Impact of Demographic Factors: Technology Adoption in Agriculure

Pooja Jain and Rekha

Abstract

Agriculture is the primary occupation of majority of Indians living in rural areas which constitutes of about 70% of India's population. Major challenge is to create and improve the existing agriculture infrastructure which can improve the livelihood of rural masses. In the present times of technological development, agriculture sector is trying to reap its benefits. The purpose of the present study is to assess the role of demographic factors on the acceptance of mobile technology by farmers in their farm operations. The study adopted 3 constructs of Technology Acceptance Model to measure the adoption of mobile phones. The outcomes revealed that except marital status of the farmers other demographic variables (age, income, educational qualifications, and gender) have significant effect on the variables of mobile acceptance. The outcomes provide implications for policy planners to adopt appropriate strategies to encourage the adoption of mobile phones among farmers having different demographic characteristics.

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Majority of people in India resides in rural areas and depend on agriculture for livelihood. More than 56% of Indian working population is engaged in agriculture and its allied activities (census 2011). India stands second in terms of the population numbers in the world. There is a huge demand for food to meet the requirements of the population which is dependent on agriculture sector. So it is important to invest considerable resources for the development of this sector to serve the growing food requirement and this sector also needs attention as it creates important linkages with manufacturing sector for providing the desired raw material. Indian agriculture has seen a substantial decline in growth rate of total output and crop yields across states after liberalisation period which has led to severe agricultural distress. Annual rate of growth in agriculture was less than 2.5 per cent in 9th and 10th five year plan. In spite of several initiatives like building irrigation facilities, extension services, land reforms, credit and marketing support taken by the central and state governments to revive the agriculture sector, it only grew at 3.7 per cent during the 11th Five Year Plan. Still it is a

very important sector for the economic development of any country. It must provide food for domestic consumption as well as produce surplus for generation of additional earnings.

Farmers in India face natural challenges of drought, flood, deforestation and natural calamities due to vast geographical disparities along with infrastructural challenges. Farmers' bargaining power is not strong as they pay high prices for input and are not able to sell their produce in market at high prices which results in overall loss in net earnings of farmers. In the present times of technological development and innovation, Information and communication technologies has the power of changing the state of agriculture in India. The rural population is largely dependent on agriculture because of dearth of alternative employment prospects, which makes the current study of strategic importance

Literature Review

Literature on rural development is replete with opinions that back the path of technological growth to agricultural development which is the backbone of rural development and welfare. Since an important reason for the existence of agricultural distress is insufficiency or absence of technological infrastructure, growth of communication technology germinates abundant information and thus enables an automatic increase in agricultural efficiencies.

Technology and information dissemination are the strategic goals for effective agriculture extension (Aker, 2010). Different types of Information Communication Technology (ICT) like internet, mobile phone, television and radio are being used to spread agricultural information to farmers. Koppel (1978) emphasized on the role of technology in enhancement of agriculture productivity. Technology has been considered as an essential resource for agricultural production. There are substantial international differences in diffusion of information and communication technology (ICT) referred as "Global Digital Divide," which pose a serious concern to policymakers throughout the world. The extent and speed of diffusion of any technology depend on the domestic capacity of absorbing the advanced technologies and this absorption capacity differs both across the countries and within the countries (among different states). Earlier more traditional tools like Radio, Television and Telephones were used for dissemination of information. Today these tools exist, but newer technologies like mobile and internet are increasingly being used to facilitate the transfer and exchange of information.

The diffusion of mobile phones has been remarkable compared to other ICT tools (e.g. PC, Internet etc.). The number of telephone subscribers in India stands at 1,151.78 million with Rural subscription of 468.64 million and Rural Teledensity of 53.27 at the end of Dec-16.(TRAI). Mobile phones have an inherent advantage over traditional Information and Communications Technology. They do not require similar physical infrastructure as compared to internet such as a wire line connection, regular electricity or moderately frequent servicing requirement. Major benefit of using mobile phones includes its ability to communicate content via voice, removing the barrier of illiteracy. According to Deloitte (2014) the reach and penetration of mobile phones in India can ensure the delivery of a large number of services in a cost effective, fast and seamless manner even without physical access.

Various studies conducted in different parts of the world have concluded that farmers received critical information about farming on their mobile phones which empowered them to make informed decisions (Nyamba and Mlozi, 2012; Tadesse and Bahiigwa, 2015), helped them to fetch higher market price for their produce (Mwakaje, 2010), received updated weather information (Nyamba and Mlozi, 2012) and minimised transportation and time costs by removing geographical boundations via calling and text messaging feature (Deloitte, 2012; Nyamba and Mlozi, 2012).

