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RESEARCH ARTICLE

Understanding agricultural grower's information seeking: An analysis of Internet sources

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ABSTRACT

Information is indispensable for the sustainability and growth of every type of business. Farmers are also among those who cannot survive without the proper acquisition and application of Information. However, very few studies have considered the farmer's need for and the seeking of information which is why to fill this gap, the study looked into the information sources used by farm growers to get the required information, the influence of land size on the utilization of information sources, and how different characteristics related to sources and individuals influence attitude toward the usage of internet sources and provided a model that takes into consideration crucial factors and their influence on attitude toward searching for information from Internet sources. Data were acquired from 400 farmers using a multistage stratified disproportionate sampling procedure and a standardized questionnaire. For evaluating the given data, various analysis techniques were utilized such as Descriptive statistics, Correlation analysis, One-way ANOVA, Factor analysis, and Multiple regression Analysis. The data were evaluated by using SPSS version 25. Farmers, according to the findings, mostly rely on other farmers and input dealers, and mass media sources of information like radio, television, magazines, and newspapers, to acquire information associated with agricultural activities. They commonly utilize mobile social media apps when surfing the internet. Furthermore, the findings discovered that there is a significant difference in the usage of various sources of information, including television, radio, newspapers/magazines, other farmers, input dealers, Krishi Vigyan Kendras, Krishi melas, the state department of agriculture, state agriculture universities, and the Internet on mobile phones-social media applications, depending on the farmers' farm size. The findings also revealed that the factors that were significantly positively associated with farmers' attitudes about internet use were, perceived usefulness, ease of use, information quality, facilitating conditions, and social influence. The technology Acceptance Model was used as the foundation for the research framework. By examining past research, the study has discovered additional factors that may influence technology adoption in addition to the two main components of the Technology Acceptance Model, namely perceived usefulness and perceived ease of use. The proposed model may assist information providers in their attempts to lessen and overcome barriers to farmers' usage of technology. When building effective extension and dissemination programs, the preferred information-gathering modalities of a certain group of farmers should be considered. Intervention techniques must take into account the wide range of information that needs to be seen in farming communities. As a result, information providers must provide context-specific information through the sources that farmers prefer, while also considering the factors that influence their adoption and overcoming those barriers that prohibit farmers from using such sources. The study categorized farmers into four categories based on land size, which would assist information providers

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in acquiring a thorough grasp of each category of farmer and in developing separate and unique strategies for each type of farmer.

Keywords: information sources; the channel of information; internet use; technology adoption; information search behavior

1. Introduction

In rural areas where large stretches of land are farmed, agriculture is one of the most important economic drivers since it generates revenue, jobs, and food for the majority of people. Agriculture is an important industry that contributes considerably to the economy of the majority of developing nations. It offers food for an expanding population, key products and raw materials for manufacturing sectors, surplus labor to the industrial sectors, and is an important connection in the value chain[1]. The achievement of numerous Sustainable Development Goals (SDGs) might be aided by raising the agricultural productivity of farmers, which would also help to alleviate poverty and increase food security and nutrition on various levels. Only by delivering the knowledge that farmers need will help this goal to be accomplished. However, farmers in most developing nations face difficulties in getting access to information akin to marketing, expertise, and knowledge which could assist in increasing their income, and among those farmers, small farmers are more devoid of these services and benefits[2,3]. Farmers need different information for day-to-day agricultural activity such as Seeds availability, new crop production, fertilizer availability, insecticide availability, water management, weather information and new agricultural equipment and along with them they need information related to marketing, government schemes, transport facilities, bank credit, crop insurance, milk production, irrigation, medicinal plants and many more[4]. The needs of smallholder farmers must be prioritized because they play a significant role in the food production and livelihood of people in the majority of developing and low-income countries[5] and account for the largest percentage of food production in total food production. Utilizing information and communication technology (ICT), such as web search on mobile phones/computers, agricultural-related applications on mobile phones/computers and other social media applications for which internet connectivity is required by farmers is one method of managing and addressing problems that restrict agricultural productivity and development. As discussed by Verdier-chouchane and Karagueuzian[6] and Khan Tithi, Chakraborty, and Aktar[7], due to the development of the internet and increased worldwide connectivity, technological advancements have a big potential to improve farmers' livelihoods. These studies have also demonstrated that farmers in regions where ICT is fully exploited are quickly acquiring information associated with agriculture such as meteorological conditions, recommended agronomical methods, and data related to price. The majority of farmers, deplorably, have not properly utilized these advantages. The successful use of ICTs in developing nations is hampered by issues such as less acquaintance as well as know-how in the utilization of the types of technologies, the inability to afford mobiles/computers, the use of foreign languages in applications, and network issues[3,8]. Consequently, it is necessary to research how farmers seek information. There are various other models of information seeking. A few of them are Krikelas[9], Ellis[10], Kuhlthau[11], Järvelin[12], Foster[13], etc. The model information-seeking behavior provides guidelines for setting research questions and formulation of the hypotheses. Information is meaningless if it is not accessed at the appropriate time, therefore, information sources play a crucial role in supplying the required information to farmers.

