CHAPTER 9

FACTORS AFFECTING ADOPTION OF ICTs

Various media have been identified to deliver advance and real time information and knowledge to farmers in rapidly technological advancement and changing agricultural environment (Birkhaeuser et al., 1991). Though, significant changes have occurred in the service provision of information delivery right from public, private and NGOs. Also several mode of transfer of information has been recognized in recent years that range from traditional sources to modern ICTs, covering the whole agricultural supply chain (Ali & Kumar, 2010).

Use of information and communication technologies (ICTs) substantially increased to meet the information needs of farming community (Rivera, 1996). Modern ICTs such as internet, mobile, television and radio have greatly identified in delivery of relevant and timely information and knowledge to farming community which equipped them with more informed decisions (Ommani & Chizari, 2008). Innovative and integrative use of these modern ICTs projects have initiated by several organizations in India last decade.

The need arises to design better information delivery system. A number of factors have been studied by several researchers for better implementation of these projects like relevant content development, good locations, good management, staff capability, socio-demographic profiles, village economy, credit facilities, farming as business, social networking etc. (Mittal & Tripathi, 2012; Benjamin, 2001; Etta & Parvyn, 2003; Xiaolan Fu & Shaheen Akter, 2012; Ali J, 2012).

An empirical model is developed among socio demographic characteristics of farmers, farm characteristics and business orientation to estimate the relationship of farmers in adoption of ICT driven information. ICT users were categorized according to the use of information sources such as e-choupal, lifeline and CSC as well as the information accessed from television, radio, internet and newspapers. The dependent variables included in the analysis are frequency of ICT adoption for various agricultural activities

and independent variables include socio demographic factors such as age, education, income, secondary source of income and social category---farm characteristics factors such as land holding size, leasing of lands, number of crops grown ---business characteristics factors such as demonstration facilities, cooperatives membership, aware of government subsidies and mobile owned.

The reduction in search costs coupled with mobile phones could increase farmers' access to information (Baye, Morgan & Scholten, 2007; Aker, 2010; Aker & Mbiti, 2010). This could speed up farmers' contact with other adopters in a social network, thereby allowing them to learn more from neighbors, to trial new technologies and to monitor these trials more frequently. The dependent variables represent the frequency of adoption of ICTs based sources for planning decisions, input decisions, cultivation decisions, post harvest decisions, marketing and distribution decisions.

All the activities in the stages of agricultural supply chain were reduced into five variables. The factor variables were calculated using average summated score i.e. 'Planning decisions' variable= {(what crop to grow + crop diversification + how to grow + soil testing + seed selection)/5}. Like this all the dependent variables were calculated for the regression analysis. Finally data has been converted into binary order in the form of '0' and '1'. From the descriptive statistics, over dispersion in the data was observed regarding dependent variables. Over dispersion defined as the conditional variance of the dependent variables exceed the conditional mean. So, Negative Binomial Regression Model was used to analyze the factors influencing the adoption of ICT driven information on various agricultural supply chain decisions.

Table 9.1 represents the variable descriptions and summary of statistics of dependent and independent variables selected in the study by specifying their mean and standard deviation. The coefficient estimate, standard errors and significant levels for the variables of Negative Binomial Model are presented in Table 9.2 for agriculture decision making, planning decisions, input decisions, cultivation decisions, post harvest decisions, marketing and distribution decisions. Due to ineffective and shortage of extension personal and inaccessibility of large number of farmers living in remote areas, difficulties are faced in accessing new information and technologies regarding their farming activities. Several modes of ICTs have been emerged to provide relevant and accurate information to farmers (Muhammad & Garforth, 1999; Butt et al., 2008).