The study uses the basic constructs of TAM i.e. perceived usefulness, ease of use and behavioral intention to use and attempts to identify demographic influences on the adoption behaviour of farmers in the districts of Haryana. TAM model is built on a strong theoretical base in the field of information technology and is a well-researched, empirically tested model with validated inventory of measurement scales across different contexts (Davis, 1989). The TAM model was adapted by Ajzen and Fishbein's theory of reasoned action (TRA) to elucidate the causal relationship between users' internal beliefs (usefulness and ease of use), attitude, intentions, and computer usage behaviour. It is considered a robust and parsimonious model in the case of Internet and mobile technologies in diverse contexts (Wang et al. 2009; Crabbe et al., 2009; Kuo and Yen, 2009; Schierz, Schilke and

Wirtz, 2010). It has been tested with different control factors (e.g., gender, age, type of organization etc) and on different subjects i.e. students, farmers and working professionals, making it a robust model. Technology Acceptance Model (TAM) initially had two constructs perceived usefulness and perceived ease of use forming attitude which were derived from Theory of Self Efficacy by Bandura (1982) and Rogers and Shoemaker (1971). This model was initially applied in IBM Canada office in context of adoption of email service and file editor which were new technologies launched during that time on a sample of 112 respondents.

Perceived usefulness in TAM refers to the beliefs of the users that using particular technology/system would improve the performance. Perceived ease of use deals with the belief of the users that using a particular technology/system would be free of efforts. Attitude deals with the predisposition of the users to behave in a particular way i.e. favourable or unfavourable; towards a new technology/system and was affected by perceived ease of use. Attitude in-turn affects the usage intentions which are also affected by perceived usefulness. Usage intentions are considered proxy for actual usage behaviour of users. TAM model was able to provide a proper description of user's intention to use technology (Hu et al. 1999). The model is simple to apply and predicts intentions to use technology very well (Mathieson, 1991).

Different researchers have tried to modify the TAM by adding new constructs to it. Agarwal and Prasad (1998a and b) included the construct of compatibility, experience, self efficacy, perceived risk and social influence to TAM and Mathieson et al. (2001) added Behavioural intention construct to the original TAM model. Venkatesh and Davis modified TAM in 2000 to include other constructs of usage intention, subjective norms, voluntariness, Job relevance, output quality, demonstrability and image in their extended model. TAM model has been a successful model revealing useful insights and predicting usage intentions in technology mediated environment across various product categories. Perceived usefulness and ease of use are among the most significant factors in adoption of mobile services (Kargin and Basoglu, 2007).

The benefit of communicating information through mobiles is that it comes directly to the user and by necessity, provides a “snapshot” of information. This eliminates the potentially overwhelming activity of sitting down at a computer and searching for the necessary information. The mobile phone technology is considered to be the cheapest and accessible ICT technology for information dissemination and reducing the digital divide (Wade 2004). Thus, mobiles address the dual nature of connectivity and comfort with technology, which has historically hindered the growth of traditional Information and Communications Technology in India. By leapfrogging all the major issues of traditional ICT delivery in India, mobiles have the ability to be a life changing method of information delivery to the rural poor. By using modern ICT along with conventional information sources, these farmers may be benefiting by having better yields or reduced cost of production or better price realization (Jensen 2000; Abraham 2007; Mittal, Gandhi, and Tripathi 2010; Aker 2008). Karamagi, and Nalumansi (2009) discussed that by using mobile phones farmers were able to improve their efficiency and mobile phone provided farmers with relevant real time information in rural Uganda. In a study conducted by Ng'ethe (2010) it was found that farmers in Kenya were able to market and sell their produce efficiently and thereby helped to increase their incomes.

Demographic variables have a substantial impact on the adoption of modern technologies (Crabbe, et al., 2009). Demographic variables like age, education qualification, family income, family size, and beliefs have significant positive relation to adoption of new technologies (Cruz 1978). There exist variations in adoption behaviour of mobile use due to demographic features like gender, age and education Sohail and AlJabri, (2014). Mattila (2003) emphasized that demographic characteristics like age, gender, income, education level, marital status and occupation needs to be explored in order to find out the behaviour pertaining to adoption of mobile phone by users. These variables play a strategic role in understanding the technology adoption process of different segment of people. It is pertinent to understand how demographic characteristics of farmers influence their perception of mobile phone acceptance for improved understanding of their adoption decision.