Users receive information from both personal and impersonal sources. Personal sources involve direct face-to-face information interaction, whereas informal sources do not. Impersonal sources include mass media, the Internet, and other technologies that do not need consumers to go a long distance to obtain information and are therefore more comfortable to use. Along with impersonal sources such as the internet, personal sources are also imperative in the acceptance of innovation and it goes to farming also. According to McBride and

Daberkow[14], Kountios et al.[15], and Caffaro et al.[16], participation in formal institutions (e.g., farmers' associations and organizations) and extension service membership is the most powerful determinants of farmers' adoption of various types of innovations. According to Leeuwis and Aarts[17] and Unay Gailhard et al.[18], regular informal interactions amongst farmers promote the adoption of farming innovations more than formal communication occasions (such as farmers' organizations or extension service events). As a result, it is critical to increase both understanding and adoption of personal and impersonal sources, as well as research how farmers interpret these two types of sources. However, the study's goal is limited to one type of source, namely internet sources, and the study's main goal is to establish the factors that influence the farmer's decision to use internet sources. To achieve this goal, the Technology Acceptance Model is used as a basic model.

Many ideas have been proposed to explain why individuals want to use or adopt a technology. For example, Davis[19] created the Technology Acceptance Model (TAM), which has been widely utilized and empirically evaluated in studies related to the adoption of technology. On the basis of the amount of recent empirical support, TAM is among the most usable as well as popular models that have studied technology acceptance and its continuation acceptance[20–22]. TAM was created to assist the implementers of technology to examine that will target individuals accept the new innovation[21].

According to Davis[19], the important constructs of TAM are Perceived Usefulness and Perceived ease of use along with attitudinal and behavioral intentions to adopt new technology. TAM has originated from the theories of psychology such as the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB) and turned out to be an imperative model in envisaging the behavior of humans' acceptance or rejection of technology in the future. It has been extensively implemented and extended by several scholars in the field of technology adoption due to its simplicity and robustness. Several studies on technology acceptance and information technology have found that TAM predicts individual technology acceptance[21]. However, researchers have specified that these constructs of TAM alone might not effectively describe the exact effects of technical and usage-context fundamentals that may impact user acceptance of technology[20,21,23,24] and highlighted that these two major two constructs of TAM may not completely elucidate behavioral intention of users towards internet usage.

Eventually, several research were conducted to look for other indicators that can predict mobile phone use, particularly in the agri-food sector[20]. Various researchers have investigated the essential factors influencing technology acceptance, actual usage, and behavioral intention of individual users[25]. Several studies have extended the original TAM by adding new constructs to acquire a better understanding of the possibility of technology uptake. As a result, the incorporation of other factors can aid and improve TAM's prediction power[26]. The original TAM has been illustrated in **Figure 1**.

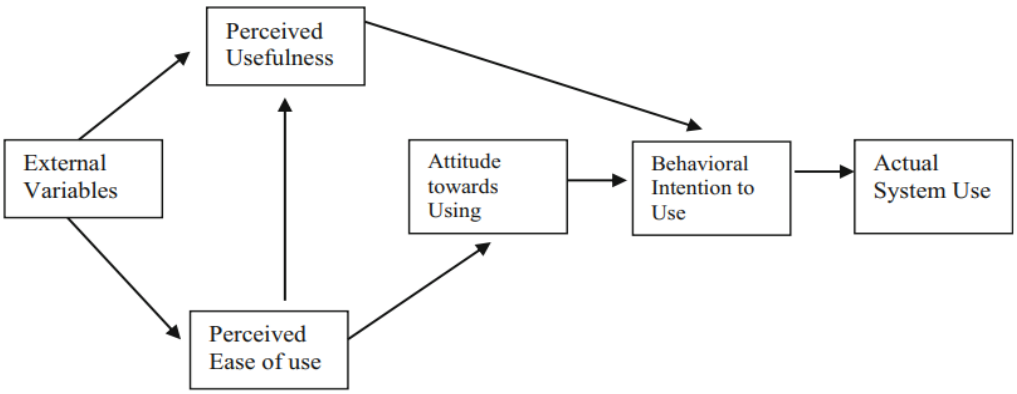

Figure 1. Technology acceptance model[19].

