed to be the biggest obstacle facing mobile phone users in rural locations (see Table 4).

Table 4. Garrett Ranking Test on the Difficulties of Rural Mobile Phone Use.

S.N.	Issues with Mobile Phone Use in Rural Locations	1	2	3	4	5	6	7	No. of Respondents	Score	Mean Score	Rank
1	Reliance on male family members for financial decisions.	52	41	23	21	23	0	0	160			
		364	246	115	84	69	0	0		878	5.49	1
2	A lack of education hinders the ability to use it effectively	8	7	21	20	22	35	47	160			
		56	42	105	80	66	70	47		466	2.91	2
3	Limited network coverage in rural areas.	76	56	17	11	0	0	0	160			
		532	336	85	44	0	0	0		997	6.23	1
4	Insufficient guidance on how to use mobile phones.	11	13	18	29	28	35	44	160			
		77	78	90	116	84	70	44		509	3.18	4

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5	Technical support services are inadequate in rural areas.	60	37	28	18	17	0	0	160			
		420	222	140	72	51	0	0		905	5.66	2
6	Mobile services available in local/regional languages	21	32	28	0	0	45	34	160			
		147	192	140	0	0	90	34		603	3.77	3
7	Health concerns associated with mobile phone radiation.	0	0	0	0	45	53	62	160			
		0	0	0	0	135	106	62		303	1.89	5

Key Insights:

1. **Limited Network Coverage (Rank 1, Mean Score: 6.23):**
   - **Limited network coverage** emerges as the most significant challenge, with a **mean score of 6.23**. This suggests that rural areas face substantial difficulty in accessing reliable mobile services, which is a primary barrier to mobile phone usage.
   - The high number of respondents rating this issue with a score of 1 (7 points) further emphasizes the severity of this problem.
2. **Reliance on Male Family Members for Financial Decisions (Rank 1, Mean Score: 5.49):**
   - The challenge of relying on male family members for financial decisions ranks second, with a **mean score of 5.49**. This reflects a societal issue where financial autonomy may be restricted, which limits the effective use of mobile phones for financial transactions or decisions.
3. **Technical Support Services (Rank 2, Mean Score: 5.66):**
   - The inadequate **technical support services** in rural areas, with a **mean score of 5.66**, ranks second. The challenge is prominent as technical issues with mobile devices or network services may be harder to resolve in areas lacking sufficient support infrastructure.
4. **A Lack of Education (Rank 2, Mean Score: 2.91):**
   - The **lack of education** about mobile phone usage ranks lower, with a **mean score of 2.91**, indicating that while it is a challenge, it may not be as urgent compared to others like network coverage and technical support.
5. **Mobile Services Available in Local/Regional Languages (Rank 3, Mean Score: 3.77):**
   - The availability of mobile services in **local/regional languages** is another important issue, but it ranks third with a **mean score of 3.77**. This is crucial for ensuring that mobile services are accessible to those who may not be familiar with national or global languages like English.
6. **Insufficient Guidance on Mobile Phone Usage (Rank 4, Mean Score: 3.18):**

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- The **lack of guidance** on how to use mobile phones ranks fourth, suggesting that although it is a concern, other issues such as network coverage and technical support take precedence.

7. **Health Concerns Associated with Mobile Phone Radiation (Rank 5, Mean Score: 1.89):**
   - **Health concerns** related to mobile phone radiation rank last with a **mean score of 1.89**, indicating that this is considered a relatively minor issue by rural respondents.

Conclusion

The Garrett Ranking Test identifies **limited network coverage** as the most pressing issue faced by mobile phone users in rural areas. **Technical support** and **reliance on male family members** for financial decisions also stand out as significant challenges. Meanwhile, concerns related to **education**, **language accessibility**, and **health risks** are less critical but still notable. These insights suggest that improving network infrastructure, providing better technical support, and addressing social and educational factors can significantly enhance mobile phone usage in rural regions.

Discussion and Conclusions

In rural areas, the application of Information and Communication Technology (ICT) by female farmers into production significantly increases their contribution to the overall agricultural productivity. Based on the reflection of the present results, it is apparent that environmental adaptation of ICT is essential, especially in training and intervention to capacitate these rural women to interact vigorously with the spheres of organized agriculture in respect to outputs in terms of one's zeal for rural upliftment.

ICT Training and Skill Development:

The most important possible thing is to inculcate habit in rural women farmers through regular, innovative and need-based training about ICT offering services. The features are such as access to mobile phones and to other ICT innovations in agriculture for accessing market information, weather forecast updates, technical advice and other agricultural information. Greater interaction with technologies can be sought in applied situations within rural communities to realize their immediate utility. This major research thrust covers southern Indian regions, where the perceived development in adopting ICT becomes significant among agriculturists (Mukherjee & Jha, 2024).

