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Farmers' Knowledge of ICT Interventions in Indian Agriculture Sector

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ABSTRACT

Present study investigates the farmers' knowledge of Information and Communication Technology (ICT) Interventions in agricultural sector. In this regard the opinion of farmers residing in Haryana State was taken in to consideration. Preliminary investigations lead to development of conceptual frame work of farmers' knowledge. Farmers knowledge is primarily has three constructs i.e. i) Knowledge of Financial and Infrastructural Interventions (KFII); ii) Knowledge of Latest Interventions (KLI); iii) Knowledge of Core Agricultural Interventions (KCAI). Result of primary data analysis the indicate an average response of farmers surveyed towards upper end of the scale which means farmers are aware of ICT interventions and have basic knowledge level and they are not unaware of ICT interventions. At component level, farmers' knowledge level ascertained highest with respect to latest interventions, followed by core agricultural interventions and lastly by financial and infrastructural interventions. A further analysis confirms that farmer's knowledge level is influenced by their education, income and ICT

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

experience levels and result in significantly different opinion in such groups. Whereas, age and farming experience noted as neutral factors resulting no influence on farmers' knowledge regarding ICT interventions.

KEYWORDS: Knowledge, Information, Communication and Technology

INTRODUCTION

"India lives in villages" once said by Mahatma Gandhi, the father of the nation. The social set up in India is a reason why a major portion of the population still resides in rural and semi- urban areas. Major share of population residing in rural India is directly or indirectly dependent on agricultural means. There has been a consistent effort to uplift the rural masses in public policy documents. Rural development, as a whole, can be understood as overall development and advancement in the quality of life of people living in hinterlands. As an integrated process, it constitutes economic, social, political and spiritual development of the economically backward and poorer sections of the rural society. According to Robert Chambers, "rural development is a strategy to facilitate a specific group of people to gain more for their wants and need". It involves helping the poorest people living in the rural areas and demanding for the benefits and development. Generally, these people include small scale, tenants and the landless farmers. In such a situation, Information and Communication Technology (ICT) create new opportunities for rural peoples by improving market information access , lower transaction costs, increasing efficiency, competitiveness and market access for farmers, enhance the ability of participate in the world's economy, agriculture, Health and Education (Srinivas, Venkatanarayana, Sreeram, Vijayasekhar, Yugandhar and Reddy, 2014).

"ICT is a diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information. These technologies include computers, Internet, broadcasting technologies (radio and television), and telephone." Suman (2013). Meera (2013) described ICT) as an umbrella word that consists of hardware, software, channel for gathering, store up, processing, diffusion and presentation of data in any forms. Although, before ICT revolution rural and agricultural sector of India has enjoyed the benefits of several other central government initiatives like green revolution, white revolution, blue revolution and bio technology revolution etc. To cater these needs several ICT-based initiatives like e-governance, sometimes e-commerce and sometimes e-education has been taken by governments and private players in form of Public-Private Partnership (PPP) to implement these models in central areas.

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

Without any question, Information and ICT has played an important function in improvement of communication channels in rural areas. The evolution of ICT in India has put a positive impact on it (Banerjee, 2011). Information and communication developments in agricultural sector are comparatively new for researchers.

Since the ancient time, agriculture has been suffering from traditional approaches and challenges of production, marketing and profit etc. Despite being a major sector of Indian economy the agriculture sector has been facing several bottlenecks in form of scattered market, agricultural illiteracy, lack of awareness, poor rural connectivity, lack of availability of quality information, disintegrated supply chain, absence of proper storage system, dominance of conventional methods and lack of adoption of technological inventions. The pace of growth of Indian economy is mainly based on the performance of agriculture sector. To make into the list of developed nations it is most essential for India that agricultural sector perform at highest level. The information and communication technology (ICT) can significantly deal with these challenges of the traditional agriculture and could play an important role in enriching the rural people. ICT can also contribute in empowering the rural people by providing better access of information, improved agricultural technologies, effective production strategies, markets reach, banking and financial services, government policies of agriculture etc (Sinha, 2013).

Okafor and Malizu (2013) described main points of the agriculture sector like crop cultivation, water management, fertilizer, pest control, harvesting, post-harvest managing, shipping of food products, packaging, food protection, food processing, high-quality control, food safety, food storage, and food advertising and marketing.

E-Agriculture, a technological development of conventional agricultural strategies and practices, is a rising area concentrating on the advancement of agricultural and countryside growth through advanced information and communication technology. E-Agriculture includes the conceptualization, layout, advancement, assessment and utilization of contemporary approaches to use ICT in the rural areas and especially in agriculture sector (Zahedi and Zahedi, 2012).

Milea, Pascu and Nedea, (2013) conceived that Farmers should receive updated information of agriculture related aspects like prices, production techniques, services, storage and processing from use of information and communication technology. This requirement of updated

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

information for change and developments in agriculture sector can be addressed by the effective implementation of ICT interventions (the Internet, mobile phone, and other digital technologies). Better access of ICT can transform lives of farmers because of efficiency brought in with the help of access to price, agriculture information, latest farming techniques and access to national and international news.