Demographic variables, ICT (Mobile adoption) and Hypothesis development

Age has a significant effect on adoption of modern ICT technologies.

Age as a predictor of ICT acceptance has received less attention from researchers in this field. Few studies (Chung et al., 2010; Tarhini, et al., 2014c; Wang, et al., 2009) have tested the impact of age and technology usage behaviour. Prado, et al. (2011) found in their study that people with age of 25 would use ICTs to learn and improve their work which is similar to the present study where majority of respondents which belong to the age category of above 25 are using modern ICT like internet and mobile phones to gather agricultural information for increasing their efficiency in farm operations. Farmers of young age are more aware and ready to adopt new technologies for long term benefits (Polson and Spencer, 1991). Jain and Hundal(2007) conducted a study on rural people of Punjab in India and it was found that majority of the respondent (62 %) using mobiles belonged were young and belonged to the age category of 20 to 40 which is consistent with the findings of the present study.

Cheong (2002) analyzed the various characteristics of users of internet and non-users of internet, in which it was observed that majority of internet users, are youngsters, who are more educated with higher incomes. A regression and correlation analysis was done and it was found that there is relationship between age and usage of internet. Demographic variables like gender, income and education have a significant relationship with internet application.

Based on the above discussion, the author hypothesizes:

Hypothesis 1: There is a significant difference in mobile technology adoption behavior among farmers belonging to different age groups.

Family income has a significant effect on adoption of modern ICT (Mobile phone) technologies.

Many previous researches depicts that income of the farmers and use of modern ICT technologies are positively and significantly associated which meant that rich large farmers were able to get more information as compared to poor farmers. (Jensen, 2007; Abraham, 2007; Mittal et al. 2010). Rich farmers are comparatively resourceful, have greater market surplus, have increased awareness and are connected to ICT devices for gathering information (Mittal and Mehar, 2015). People with higher incomes have personal electronic devices like computer, internet connection, television and mobile phones which can be used to grab market information (Padachi et al. 2008). Zhang et al., (2010) depicted that there is a direct relationship between income and accepting the technology for getting agricultural information by farmers. Kalba (2008) emphasized that adoption of mobile technology (Post paid as well as prepaid) is dependent on income of the family over time. Chowdhury, and Wolt, (2003) found a significant positive correlation between family income of the farmers and mobile technology adoption. Thus author hypothesize that:

Hypothesis 2: There is a significant difference in mobile technology adoption behaviour among farmers belonging to various monthly family income groups.

Education Level has a significant effect on adoption of modern ICT (Mobile phone) technologies.

The results of many studies suggest that as education level increases farmers shift to modern ICT technologies for gathering agricultural information (Mittal and Mehar 2015). Educational background of user significantly affects the perceived ease of use and perceived usefulness of using ICT technologies (Chung and Paynter, 2002). The process of diffusion of new technologies like mobile and internet has been slow for farmers as they are not much educated (Fuglie and Kascak, 2001). Feder and Umali (1993) submitted that farmers need knowledge and information to use new interactive technologies for improving their agricultural performance and education level positively correlated with embracing of new technologies by farmers.

Hypothesis 3: There is a significant difference in mobile technology adoption behavior among farmers with different educational backgrounds.

Gender Level has a significant effect on adoption of modern ICT (Mobile phone) technologies.

Ownership of mobile phone among women is less than 21% as compared to ownership of males in spite of skyrocketing increase in the penetration levels of mobile diffusion across the world (GSMA Development Fund, 2010). Gender ratio of ownership of mobile phone adoption in a study conducted on farmers in Bangladesh found that majority of the farmers were males (Islam and Grönlund, 2011) Mobile usage is more popular among males, who are more educated with high-incomes in the context of M banking (Sulaiman, et al. 2006). Gender of the respondent moderates the effect of intention to adopt mobile in context of m-banking (Yuan , et al. 2014)

Hypothesis 4: There is a significant difference in mobile technology adoption behavior among farmers belonging to different gender groups.

Marital status has a significant effect on adoption of modern ICT (Mobile phone) technologies.

Majority of the respondents considered for the present study are married and are responsible for family welfare and need to earn substantially from agriculture to support their families. This concurs with findings of Wanyeki (2003) and Goetting and Schumacher(2011) who stated that male members of the family are farm owners and not female. Young males are not considered reliable and responsible for farming as compared to married men.

Hypothesis 5: There is a significant difference in mobile technology adoption behavior among farmers who are single and married.