Table 9.1: Variables Descriptions and Summary Statistics

Variables	Description	Mean	Standard Deviation
Dependent Variables			
FrqPLNG	Frequency of ICT adoption for Planning decisions	0.65	1.387
FrqINPT	Frequency of ICT adoption for Input Decisions	1.14	1.531
FqCULT	Frequency of ICT adoption for Cultivation practices	0.40	0.738
FrqPHS	Frequency of ICT adoption for Post Harvest Decisions	0.11	0.434
FrqMKT	Frequency of ICT adoption for Marketing and Distribution	0.95	1.116
FrqAGD	Frequency of ICT adoption for Agricultural Decision Making	3.25	4.484
Independent Variables			
AGE	Farmers age (years)	37.41	10.280
EDU	Farmers education (secondary school & above=1, otherwise=0)	0.69	0.465
INC	Monthly household income (>5000=1, otherwise=0)	0.58	0.495
SOCIAL	Social category of farmers (General/other backward class=1, otherwise=0)	0.93	0.260
OCPSC	Secondary sources of occupation (Yes=1, No=0)	0.32	0.469
LEASE	Lease land (>5 ha.=1, otherwise=0)	0.27	0.443
AGLAND	Farmers operational land holding (hectares)	9.79	20.856
NOC	Number of crops grown by the farmers	2.10	1.964
GSD	Aware of Government subsidies (Yes=1, No=0)	0.21	0.411
DMO	Demonstration Facilities availed (Yes=1, No=0)	0.25	0.435
COOP	Cooperative Membership (Yes=1, No=0)	0.30	0.461
MOB	Mobile own (Yes=1, No=0)	0.21	0.41

Source: Field Survey

Our evidences demonstrate that the social category of farmers, secondary source of income, possession of leased lands greater than five hectare, aware of government subsidies, demonstration facilities availed and ownership of mobile phones have been found significant at 1%, 5% and 10% level of significance for overall agricultural decision making using ICTs. Though, several studies have analyzed the factors that affect information adoption by agrarian communities (Agwu et al., 2008; Feder et al., 1985; Ali, 2012). Among the factors of socio demographic profiles, social category of farmers and

secondary occupation are more likely to affect the adoption of ICT based information because of their beta coefficient was found significant.

The results showed that the farmers having income from other sources are less likely to use innovative farm technologies than farmers having income from farming only (negative beta coefficient). This illustrates the view that the major part of farmer's income coming from the farming sector is 72 % more likely to influence the adoption of ICTs related decisions. Previous studies showed that the farmers who have alternate sources of income were on better position to avail innovative farm technologies (Ali, 2012).

Among the social class, the decision making is not homogeneous and influenced by social and cultural system of a society (Nazarea-Sandoval, 1995). Ali (2011) reported that the socially lower class farmers are more privileged to make better decisions using ICTs. The negative coefficient of regression analysis for social category demonstrates a crucial finding that the disadvantaged farmers and poorer communities gained more from the ICT-assisted interventions than those who belongs to socially higher class.

The predicted percentage change (Table 9.3) showed that backward classes are 57% more likely to use ICTs for agricultural decision making. This analysis also implies that the farmers belonging to socially lower class are more progressive in making their decisions from planning to market the product for better income. This has diluted the falsehood that the modern technologies such as ICT assist only the rich and educated, but do not really work for the bottom of the pyramid. The developmental goal cannot be achieved until the technological advancement reach to the deprived communities.

Though, age income and education are the important factors in adopting modern agricultural practices, the coefficient of these variables found to be not significant. The variable factor 'Age' was found not significant. It may be due to not significant difference was found in user and non user analysis (Table 6.1). Age factor shows that the older farmers are less likely to adopt modern agricultural planning decisions because the age coefficient is significantly negative. It may indicate that the older farmers usually plan their farming as they have adopted for years and they lack in farming practices according to the present demands of the market.

Table 9.2: Variables Estimates of Negative Binomial Model for Agriculture Decision Making and for Different Stages

	FrqAGD		FrqPLNG		FrqINPT		FqCULT		FrqPHS		FrqMKT	
Variables	ß	Std. Error	ß	Std. Error	ß	Std. Error	ß	Std. Error	ß	Std. Error	ß	Std. Error
INC	-0.343	0.391	-1.465**	0.621	-1.232**	0.543	-0.981**	0.467	-1.358	0.827	-0.907	0.802
AGE	-0.004	0.013	-0.04**	0.019	-0.007	0.016	0.003	0.014	-0.008	0.026	-0.003	0.024
EDU	-0.270	0.396	0.956	0.620	0.528	0.571	0.168	0.463	0.001	0.870	-0.079	0.817
SOCIAL	-0.848*	0.497	-1.551**	0.703	-1.898***	0.626	-1.61***	0.529	-1.553*	0.933	-2.462***	0.819
OCPSC	-1.271**	0.429	-1.045*	0.611	-1.351**	0.557	-1.30***	0.480	-2.757**	1.231	-1.679*	0.923
LEASE	0.731*	0.429	0.649	0.628	1.172**	0.568	0.465	0.494	0.506	0.917	1.113	0.840
AGLAND	0.003	0.009	0.009	0.011	0.007	0.010	0.004	0.010	0.023*	0.013	0.020*	0.012
NOC	-0.190	0.130	-0.067	0.200	-0.136	0.164	-0.120	0.151	0.009	0.223	-0.187	0.245
GSD	1.28***	0.373	0.184	0.633	1.25***	0.479	0.099	0.499	-1.118	1.303	0.719	0.767
DMO	0.97***	0.353	1.59***	0.540	1.51***	0.471	1.29***	0.409	0.647	0.802	1.068	0.775
COOP	-0.246	0.321	-0.386	0.493	-0.078	0.404	-0.109	0.371	-1.837*	0.994	-0.207	0.617
MOB	0.674**	0.337	1.133**	0.477	-0.148	0.455	0.882**	0.379	0.085	0.751	-0.111	0.716
Log likelihood	-138.12		-72.39		-89.78		-109.05		-42.00		-47.20	
Akaike info criterion	1.472		0.827		0.998		1.187		0.529		0.580	
Schwarz criterion	1.667		1.023		1.193		1.382		0.725		0.776	
Hannan-Quinn criter.	1.551		0.906		1.077		1.266		0.608		0.659	