The acceptance of ICT has never been easy like any other intervention in other areas. Because every invention or intervention has to pass through various stages of a complex adoption process like awareness, interest, information, trail and then adoption which creates confidence, trust and belief among the farmers. ICTs can have a significant impact on agricultural activities by covering farmers' services in various villages in different local languages in a simultaneous manner (Rao, 2013).

Information and communication technology (ICT) can change the economic environment for poor people in underdeveloped regions of India. The adoption of ICT in rural areas are having many problems like ICT unawareness, availability of useful and local information in their local languages, easy and affordable convenience and knowledge and readiness for acceptance of new technologies etc. Only better ICT services can help the farmers to know the new farming methods, accessibility of latest tools, irrigational suppliers, accessibility of pesticide and fertilizers to enhance the production and efficiency in agriculture and whether information etc. (Kumar and Kumar, 2012).

As relevance of the ICT is established in numerous studies and lot many initiatives are taken in public and private policies. In India more than 50 Information and communication technology (ICT) based projects are functioning in agriculture sector like Deesha, ASHA,AKASHGANGA, FRIENDS, Dhan, Digital Mandi, , Sari, Sks, Akshaya, Cybermohalla, E-Mitra, , Star, Setu, E-Seva, Lokmitra, E-segu, Gramdoot, E-Chaupal, Gyandoot, Tarahaat, Honeybee, Dristee , AGMARKNET, Kisan call centers, Bhoomi, etc. These projects are providing market information, market reach, latest farming techniques and whether information to the farmers which are very beneficial for the growth of agriculture sector. Seeking the importance of ICT and ICT Interventions, a need is felt to observe the knowledge level of the residents of Haryana pursuing agriculture for livelihood. It has been said that rural masses in Haryana are still to take

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

complete advantages of ICT platforms. In order to know the readiness of targeted population about the relevance of ICT intervention, present study was undertaken. Study also look for the influence of farmers' characteristics on their knowledge level of ICT.

OBJECTIVES OF THE STUDY

The primary objective of the study is to analyze the existing knowledge level of the farmers regarding ICT interventions and influence of farmers' demographics on such knowledge. Precisely the objectives are undermined as following:

1. To ascertain the knowledge of farmers about corporate information and communication technology interventions in agriculture sector.
2. To investigate the influence of selected demographics of farmers on their knowledge about corporate information and communication technology interventions.

HYPOTHESES OF THE STUDY

In order to provide a sense of direction to the study and draw conclusion regarding objectives set, following hypotheses are drawn:

H_1: *There is significant difference in farmers' knowledge of corporate information and communication technology interventions in agriculture sector across demographic variables i.e. age, education qualification, annual family income, years of farming (agriculture experience), and years of ICT exposure (ICT experience).*

$H_{1\text{-}1}$: *There is significant difference in farmers' knowledge of corporate information and communication technology interventions in agriculture sector across age.*

$H_{1\text{-}2}$: *There is significant difference in farmers' knowledge of corporate information and communication technology interventions in agriculture sector across education qualification.*

$H_{1\text{-}3}$: *There is significant difference in farmers' knowledge of corporate information and communication technology interventions in agriculture sector across annual family income.*

$H_{1\text{-}4}$: *There is significant difference in farmers' knowledge of corporate information and communication technology interventions in agriculture sector across years of farming (agriculture experience)*

$H_{1\text{-}5}$: *There is significant difference in farmers' knowledge of corporate information and communication technology interventions in agriculture sector across years of ICT exposure (ICT experience).*

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

SAMPLE DESIGN OF THE STUDY

The target population for the study is farmers of Haryana only. In Haryana, a total number of 7.78 lakh (48.11%) marginal farmers own 3.60 lakh hectares cultivable land and 3.15 lakh (19.47%) small farmers have 4.63 lakh hectares. In all, there are a total of 16.17 lakh farmers in the state who own 36.46 lakh hectares of cultivable land. Farming is one of the prime profession of a large number of residents, therefore, famers located in Haryana are taken as the population of the study. The simple random sampling has been used to collect representation from farming community from Haryana. Respondent farmers were chosen with the help of multi- stage random sampling process. Haryana has six administered zones i.e., Ambala, Faridabad, Gurugram, Hisar, Rohtak and Karnal. Initially, one district was selected from each zone randomly from the list of districts covered under all the six administrative zones; Kurukshetra from Ambala zone, Fridabad from Faridabad zone, Mehendergarh from Gurugram zone, Sirsa from Hisar zone, Sonipat from Rohtak zone and Karnal from Karnal zone. Further, randomly four villages were selected randomly from each district (Fridabad:-Jasana, Faridpur, Knaura, Kheri Jmalpur. Kurukshetra:- Amin, Babain, Dabkheri, Daultpur. Mehendergarh:- Beri, Basai, Khatiwas, Satnali. Gurugram:- Hamirpur, Hayatpur, Mankrola, Wazirpur. Sirsa:- Khai Shergarh, Chahar Wala, Rampura Bhisnoian, Daulatpur Khera. Sonipat:- Mudlana, Bahalgarh, Chitana, Hassanpur. Karnal:- Budha Khera, Gularpur, Kutail, Sambhli). In order to identify the respondents, voter list of the selected village is taken in to consideration and respondents were identified randomly. Initially 23 responses were collected from each village making a total of 552 responses for the study. Out of collected responses, 47 responses were eliminated on the basis of extreme values (outliers) and missing data when visually inspected. Hence, total 505 responses were retained for analysis. Sample size is found to be in acceptable range on the principle that sample size should be more than ten times of variables (Hair et al. 2014). The responses rate was 91.48 per cent which was higher than acceptable rate of 52 per cent of individual response for social sciences (Baruch and Holtom, 2008 and Helakorpi, Patja, Prattala, and Uutela, 2010). In order to overcome language barriers, schedule filling is preferred over questionnaire filling for collection of responses of farmers. A summarized profile of respondents with respected to the demographics is as given in the appended table.