Table 1 includes all the studies that have been conducted in the past on the factors that impact the utilization of Internet sources. The study has reviewed different past studies and included only a few factors to conduct an empirical investigation of the respondents under study.

Table 1. Overview of some previous studies considered.

S. No.	Country	Sample	Factors impacting utilization of Internet sources of information
[27]	Vietnam	Farmers	Perceived ease of use and perceived usefulness
[28]	Italy	Farmers	Performance expectations, the complexity of technologies, and social influence
[29]	Philippines	Farmers	Age, education, income, farm size, number of smartphones, internet usage, perceived innovativeness, information awareness, perceived usefulness, social influence, perceived ease of use, and perceived cost
[30]	Nigeria	Farmers	Perceived usefulness, information awareness, social influence, perceived risk, perceived cost
[31]	Italy	Farmers	Perceived usefulness
[32]	Germany	Farmers	Farm size
[33]	Trinidad	Farmers	Performance expectancy, effort expectancy,social influence, facilitating conditions, experience with using technology
[34]	Serbia	Farmers	Farmer's innovativeness
[35]	Malaysia	Employees of agro-based small and medium enterprises	Performance expectancy, Innovativeness,organizational size, Effort expectancy, Facilitating conditions
[36]	Ethiopia	Farmers	Distance from the electric power source, years of education, income, age, and farm size
[37]	Pakistan	Farmers	Education, land holding size
[38]	Mali	Farmers	Relative advantage, compatibility, suitability and information quality
[39]	United States	Farmers	Education, age, farm size
[40]	Bangladesh	Farmers	Tech-service promotion and tech-service attributes, Perceived Usefulness (PU) and Perceived Ease of Use (PEU), and social influence
[41]	Iran	Farmers	Yield per hectare, size of cultivated land holding, education level, social status, age
[42]	India	Farmers	Age, sex, and size of land holding

1.1. Statement of the problem

The study investigated the types of information sources used by farmers to obtain the necessary information related to their agricultural activities, and these sources were also compared on the basis of farmers' land size to see if information source utilization differed with different land sizes. The study also explored the factors that influence farmers' choices of internet sources. Proper knowledge of the information sources utilized such as the media, other farmers, input dealers, ICT, and other sources, as well as the factors that influence internet adoption, will support the development of new and modification of an existing information distribution system, as well as in providing upgraded extension services for improving socioeconomic standing. Several studies[29,39,43,44,45–48] have concentrated on the socioeconomic features of farmers that influence internet source usage, but have disregarded source characteristics as well as individual traits that may influence internet source adoption. This investigation was essential because there is a necessity to fill this gap. These distinct objectives have been devised in response to the various gaps in the research.

1) To study the impact of land size on the frequency of utilization of information sources.
2) To identify the factors influencing the selection of internet sources.

1.2. Research framework

TAM was utilized as a basic model in this study to explore farmers' acceptance of technology. Previous research has discovered additional factors that potentially influence technology adoption in addition to the two basic components of TAM, namely perceived usefulness and perceived ease of use[35,49–51]. The study created

Table 2. Factor-related items and their sources.