Research Methodology

The target population considered for the present study is:

Sampling unit: Farmers who were users and non-users of ICT technologies

Extent: 10 villages each from two districts of Haryana; Karnal and Sonipat

Sampling design: A non-probability convenience sampling technique was adopted for the present study

Execution: The questionnaire tapped different measures like demographic information, and measures of ICT usage, based on the three constructs of TAM, that is, perceived usefulness, lase of use and behavioural intention to use ICT(Mobile phone) technology. The final questionnaire administered to the respondents consisted of items and comprised of two sections. Part 1 deals with socio-demographic variables such as age, gender, marital status, education qualification and income. Part 2 measured farmers perception about the perceived usefulness(6 items), ease of use (6 items) and behavioural intention (4 items) to use ICT technologies in farm operations based on Davis (1989), Technology Acceptance Model (TAM).

Questionnaire was self-administered on 300 (150 per district) farmers to solicit factual responses in a timely manner. It comprised close ended questions in which participants responded using a five point Likert scale, ranging from strongly agree to strongly disagree. The questionnaire was subjected to review by experts for validity. Out of the total 300 questionnaires 12 were discarded due to incomplete information.

Data Analysis and Results

Reliability Analysis

The TAM instrument has good internal consistency estimates (Cronbach's alpha), across studies ranging from .80 to .98, and a well-defined factor structure. Its factor structure is clean and strong, its internal reliabilities are very strong. The Cronbach's alpha can range from 0 to 1, with higher values indicating higher internal consistency. Generally, it is accepted that values above 0.6(Malhotra, 2007) or 0.7 (DeVellis, 2003) indicate satisfactory internal consistency. Cronbach alpha of the 3 constructs of TAM was calculated which came as 0.830(PU), 0.797(EOU) and 0.761(BI) as shown in Table 1.1. Since a reliability of 0.7 and above is considered to be high, all constructs were deemed highly reliable.

Table 1.1: Reliability Results

Constructs	Cronbach's Alpha
Perceived Usefulness(PU)	0.830
Ease of Use(EOU)	0.797
Behavioral Intention(BI)	0.761

One way Annova factor wise was applied in order to measure the demographic differences in acceptance of mobile technologies among farmers in the field of agriculture. In order to perform Annova three assumptions were checked. Since the sample was collected on random basis, all respondents(farmers) had equal chance of selection which means all groups are independent of each other which fulfils the assumption of independence The z score of skewness and kurtosis was calculated to test normality which was

2.83 and 2.42 which signifies deviation of normality but not a substantial one as according to Kline(2011) deviation from normality is not a serious issue as the value of skewness and Kurtosis was below 3 and 10 respectively. Levene's test was performed to check equality of variance and it was observed that all the demographic variables except educational qualification had a significance(p value) of greater than 0.05 level shown in Table 1.2.

Table 1.2: Levene's Test Results

Demographic Indicators	Levene's Test	Sig value
Age	1.356	.260
Gender	1.235	.268
Education	6.543(welch Statistic 7.890)	.003 (welch sig .001)
Income (Monthly)	.487	.617
Marital status	.486	.486

Among the demographic variables considered in the study, age was found to have significant difference among the factors of mobile adoption (PU, EOU and BI<0.05). This signifies that farmers of different age groups perceive difference among these factors of mobile adoption. Young and middle age farmers perceive mobile phones as useful, find them easy to use and intend to use mobile phones in the future for getting agricultural information as compared to the old farmers belonging to age category 60 and above. These findings are consistent with the findings of Chi and Yamada(2002) in which it was found that young farmers less than 40 years old are ready to adopt new technologies.

Males and females both are using mobile technology for deriving agri information but males perceive mobile phones to be more useful in comparison to females. There was no significant difference found between the genders in behavioural intention of adopting mobile phones for farming purpose.(p>0.05).

Farmers who were graduates perceived mobile phones to be quite useful, felt ease of use and intend to use mobile phone in the future in comparison to farmers who were class XII pass. There was significant difference observed in factor wise analysis between farmers of different educational qualifications (PU, EOU and BI, p<0.05). These findings are consistent with the findings of Chi and Yamada (2002) in which it was found that educated farmers are progressive and have belief on the role of science and technology in enhancing agricultural performance.