Table 1 Demographic Profile of the Sample

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

Variable	Category	Frequency	Percentage
Gender	MALE	482	95.4
	FEMALE	23	4.6
	Total	505	100.0
Age	BELOW 30	225	44.6
	30 TO 40	133	26.3
	41 TO 50	89	17.6
	ABOVE 50	58	11.5
	Total	505	100.0
Social Category	GENREAL	382	75.6
	OBC	90	17.8
	SC/ST	33	6.5
	Total	505	100.0
Education	ILLITERATE	67	13.3
	10TH TO 12TH	266	52.7
	GRADUATE	136	26.9
	POST GRADUATE AND ABOVE	36	7.1
	Total	505	100.0
Agriculture Land in Acre	BELOW 5 ACRES	312	61.8
	6 TO 10 ACRES	119	23.6
	11 TO 15 ACRES	37	7.3
	ABOVE 15 ACRES	37	7.3
	Total	505	100.0
Farming experience	BELOW 5 YEARS	219	43.4
	6 TO 10 YEARS	112	22.2
	11 TO 15 YEARS	59	11.7
	ABOVE 15 YEARS	115	22.8
	Total	505	100.0
Annual Family income	BELOW 50000	126	25.0
	51000 TO 100000	147	29.1
	100001 TO 150000	117	23.2
	ABOVE 150000	115	22.8
	Total	505	100.0
Number of crops taken in a year	One	28	5.5
	Two	421	83.4
	Three	41	8.1
	Four	15	3.0
	Total	505	100.0

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

ICT Exposure	BELOW 5	389	77.0
	6 TO 10	92	18.2
	11 TO 15	16	3.2
	ABOVE 15	8	1.6
	Total	505	100.0
			Source :- Primary Data

DATA COLLECTION MEASURES OF THE STUDY

The study primary data has been collected with help self-structured schedule. The schedule was divided into two parts. The first part of the schedule contains demographic characteristics of the respondents such as age, education level, social category, family income, total land holding, agricultural experiences, ICT exposure and number of crops taken in a year. The second part of the schedule includes farmers' knowledge about agriculture related corporate ICT sources in agriculture sector measured on the basis of 5 point Likert's scale (1= Least Aware, 2= Not Aware, 3= Neutral, 4= Aware, 5= Highly Aware).

In order to get objective specific information, survey schedule was developed with help of relevant studies reviewed in this regard. A brief profile of the scale items considered along with sources are listed in the following table. In accordance with the purpose of survey twenty three statements were retained after taking opinion of field experts and academicians in to the consideration.

Table 2 Statements taken under Consideration for Development of Survey Schedule

S.N.	CODE	ITEMS	ORIGIN/SOURCE
1.	ICTKNOW1	ICT provides support through Financial Institutions.	Ghanshala and Pandey, (2013).
2.	ICTKNOW2	ICT provides the Infrastructure Facilities.	
3.	ICTKNOW3	ICT provides the information of new Employment Opportunities.	
4.	ICTKNOW4	ICT assist the Marketing Training Programs.	Banmeke and Ajayi, (2008) and Alibaygi et al., (2011).
5.	ICTKNOW5	ICT provides the information of Supportive Policy Environment.	
6.	ICTKNOW6	ICT provides information of Computerization of land records and new registration.	
7.	ICTKNOW7	ICT provides the timely information of Weather Forecasts and Calamities	Meera et al., (2012), Kukreja and Chakrabarti, (2013).
8.	ICTKNOW8	ICT provides the of facilities of Online Trading	
9.	ICTKNOW9	ICT provides information of Mandi Rates	