Factor	Items	Source
Innovativeness	• INN1—I like to try a new innovation/technology firstly just after I hear about it • INN2—I love to follow new trends and technologies • INN3—My friends and relatives frequently ask me for information related to modern technology • INN4—I am usually one of the first person in my group to explore the new technologies • INN5—I consider myself to be an innovative type of person • INN6—I usually consider new innovation only if I see other people using it	[52]
Social influence	• SI1—Fellow Farmers who influence my behavior feel that I should use internet sources for searching agricultural information • SI2—Fellow Farmers and relatives who are important to me feel that I should consider the usage of internet sources for searching agricultural information • SI3—The individuals who are very close to me will support me in using internet sources for getting the required information • SI4—People who are very close to me suggest me to use internet sources for information searching	[53]
Information quality	• IQ1—I can get abundant information from Internet sources (including information on government notifications) • IQ2—The information available on internet sources is reliable • IQ3—Internet sources provide information tailored to farmer's interest • IQ4—Internet sources provide the information when it is required • IQ5—Internet sources provide information that is easy to understand	[54–56]
Search effort	• SE1—I have to devote a lot of time to obtain access to internet sources • SE2—It would take a lot of effort to reach internet sources • SE3—It would be difficult to get to internet sources • SE4—It would take too long to reach internet sources • SE5—It would be not very easy to approach internet sources	[57–59]
Facilitating conditions	• FC1—I have all the resources that are necessary to use internet sources • FC2—I have proper knowledge which is required to use internet sources • FC3—Internet sources are compatible with other technologies that I use • FC4—I get help from others (e.g., extension agents or children) when I face difficulty in using internet sources • FC5—Government also motivates and supports to use of internet sources for getting information regarding agricultural activities.	[53]
Perceived usefulness	• PU1—I found that Internet sources are useful in my agricultural activities • PU2—Using internet sources increase my chances of achieving high productivity • PU3—Using Internet sources simplify my agricultural activities • PU4—Internet sources help me in accomplishing tasks more quickly on the farm • PU5—Internet sources improve my performance in agricultural activities	[60]
Perceived ease of use	• EOU1—Learning how to use internet sources is very easy for me • EOU2—It is easy for me to become skillful in using internet sources • EOU3—It is easy for me to remember how to perform tasks using internet sources • EOU4—Interacting with internet sources does not require a lot of mental effort	[61]
Search attitude	• ATT1—I feel satisfied while searching agriculture-related information on internet sources • ATT2—Searching for information on the internet source is an intelligent decision • ATT3—I enjoy for searching information on internet sources • ATT4—I feel dissatisfied while looking for information from internet sources	[62–64]

a conceptual research model based on an examination of a variety of studies relevant to technology acceptance in general and internet technology in particular. **Table 2** shows the factors used to create a framework as well

as their sources.

Figure 2 depicts the research model recommended for this study. This study establishes a research framework based on seven independent variables, namely perceived usefulness, perceived ease of use, search effort, facilitating conditions, social influence, innovativeness, and information quality, which have been discovered through a review of the literature. The effect of these independent variables on farmers' attitudes regarding using Internet sources to search for agricultural knowledge will be investigated. This study aims to improve Indians' attitudes toward using internet sources by using five more variables that expand the TAM. Based on the previous studies, various hypothesis has been developed.

Figure 2. Research framework.

1.3. Research hypothesis

1) There are significant differences in the frequency of utilization of agricultural information sources among different categories of farmers based on land size.
2) There is a positive and significant influence of Innovativeness (INN) on Attitude towards using Internet Sources (ATT).
3) There is a positive and significant influence of Information quality (IQ) on Attitude towards using Internet Sources (ATT).
4) There is a positive and significant influence of Perceived Usefulness (PU) on Attitude toward using Internet Sources (ATT).
5) There is a positive and significant influence of Perceived Ease of Use (PEU) on Attitude toward using Internet Sources (ATT).
6) There is a positive and significant influence of Facilitating Conditions (FC) on Attitude toward using Internet Sources (ATT).
7) There is a positive and significant influence of Social Influence (SI) on Attitude toward using Internet Sources (ATT).

8) There is a negative and significant influence of Search effort (SE) on Attitude toward using Internet Sources (ATT).

2. Methodology

2.1. Study area

The Malwa region of Punjab, India, was chosen as the study location since it covers roughly 60%–70% of the state's land area. Firozpur, Faridkot, Fazilka, Shrimuktsar Sahib, Bathinda, Moga, Barnala, Ludhiana, Mansa, Patiala, and Sangrur are among the 11 districts that comprise the Malwa region. Poadh is one of Punjab's most important regions, yet it is merely incorporated into Malwa and does not have its own status. Poadh (Ropar) includes districts like Fatehgarh Sahib, Rupnagar, and Ajitgarh (Mohali).

2.2. Sampling design

In this investigation, multistage sampling was used. The Malwa region of Punjab, India, was chosen as the study area since it accounts for roughly 60%–70% of Punjab's land area. Following that, stratified sampling was used to classify farm households into small (less than 2 ha), semi-medium (2–4 ha), medium (4–10 ha), and large (10 ha and beyond). On Survey Monkey, the total sample size for a finite population was calculated to be 384. As a result, a final selection of 400 responders was made. Those 400 respondents were further separated based on land size, and an equal number of respondents were chosen for each category using the proportionate sampling technique, i.e., 100 respondents in each category. One specific fraction or a percentage is applied to subgroups i.e., ¼. Finally, judgmental sampling was employed in the selection process of 400 farm households for the field survey.