Source: Field Survey

Note: ***significant at 1%, **significant at 5%, *significant at 10%

Table 9.3: Predicted Percentage Change in Adoption of ICTs for Agricultural Decision Making

Variables	Description	FrqAGD	FrqPLNG	FrqINPT	FqCULT	FrqPHS	FrqMKT
INC	Monthly household income (>5000=1, otherwise=0)	-29.03	-76.88	-70.83	-62.49	-74.29	-59.61
AGE	Farmers age (years)	-0.35	-3.88	-0.71	0.32	-0.79	-0.30
EDU	Farmers education (secondary school & above=1, otherwise=0)	-23.64	160.03	69.55	18.28	0.06	-7.59
SOCIAL	Social category of farmers (General/other backward class=1, otherwise=0)	-57.17	-78.80	-85.02	-80.03	-78.85	-91.48
OCPSC	Secondary sources of occupation (Yes=1, No=0)	-71.96	-64.82	-74.09	-72.94	-93.65	-81.35
LEASE	Lease land (>5 ha.=1, otherwise=0)	107.72	91.34	222.99	59.22	65.80	204.46
AGLAND	Farmers operational land holding (hectares)	0.32	0.93	0.69	0.44	2.35	2.05
NOC	Number of crops grown by the farmers	-17.34	-6.52	-12.71	-11.32	0.89	-17.08
GSD	Aware of Government subsidies (Yes=1, No=0)	259.65	20.26	250.68	10.45	-67.32	105.32
DMO	Availed Demonstration Facilities (Yes=1, No=0)	164.70	393.55	353.05	263.44	90.97	190.92
COOP	Cooperative Membership (Yes=1, No=0)	-21.83	-32.03	-7.52	-10.34	-84.07	-18.73
MOB	Mobile own (Yes=1, No=0)	96.23	210.55	-13.73	141.66	8.82	-10.46

Source: Field Survey

The variable 'income' was found not significant for overall information adoption. For planning, input and cultivation decisions, it was found significant at 5% level of significance having negative beta coefficient. It implies that the farmers having income less than Rs. 5000 were more likely to adopt technological information as 77% for planning, 71% for input and 63% for cultivation decisions. The above results indicate that the farmer's socio demographic characteristics are likely to influence information adoption failed partially (hypothesis 1) as 3 out of 5 indicators are not significant whereas 2 indicators are significant.

Farm characteristics are defined as another set of variables influencing the information adoption using ICTs. Though, several studies have established strong relationship between farm size and adoption of technological farming information (Caswell et al., 2001; Yahaya, 2002; Isgin, Bilgic, Forster & Batte, 2008; Boz & Ozcatalbas, 2010; Jans & Kascak, 2001; Tucker & Napier, 2002; Rogers, 2003; Rahelizatovo & Gillespie, 2004).

The results of the study indicate that leasing of land greater than 5 ha is significantly positive factor in the adoption of ICTs for agricultural decision making. The farmers adopted leased land greater than 5 ha are more consistent in farming activities showing their interested concern in adopting farming technologies. The results indicate that the farmers leasing land of >5 ha are 107 % more likely to use innovative farm technologies. It may be due to leasing out of lands possessed by the migrated people, since it witnessed the migration of rural people to urban cities in India at large level because of less profitable farming now a days. Land and labor department recently in 2012 reported that more than two thousand farmers are leaving farming every day in India (The Hindu, May 2, 2013).