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

10.	ICTKNOW10	ICT provides the information of Soil and Seed	
11.	ICTKNOW11	ICT provides the information of Crop Life Cycle	Williams and Agbo, (2013).
12.	ICTKNOW12	ICT provides the information of Bank loan & Insurance	
13.	ICTKNOW13	ICT provides the information of Modern Tools and Equipments	Nnenna, (2013).
14.	ICTKNOW14	ICT provides the information of Government Policy on Agriculture	
15.	ICTKNOW15	ICT enables the use of mobile technologies as a tool of intervention in agriculture.	Oladele, (2011).
16.	ICTKNOW16	Online purchasing order of agri-inputs and agri-equipments is a subset of E-Commerce.	
17.	ICTKNOW17	ICT provides the information of Irrigation Source and Water Management.	
18.	ICTKNOW18	ICT provides geo-fencing, map-making and surveying of land through Global Positioning System in Agriculture	Kumar and Sankarakumar, (2012).
19.	ICTKNOW19	ICT provides the information of Fertilizer and Pesticide Utilization.	
20.	ICTKNOW20	ICT provides the information of Computer-Controlled devices use in agriculture.	
21.	ICTKNOW21	ICT provides the information of latest Agricultural Schemes	Ali and Kumar, 2011.
22.	ICTKNOW22	ICT Provides facilities of timely Feedback to the farmer	
23.	ICTKNOW23	ICT Provides the information about new research and developments in agriculture.	
Source: Reviewed Research Articles			

FACTORS OF FARMERS' KNOWLEDGE OF ICT INTERVENTIONS

With the help of factor analysis following three factors were identified which constitute the farmers' knowledge:

1. Knowledge of Financial and Infrastructural Interventions (KFII): This is the first factor of measurement scale of knowledge about the information and communication technology services in agricultural sector. It comprises 8 items loading on it in a significant manner namely, *ICT provides support through financial institutions, ICT provides the infrastructure facilities**,** ICT provides the information of new employment opportunities**,** ICT assist the marketing training programs, ICT provides the information of supportive policy environment, ICT enables the use of mobile technologies as a tool of intervention in agriculture, Online purchasing order of agri-*

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

inputs and agri- equipments is a subset of E-Commerce and ICT provides the information of irrigation source and water management.

2. Knowledge of Latest Interventions (KLI): This is the second factor of measurement scale of knowledge about the information and communication technology services in agricultural sector. It comprises 6 items loading on it in a significant manner namely, *ICT provides geo-fencing, map-making and surveying of land through global positioning system in agriculture, ICT provides the information of fertilizer and pesticide utilization, ICT provides the information of computer-controlled devices use in agriculture, ICT provides the information of latest agricultural schemes, ICT provides facilities of timely feedback to the farmer and ICT provides the information about new research and developments in agriculture.*

3. Knowledge of Core Agricultural Interventions (KCAI): This is the third extracted factor of measurement scale of knowledge about the information and communication technology services in agricultural sector. It comprises 6 items loading on it in a significant manner namely, *ICT provides the timely information of weather forecasts and calamities, ICT provides the of facilities of online trading, ICT provides information of mandi rates, ICT provides the information of soil and seed, ICT provides the information of crop life cycle and ICT provides the information of bank loan & insurance.*

ANALYSIS AND INTERPRETATION OF DATA

Knowledge of Farmers about Corporate Information and Communication Technology (ICT) Interventions in Agriculture Sector

As seen in the Table 3, the opinion of farmers falls at 3.25 which indicate an average response towards upper end of the scale which means farmers are aware of ICT interventions and have basic knowledge level and they are not unaware of ICT interventions. The level of farmer's knowledge is further examined on various demographic basis and the study hypotheses are tested. Important findings on select characteristics of farmers is as following:

1. **Education-Wise Farmers' Knowledge about Corporate ICT Interventions**

If measured on farmers' education basis, knowledge level seems to be highest with respect to latest interventions, followed by core agricultural interventions and lastly by financial and infrastructural interventions.

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

Here, the descriptive statistics on the basis of education level of farmers indicates that the maximum of the farmers attained education from 10^{th} to 12^{th} standard (n=266) followed by those who did graduation (n=136). Also, farmers more qualified are more aware and have better knowledge level regarding ICT interventions

Table 3 Education-Wise Farmers' Knowledge about Corporate ICT Interventions

Descriptive Statistics		**N**	**Mean**	**Std. Deviation**
Knowledge about ICT interventions		**505**	**3.2597**	**.74387**
KFII	ILLITERATE	67	2.9723	.71698
	10TH TO 12TH	266	3.1353	.82394
	GRADUATE	136	3.3613	.80867
	POST GRADUATE AND ABOVE	36	3.3929	.91720
	Total	505	3.1929	.82255
KLI	ILLITERATE	67	3.2644	.73404
	10TH TO 12TH	266	3.2675	.80591
	GRADUATE	136	3.5095	.84268
	POST GRADUATE AND ABOVE	36	3.6349	.86219
	Total	505	3.3584	.81918
KCAI	ILLITERATE	67	2.7724	.79503
	10TH TO 12TH	266	3.2312	.90446
	GRADUATE	136	3.3971	.87796
	POSTGRADUATE AND ABOVE	36	3.4097	.85597
	Total	505	3.2277	.89884

Source: Primary Data

The Table 4 and few other similar tables presents the output of Levene's tests and analysis of variance tests with their respective significance. Levene's tests were used to test the equality of variances among different categories of farmers.