Farmers belonging to family monthly income group of 20,000- 30,000 were found to higher acceptance of mobile phones than the other three income groups based on the mean values. No significant difference was observed in mobile acceptance variables between the various income groups. (PU, EOU and BI, p > 0.05). No significant difference was also observed on marital status of the respondent on the adoption of mobile technology as shown in Table 1.3 there is positive association of mobile phone usage experience and mobile phone acceptance in agriculture. It depicts that people who have more experience in using mobile phone have more acceptance of this technology in agriculture. Respondents who have used mobile phones for shorter periods perceive mobile phones to be less useful as compared to respondents who have used it for more than 5 years as shown in Table 1.3.

Table 1.3 : Demographic profite of the respondents

Demographic variables	Perceived Usefulness			Ease of use			Behavioural Intention		
Age	Mean	F	sig	Mean	F	Sig	Mean	F	sig
20-40 years	3.92	27.98	.000	3.68	11.04	.000	3.98	8.01	.000
40-60 years	4.23			3.89			3.96		
60 & above years	2.67			2.89			3.32		
Gender									
Male	3.89	6.79	.010	3.58	8.43	.004	3.96	2.14	.145
Female	3.36			3.52			3.80		
Education									
XII	3.32	16.28	.000	3.49	4.05	.018	3.63	7.80	.001
Graduate	4.17			3.80			4.10		
Post graduate	4.03			3.79			3.96		
Family income									
10,000-20,000	3.69	1.6	.204	3.62	1.01	.366	3.86	2.01	.137
20,000-30,000	3.98			3.96			4.06		
30,000-40,000	3.80			3.94			3.80		
40,000 and above	3.80			3.93			3.82		
Marital Status									
Married	3.96	2.78	.097	3.83	2.84	.093	3.94	.28	.593
Single	3.73			3.63			3.88		
Mobile phone usage experience									
Less than 2 yrs	2.76	17.99	.000	3.15	8.34	.000	2.95	20.83	.000
2- 5 yrs	3.81			3.67			3.96		
5 yrs and above	4.10			3.96			4.07		

Implications for the study

Mobile phone intervention in the field of agriculture is still at a nascent stage in many parts of India and there are limited number of studies that have been conducted in this regard in Indian context. Dissemination of information through internet is a newly emerging concept in agriculture and allied sector. Usage of communication technologies in Indian rural society has to be viewed as a process marked by promises, opportunities, ironies and complexities. Farmers in India represent a large segment of the Indian population and they cannot be ignored as a topic of study.

Mobile is an interactive technology and the user needs not only access to that infrastructure but also needs the ability to access the information and use it. Young people should be encouraged to take up formal agribusiness practises as they are the early and major adopters of technology including mobile phones. The overarching challenge is to scale up pilot studies of Mobile usage in agriculture and make majority of non-adopter farmers about the best practise farming methods. Mobile technology is merging with Internet as Internet could also be accessed through smart phones. Radio services can also be merged with mobile phones as it allows the accessibility of radio services. India has not been able to convert the impact of Mobile technology on agriculture to the expected extent, so it is important to provide critical analyses of the impacts of mobile phones on economic development in India.

Conclusion

In this study, six demographic variables have been measured i.e, age, gender, educational qualification, marital status, family income and mobile phone usage. The study used the three constructs of the TAM model, perceived usefulness, ease of use and behavioral intention to use mobile technology in farming.

Consequently, it can be stated that there is no doubt or debate that mobile technology adoption provides a basis for improvement in the agriculture performance and Demographic factors have strong influence on adoption of this technology by farmers. Six decades of planning and focus on agriculture sector by the government after independence have borne fruits but these are too few in relation to the ever growing need of the growing population. The numbers reeling under poverty in rural areas let alone chronic poverty are a major concern in case India is striving for inclusive growth. Improvement in agricultural productivity can create economic and social welfare for majority of the masses living in rural areas. This makes the issue of mobile technology adoption worthy of discussion and solution hunting, not only because of its intrinsic enormity but more so due to its functional significance.

Limitations and Scope of future Research

The sample was limited to farmers of only two districts of Haryana; Karnal and Sonipat, with limited sample size and it can be extended to other districts of Haryana and other States of India where farming is the major occupation of the residents of the State. Respondents who completed the questionnaire were contacted personally yet the conditions under which the test was completed were not controlled, so it is not known if conditions were always optimal for test taking of this nature, that includes the time of day, sincerity, setting with limited distractions and free from source of bias and the test was completed in one sitting without interruptions. At times the researcher had to leave the questionnaire with the respondents to be filled later. It may have been preferable to have had respondents complete the questionnaire under best test conditions and supervision. Limited number of demographic indicators were considered in the present study whereas in future other demographic variables like household composition, Ethnic background, social class etc. can be considered for similar study.

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