Farmers having large land holdings (mean land holding is 9.79 ha) positively influenced the post harvest and marketing decisions and adopt information delivery using ICTs. This may be caused due to possession of large surpluses of the agriculture produce. And they may consider more strategic farming to reap the benefits of opportunity price and to make better income. Thus hypotheses 2 is partially true as 2 out of 3 indicators are statistically not significant.

About the business characteristics of farmers, who are aware of government subsidies like fertilizers subsidies, credit issues, crop insurance etc. are 2.5 times more likely to adopt ICT based information for agricultural decision making (significant at 1% level). The

result also concludes that the farmers who are aware of government subsidies adopt ICT based information 2.5 times more likely to adopt input decisions.

The study suggests that the demonstration facilities play significant role to make farmers more informed decisions regarding their farming practices. The farmers who availed demonstration facilities are 164 % more likely to adopt ICT based information for overall agriculture decisions whereas planning, input and cultivation decisions are better adopted by the farmers using ICT based sources at 1% level of significance. Cooperatives membership of farmers has no effect on ICT driven information except in the case of post harvest decisions. Its negative beta coefficient showed that farmers are 84 % less likely to use ICTs for post harvest information.

The experience of using mobile phone technology assisted agricultural extension services which has opened up the mind and vision of these farmers about modern technology and the changes in the external world and the relevance to their farming and life in general. Subsequently, as reported by several studies (Qiang, Kuek, Dymond & Esselaar, 2011) that by using mobile facilities, farmers are getting more relevant information and are more familiar in accessing the relevant content (Xiaolan & Akter, 2012).

The study found that the farmers having mobile as an asset are 96% more likely to use this for information dissemination for agricultural decisions and 211% for planning and 147% for cultivation decisions, as shown by positive beta coefficient of the regression analysis employed in the study. The negative beta coefficient for marketing and distribution indicates that farmers are 12 % less likely to adopt ICT based information. The findings clearly indicate that the hypotheses 3, which assume that the farmers who are business oriented are more likely to adopt ICT based information for their agricultural decision making, is partially accepted as 3 out of 4 indicators are statistically significant.

9.1 Testing of Hypotheses:

The study assumed three hypotheses to test whether these are affecting the adoption of ICTs based information's use in agricultural supply chain decisions. Summarily we found that the hypothesis 1 (socio-demographic profile of the farmers) was partially failed as five out of three indicators namely 'Age', 'Education' and 'Income' were found not significant. It interprets the findings that these factors are not likely to affect the ICT based information use in agricultural supply chain decisions. The remaining two factors

namely 'secondary occupation' and 'social category' were found to be significant and it indicates that these factors influence on the adoption of ICT based information use in agricultural supply chain.

Table 9.4: Summary of the Testing of Hypotheses

Number	Hypotheses	Sub Hypotheses		Coding of Hypotheses	Results of the Hypotheses
1	**H1**	$H1_{01}$	Age	AGE	Rejected
2		$H1_{02}$	Education	EDU	Rejected
3		$H1_{03}$	Income	INC	Rejected
4		$H1_{04}$	Secondary occupation	OCPSC	Accepted
5		$H1_{05}$	Social category	SOCIAL	Accepted
6	**H2**	$H2_{01}$	Landholding size	AGLAND	Rejected
7		$H2_{02}$	Leasing of lands (>5ha)	LEASE	Accepted
8		$H2_{03}$	Number of crops grown	NOC	Rejected
9	**H3**	$H3_{01}$	Cooperative membership	COOP	Rejected
10		$H3_{02}$	Aware of government subsidies	GSD	Accepted
11		$H3_{03}$	Demonstration facilities	DMO	Accepted
12		$H3_{04}$	Mobile phone owned	MOB	Accepted

The results indicate that hypothesis 2 partially failed as two out of three indicators were found not significant. Leasing of land greater than 5 ha is significantly positive factor in the adoption of ICTs based information use in agricultural decision making. The other two farm characteristic variables, landholding size and number of crops grown have not influenced on the adoption of ICT based information use in agricultural supply chain. The results show that the hypothesis 3 (Business Characteristics of Farmers) which assumes that the farmers who are business oriented are more likely to adopt ICT based information for their agricultural decision making, is partially accepted as 3 out of 4 indicators are statistically significant. It turns out that the factors 'Aware of Government Subsidies', 'Availed Demonstration Facilities' and 'Mobile Phone Owned' influence the adoption of ICT based information use in agricultural decision making. Whereas the factor 'cooperative membership' concerned to the farmers does not influence the adoption of ICT based information use in agricultural decisions making.