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

In the table, the values of Levene's tests for knowledge scale were found above 0.05, except KLI, that confirmed that the assumption of homogeneity of variances is achieved. Further, F test results were considered for finding statistical difference between various groups of the farmers (Table 4.4). Any value less than or equal to 0.05 confirms that significant differences exist among the various groups of farmers. F tests for the factors of knowledge were found significant; communicating that education level has a significant impact on knowledge of the farmers regarding the ICT interventions in the agricultural sector.

Table 4 Education Wise Variance in Farmers' Knowledge about ICT Interventions

Constructs	**Levene Statistic**	**Sig.**	**F**	**Sig.**
Knowledge of ICT Interventions				
KFII	0.819	0.484	4.755	.003
KLI	0.043	0.988	4.382	.005
KCAI	0.523	0.667	8.168	.000
Overall knowledge	0.780	0.505	6.456	.000

Source: Primary data

Farmers having post graduate or higher education shown the highest level of knowledge about *KFII* (mean=3.3929) followed by graduates (mean=3.3613), 10^{th} to 12^{th} class (mean=3.1353) and illiterate farmers (mean=2.9723). In similar manner farmers having post graduate or higher education has shown the highest level of knowledge about KLI (mean=3.6349) followed by graduates (mean=3.5095), 10^{th} to 12^{th} class (mean=3.2675) and illiterate farmers (mean=3.2644). Further, farmers having post graduate or higher education shown the highest level of knowledge about *KCAI* (mean=3.4097) followed by graduates (mean=3.3971), 10^{th} to 12^{th} class (mean=3.2312) and illiterate farmers (mean=2.7724). These metrics indicate a clear positive association between education level and knowledge of the farmers about information and communication technology interventions in the agricultural sector.

Therefore, the hypothesis (H_{1-2}), there is a significant difference in farmers' knowledge of corporate information and communication technology (ICT) interventions in the agriculture sector across education qualification was accepted.

2. Age-Wise Farmers' Knowledge of Corporate ICT Interventions

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

Table 5 demonstrates the descriptive statistics of particular categories of farmers on the basis of their age. These descriptive values show the farmers' knowledge about the information and communication interventions in agriculture across their age groups. The table shows that the majority of the farmers approached to collect data were below 30 years of age (n=225) followed by those aged between 30 and 40 years (n=133).

If measured on farmers' age basis, again knowledge level seems to be highest with respect to latest interventions, followed by core agricultural interventions and lastly by financial and infrastructural interventions.

Table 5 Age-Wise Farmers' Knowledge of Corporate ICT Interventions

Descriptive Statistics		**N**	**Mean**	**Std. Deviation**
Knowledge about ICT interventions		**505**	**3.2597**	**.74387**
KFII	BELOW 30	225	3.1549	.85017
	30 TO 40	133	3.1654	.85874
	41 TO 50	89	3.2295	.75181
	ABOVE 50	58	3.3473	.72652
	Total	505	3.1929	.82255
KLI	BELOW 30	225	3.2533	.82582
	30 TO 40	133	3.4168	.86129
	41 TO 50	89	3.4783	.72527
	ABOVE 50	58	3.4483	.80076
	Total	505	3.3584	.81918
KCAI	BELOW 30	225	3.2467	.92657
	30 TO 40	133	3.2237	.93352
	41 TO 50	89	3.2079	.80679
	ABOVE 50	58	3.1940	.86227
	Total	505	3.2277	.89884

Source: Primary Data

Table 6 presents results of Levene's Test which is used to test the equality of variances among different age groups of farmers. In the table, the values of Levene's tests for the factors of

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

knowledge scale were found above 0.05 that confirmed that the assumption of homogeneity of variances is achieved.

Further, F test results were considered for finding statistical difference between various age-groups of the farmers (Table 4.6). Any value less than or equal to 0.05 confirms that significant differences exist among the various groups of farmers. F tests for the factors of knowledge were found non-significant, communicating that age does not have a significant impact on knowledge of the farmers regarding the ICT interventions in agriculture sector.