Peer Learning and Mentorship:

Facilitating peer learning, as well as mentorship opportunities, also holds equal importance, especially for senior rural women farmers who may be very hesitant about the new technologies introduced to them. Involving experienced users in mentoring others can create a more inclusive learning environment that increases skills and helps to boost confidence in handling mobile phones and ICT tools. It enhances rural women with their digital literacy levels and creates a close community that motivates participation.

Impact on Rural Productivity:

This shift in greening includes the diffusion of mobile phones in rural areas, making the rural development environment much periodic. Previously to reach the market and have any information, farmers had to pay a significant amount of money first to travel to the market and back. However, a farmer can now achieve application of agricultural information at the proper market price because of the very usefulness of the mobile phone. It becomes possible to access very real-time data of the product and market conditions on mobile phones to make the exercise more efficient and cost-effective. Therefore, as much as the mobile phone usage will be taking over, significant for farmers would be better access to quality life-saving information that can be directly used to improve farming practices and productivity (Ahmad et al., 2024)

Policy Implications and Support Mechanisms:

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This ground-breaking study aligns with a number of government initiatives, including the SHE Scheme, Training of Women in Agriculture, Agricultural Skill Development Program, and Mahila Kisan Sashaktikaran Yojana-Innovative Initiative. These initiatives highlight the need for focused financial assistance, skill development, and stronger capacity building for women in farming and technology. In the end, they will greatly advance the goals of gender gap-closing initiatives such as the Gender Equality and Women Empowerment Policy, which is as innovative and pervasive as the idea of appointing female leaders to positions within organizations. Therefore, thorough training would benefit women workers by improving their learning and job prospects in the technology and agriculture sectors. Including workshops with REACH (Rural Education and Agricultural Capacity Building for Holistic Empowerment) might also assist in developing such dye skill improvements in women.

Addressing Mobile Network and Infrastructure Challenges:

The most important responsibility of government is the ensuring the solution of mobile network coverage and infrastructure issues in rural areas. These policies should be gender-sensitive, recognizing that rural women hold specific obstacles. Broadened access to telephone technology combined with technical assistance and training will undoubtedly support women empowerment for the long term. One can socialize mobile technology on campus or among community education providers to facilitate integration of mobile technology into farm practices for rural female farmers' livelihood improvement.

Study Limitations and Future Research Directions:

Although the research provides insight into the practice of ICT difficulties for rural women farmers, a great number of limitations need to be acknowledged. For example, the concentrations of those district areas in Palakkad, Kerala, might not make generalizations possible to such areas in different methods of farming or levels of ICT adoption. Also, variations in participants, improved digital literacy, and the country's current infrastructure regarding mobile may most likely overshadow the test results to some extent. To unravel this complexity further, future ventures ought to ignite these variables into a broader socio-technical argument to understand the impacts of numerous variables-in this instance, adoption and usage of ICTs.

Future research should look at the effectiveness of public policy and community support structures to address the practice, and dissonance between intervention and incorporation could potentially further the research. This could provide a deeper insight into the barriers and opportunities for greater mobile phone adoption in rural agricultural practices and the reasons why a limited portion of community groups might have little or substantial impact, up to finding out what influences mobile utilization concerning certain activities.

Increasing Mobile Use and Promoting Financial Aid:

To ensure that wheat has been promoted in the rural areas, government (but also NGOs) should promote the countryside in and around phones among farmers by advancing secret schemes like the provision of soft loans to farmers to buy cell phones, etc. One reason that this would be effective is that technologies can be countered with even more sophisticated tools-the latest indeed-so that farmers are able to learn something about how they can produce and market things.

Conclusion:

Mobile technology has changed the rural women farmers' lives' possibilities to the greatest extent possible. The access to vital information and resources has given the female farmers leverage to become active forceful participants in the development of agriculture. These technologies empower rural women to address both the issues of production and marketing, ultimately contributing to their economic and social uplifting. Taking it further still demands a total support system: trainings, credit; and a policy framework as well as inclusion and so on must be in place for these potentials to be fully realized. Working together can drive mobile technology to be the fundamental factor in the empowerment and economic growth of rural women farmers.

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Declaration of Interest

We declare the following potential conflicts of interest with regard to the research paper for publication:

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We confirm that the manuscript represents original work and has not been published previously, nor is it currently under consideration for publication elsewhere.

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