Table 6 Age Wise Variance in Farmers' Knowledge about ICT Interventions

Constructs	**Levene Statistic**	**Sig.**	**F**	**Sig.**
Knowledge about ICT Interventions				
KFII	2.243	0.082	0.949	0.417
KLI	1.040	0.374	2.346	0.072
KCAI	0.864	0.459	0.076	0.973
Overall knowledge	0.956	0.413	0.520	0.669

Source: Primary data

Although, farmers aged above 50 years have shown the highest level of knowledge about KFII (mean=3.3473) followed by aged between 41 and 50 years (mean=3.2295), between 31 and 40 years (mean=3.1654) and below 30 years (mean=2.1549). Further, farmers aged between 41 to 50 years have shown the highest level of knowledge about KLI (mean=3.4783) followed by aged above 50 years (mean=3.4483), between 31 and 40 years (mean=3.4168) and below 30 years (mean=2.2533). Surprisingly, farmers aged above 50 years have shown the least level of knowledge about KCAI (mean=3.1940) sequentially lead by farmers aged between 41 and 50 years (mean=3.2079), between 31 and 40 years (mean=3.2237) and below 30 years (mean=3.2467). But all these mean differences were not significantly high so we can say that no relationship exists between age and knowledge of the farmers about information and communication technology interventions in agriculture sector. So, hypothesis (***$H_{1\text{-}1}$),*** *there is a significant difference in farmers' knowledge of corporate information and communication technology (ICT) interventions in agriculture sector across age was rejected.*

3. **Family Income Wise Farmers' Knowledge about Corporate ICT Interventions**

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

Table 7 exhibits the descriptive statistics of individual categories of farmers on the basis of their annual income. These descriptive values show the farmers' knowledge about the information and communication interventions in agriculture across their annual incomes. The table shows that the majority of the farmers have their annual income between 51000 and 100000 INR (n=147) followed by those who have income below 50000 INR (n=126).

When measured on farmers' age basis, again knowledge level seems to be highest with respect to latest interventions, followed by core agricultural interventions and lastly by financial and infrastructural interventions.

Table 7 Family Income Wise Farmers' Knowledge about Corporate ICT Interventions

Descriptive Statistics		**N**	**Mean**	**Std. Deviation**
Knowledge about ICT interventions		**506**	**3.2597**	**.74387**
KFII	BELOW 50000	126	3.0363	.84175
	51000 TO 100000	147	3.1438	.81458
	100001 TO 150000	117	3.1355	.79713
	ABOVE 150000	115	3.4857	.77321
	Total	505	3.1929	.82255
KLI	BELOW 50000	126	3.2698	.84471
	51000 TO 100000	147	3.2877	.79592
	100001 TO 150000	117	3.3480	.85125
	ABOVE 150000	115	3.5565	.76215
	Total	505	3.3584	.81918
KCAI	BELOW 50000	126	3.1052	.91562
	51000 TO 100000	147	3.2024	.94558
	100001 TO 150000	117	3.1432	.84863
	ABOVE 150000	115	3.4804	.82793
	Total	505	3.2277	.89884

Source: Primary Data

Table 8 presents the output of Levene's tests and analysis of variance tests with their respective significance. Levene's tests were used to test the equality of variances among different categories

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

of farmers. In the table, the values of Levene's tests for knowledge scale were found non-significant i.e. below 0.05 that confirmed that the assumption of homogeneity of variances is violated. For these factors Welch tests were used to know the significant differences if any. The result of Welch test shows the significance difference in the ICT initiatives across.

Table 8 Family Income Wise Variance in Farmers' Knowledge about ICT Interventions

Constructs	**Levene Statistic**	**Sig.**	**F**	**Sig.**
Knowledge about ICT Interventions				
KFII	1.054	0.368	6.985	0.000
KLI	3.073	0.027	3.144	0.025
KCAI	1.835	0.140	4.277	0.005
Overall knowledge	1.886	0.131	5.957	0.001

Source: Primary data

Further, F test results were considered for finding the statistical difference between various groups of the farmers on the basis of their monthly family income (Table 8). Any value less than or equal to 0.05 confirms that significant differences exist among the various groups of farmers. F tests for all the factors of knowledge were found significant; communicating that education level has a significant impact on knowledge of the farmers regarding the ICT interventions in agricultural sector. Farmers having annual income above 150000 shown the highest level of knowledge about KFII (mean=3.4857) followed by farmers having annual income between 51000 to 100000 (mean=3.1438), between 100001 to 150000 (mean=3.1355) and below 50000 (mean=3.0363). In similar manner farmers having annual income above 50000 shown the highest level of knowledge about KLI (mean=3.3580) followed by farmers having annual income between 100001 to 150000 (mean=3.1438), between 51000 to 100000 (mean=3.2877) and below 50000 (mean=2.2698). Further, farmers having annual income above 150000 shown the highest level of knowledge about KCAI (mean=3.4804) followed by farmers having annual income between 51000 to 100000 (mean=3.2024), between 100001 to 150000 (mean=3.1432) and below 50000 (mean=3.1052). These metrics indicate a clear statistical significant positive association between education level and knowledge of the farmers about information and communication technology interventions in agricultural sector. *So, hypothesis (H_{1-3}), there is significant*

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

difference in farmers' knowledge of corporate information and communication technology (ICT) interventions in agriculture sector across annual family income is accepted.

4. Agriculture Experience Wise Farmers' Knowledge about Corporate ICT Interventions

Table 9 presents the descriptive of individual categories of farmers on the basis of their agricultural experience. These descriptive values show the farmers' knowledge about the information and communication interventions in agriculture across their agricultural experience. The table shows that the majority of the farmers have agricultural experience below 5 years (n=219) followed by those who have experience above 15 years (n=115).

Table 9 Agriculture Experience Wise Farmers' Knowledge about Corporate ICT Interventions

Descriptive Statistics		**N**	**Mean**	**Std. Deviation**
Knowledge about ICT interventions		**505**	**3.2597**	**.74387**
KFII	BELOW 5 YEARS	219	3.1155	.81745
	6 TO 10 YEARS	112	3.2730	.88512
	11 TO 15 YEARS	59	3.0436	.79107
	ABOVE 15 YEARS	115	3.3391	.76240
	Total	505	3.1929	.82255
KLI	BELOW 5 YEARS	219	3.2492	.82575
	6 TO 10 YEARS	112	3.4452	.80029
	11 TO 15 YEARS	59	3.3656	.75279
	ABOVE 15 YEARS	115	3.4783	.84028
	Total	505	3.3584	.81918
KCAI	BELOW 5 YEARS	219	3.2317	.92165
	6 TO 10 YEARS	112	3.2746	.94259
	11 TO 15 YEARS	59	3.1102	.78958
	ABOVE 15 YEARS	115	3.2348	.86937
	Total	505	3.2277	.89884

Source: Primary Data

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

Table 10 presents the output of Levene's tests and analysis of variance tests with their respective significance. Levene's tests were used to test the equality of variances among different categories of farmers across their agricultural experience. In the table, the values of Levene's tests for knowledge scale were found above 0.05 that confirmed that the assumption of homogeneity of variances is achieved.

Table 10 Agriculture Experience Wise Variance in Farmers' Knowledge about ICT Interventions

Constructs	**Levene Statistic**	**Sig.**	**F**	**Sig.**
Knowledge about ICT Interventions				
KFII	0.780	0.506	2.893	0.035
KLI	0.608	0.610	2.562	0.054
KCAI	0.728	0.536	0.440	0.724
Overall knowledge	0.593	0.620	1.678	0.171

Source: Primary data

Further, F test results were considered for finding statistical difference between various groups of the farmers (Table 10). Any value less than or equal to 0.05 confirms that significant differences exist among the various groups of farmers. F tests for the factors of knowledge were found significant only for KFII communicating that agricultural experience of the farmers has a significant impact on knowledge of the farmers regarding the KFII of ICT interventions in agricultural sector. Farmers having above 15 years of experience have shown the highest level of knowledge about KFII (mean=3.3391) followed by those having experience between 6 to 10 years (mean=3.2730), below 5 years (mean=3.1155) and 11 to 15 years (mean=2.0436). Further, farmers having above 15 years of experience have shown the highest level of knowledge about KLI (mean=3.4783) followed by those having experience between 6 to 10 years (mean=3.4452), 11 to 15 years (mean=3.3656) and below 5 years (mean=3.2492. Further, farmers having between 6 to 10 years of experience have shown the highest level of knowledge about *KCAI* (mean=3.2746) followed by those having experience above 15 years (mean=3.2348), below 5 years (mean=3.2317), and 11 to 15 years (mean=3.1102). These metrics indicates that no significant association between agricultural experience and knowledge of the farmers exist about KLI and KCAI interventions of ICT. *Thus, hypothesis ($H_{1\text{-}4}$), there is significant difference in*

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

farmers' knowledge of corporate information and communication technology (ICT) interventions in agriculture sector across years of farming (agriculture experience) got rejected.

5. ICT Experience Wise Farmers' Knowledge about ICT Interventions

Table 11 presents the descriptive statistics of particular categories of farmers on the basis of their ICT experience. These descriptive values show the farmers' knowledge about the information and communication interventions in agriculture. The table indicated that the maximum of the farmers have agricultural experience below 5 years (n=389) followed by those who had experience between 6 to 10 years (n=92).

Table 11 ICT Experience Wise Farmers' Knowledge about ICT Interventions

Descriptive Statistics		**N**	**Mean**	**Std. Deviation**
Knowledge about ICT interventions		**505**	**3.2597**	**.74387**
KFII	BELOW 5	389	3.1414	.84185
	6 TO 10	92	3.3975	.74361
	11 TO 15	16	3.2679	.62352
	ABOVE 15	8	3.1964	.83627
	Total	505	3.1929	.82255
KLI	BELOW 5	389	3.3000	.81883
	6 TO 10	92	3.5512	.78291
	11 TO 15	16	3.6607	.75028
	ABOVE 15	8	3.3750	1.04404
	Total	505	3.3584	.81918
KCAI	BELOW 5	389	3.1671	.92417
	6 TO 10	92	3.4348	.76124
	11 TO 15	16	3.4375	.86843
	ABOVE 15	8	3.3750	.88641
	Total	505	3.2277	.89884

Source: Primary Data

Table 12 presents the output of Levene's tests and analysis of variance tests with their respective significance. Levene's tests were used to test the equality of variances among different categories of farmers. In the table, the values of Levene's tests for knowledge scale were found above 0.05

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

that confirmed that the assumption of homogeneity of variances is achieved. It was found significant for KCAI factor of knowledge (0.022).

Table 12 ICT Experience Wise Variance in Farmers' Knowledge about ICT Interventions

Constructs	Levene Statistic	Sig.	F	Sig.
Knowledge about ICT Interventions				
KFII	1.771	0.152	2.472	0.061
KLI	0.655	0.580	3.124	0.026
KCAI	3.229	0.022	2.604	0.051
Overall knowledge	1.095	0.351	3.441	0.017

Source: Primary data

Further, F test results were considered for finding statistical difference between various groups of the farmers (Table 12). Any value less than or equal to 0.05 confirms that significant differences exist among the various groups of farmers. F test for KLI factor of knowledge found significant, communicating that education level has a significant impact on knowledge of the farmers regarding the KLI ICT interventions in agricultural sector. For rest other factors of knowledge and perception the analysis of variance test results found non-significant. Farmers having ICT experience between 11 to 15 years have shown the highest level of knowledge about KLI (mean=3.6607) followed by those having experience between 6 to 10 years (mean=3.5512), above 15 years (mean=3.3750) and below five years (mean=3.3000). These metrics indicated mixed results about association between ICT experience and knowledge of the farmers about information and communication technology interventions in agricultural sector. *Thus, hypothesis ($H_{1\text{-}5}$), there is significant difference in farmers' knowledge of corporate information and communication technology (ICT) interventions in agriculture sector across years of ICT exposure (ICT experience) was accepted.*

CONCLUSION

The study investigated the farmers' knowledge of Information and Communication Technology (ICT) Interventions in agricultural sector. In this regard the opinion of farmers residing in Haryana State was taken in to consideration. Preliminary investigations lead to development of conceptual frame work of farmers' knowledge. Farmers knowledge is primarily has three constructs i.e.

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

i) Knowledge of Financial and Infrastructural Interventions (KFII)**:** This is the first factor of measurement scale of knowledge about the information and communication technology services in agricultural sector. It comprises 8 items loading on it in a significant manner namely, ICT provides support through financial institutions, ICT provides the infrastructure facilities**,** ICT provides the information of new employment opportunities**,** ICT assist the marketing training programs, ICT provides the information of supportive policy environment, ICT enables the use of mobile technologies as a tool of intervention in agriculture, Online purchasing order of agri-inputs and agri- equipments is a subset of E-Commerce and ICT provides the information of irrigation source and water management.

ii) Knowledge of Latest Interventions (KLI): This is the second factor of measurement scale of knowledge about the information and communication technology services in agricultural sector. It comprises 6 items loading on it in a significant manner namely, ICT provides geo-fencing, map-making and surveying of land through global positioning system in agriculture, ICT provides the information of fertilizer and pesticide utilization, ICT provides the information of computer-controlled devices use in agriculture, ICT provides the information of latest agricultural schemes, ICT provides facilities of timely feedback to the farmer and ICT provides the information about new research and developments in agriculture.

iii) Knowledge of Core Agricultural Interventions (KCAI): This is the third extracted factor of measurement scale of knowledge about the information and communication technology services in agricultural sector. It comprises 6 items loading on it in a significant manner namely, ICT provides the timely information of weather forecasts and calamities, ICT provides the of facilities of online trading, ICT provides information of mandi rates, ICT provides the information of soil and seed, ICT provides the information of crop life cycle and ICT provides the information of bank loan & insurance.

Result of primary data analysis the indicate an average response of farmers surveyed towards upper end of the scale which means farmers are aware of ICT interventions and have basic knowledge level and they are not unaware of ICT interventions. At component level, farmers' knowledge level ascertained highest with respect to latest interventions, followed by core agricultural interventions and lastly by financial and infrastructural interventions. A further analysis confirms that farmer's knowledge level is influenced by their education, income and ICT experience levels and result in significantly different opinion in such groups. Whereas, age

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

and farming experience noted as neutral factors resulting no influence on farmers' knowledge regarding ICT interventions.

As knowledge is generally taken as retrievable information which can leverage into an advantage. The farmers' knowledge level can also be related with farmers' awareness level regarding ICT intervention. Results confirmed the farmers knowledge level at preliminary level, therefore inference can be drawn that they are informed insufficiently. Farmer need to be promoted more about the various ICT intervention, so that they can be motivated to utilize the interventions in farming progressively. All public and private ICT policies need to be adapted as per the characteristics of the farmers and other regional limitations. Researcher may pursue for factors restricting reach of farmers to ICT, all technological, cultural and social barriers need to investigate. The usefulness of various ICT initiatives also need to investigated.

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Vol-68-Issue-1-January-2020

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Vol-68-Issue-1-January-2020

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