2.3. Data collection

As the primary mode of data gathering, a field survey was carried out. A survey can collect a huge number of responses, allowing statistical analysis techniques to be used[65]. A survey method was used which involved standardized questionnaires that included questions about the kind of sources used for gathering agricultural information, as well as statements about farmers' perceptions of various characteristics of sources and individuals that could influence their use of internet sources.

2.4. Data analysis

Quantitative data analysis techniques have been utilized in the study which includes descriptive statistics like frequencies and percentages to define the profile of respondents, as well as mean and standard deviation to rank the farmers' use of information sources. The one-way ANOVA method was utilized to determine differences in information source utilization among different farm sizes. The current study applies correlation analysis, Factor analysis, and multiple regression analysis in order to study the impact of the identified independent variables on the dependent variables i.e., attitude. The data was analyzed using SPSS version 25.

3. Results

3.1. Socioeconomic characteristics of the farmers

Results given in **Table 3** display that the maximum number of farmers were within the age range of 31–40 years i.e., 31.5% followed by the age range of 21–30 with 21.5% of respondents. 82.8% of farmers are married, with only a small minority of farmers being single. Only about 21% of respondents had no formal education; a larger proportion (79.1%) had formal education. Farmers ability to use ICTs and recognize their usefulness in farming activities would be enhanced through education. Education has been noted as a crucial component in the adoption and absorption of technology by Adesina and Baidu-Forson[66].

Table 3. Socioeconomic characteristics of the farmers (n = 400).

Characteristics		Frequency	Percentage
Age (in years)	Less than 21 years	12	3.0
	From 21 to 30 years	86	21.5
	From 31 to 40 years	126	31.5
	From 41 to 50 years	72	18.0
	From 51 to 60 years	79	19.8
	More than 60 years	25	6.3
Marital status	Single	69	17.3
	Married	331	82.8
Educational qualification	No formal education	84	21.0
	Primary education	98	24.5
	Secondary education	111	27.8
	Graduate	73	18.3
	Post graduate	34	8.5
Household size (Number of household persons)	5 or less than 5	206	51.5
	6–10	164	41.0
	11–15	30	7.5
Income from farming (in rupees/per annum)	50,000 or less than 50,000	54	13.5
	50,001–100,000	177	44.3
	100,001–150,000	42	10.5
	150,001–200,000	42	10.5
	200,001–250,000	59	14.8
	More than 250,000	26	6.5
Farming experience (in years)	10 or less than 10	179	44.8
	11–20	150	37.5
	21–30	57	14.3
	31–40	14	3.5
Farm size (in Ha)	Below 2 hectares	100	25.0
	2–4 hectares	100	25.0
	4–10 hectares	100	25.0
	10 or above 10 hectares	100	25.0

The majority of farmers have a household size of 5 or less, followed by 6–10, with only a few farmers having a family size of 11 to 15. Furthermore, the findings revealed that the majority of farmers had 10 or less years of experience, followed by 11–20, 21–30, and so on. According to the findings, just a small percentage of farmers earn a good living, with the majority earning in the range of 50,001–100,000, or 44.3% of total respondents, and only 21.3% earning more than 2 lakhs per year from their agricultural company. As a result, numerous activities must be implemented to boost farmer income levels in order to ensure agricultural sustainability for future generations.

3.2. Utilization of agricultural information sources

Different categories of sources were recognized—ICT sources, interpersonal sources, mass-media

sources, extension programs, and other sources. ICT consists of the internet on mobile phones and computers. Utilization of these sources is measured using a 7-point Likert scale i.e., 1—Never, 2—once in a year, 3—several times in a year, 4—once in a month, 5—several times in a month, 6—once in a week and 7—several times in a week.

Descriptive analysis findings presented in **Table 4** specified that farmers still prefer to acquire knowledge on agriculture through their personal links such as from other farmers (Mean = 4.59, S.D = 1.529) and input dealers (Mean = 4.56, S.D. = 1.618) and these results are consistent with the findings given[67–70]. These sources are further followed by the utilization of mass media sources such as television, radio, and newspapers/magazines because they are more convenient and inexpensive to use in comparison to internet sources. It can be observed from the interpretation of mean results given in **Table 4**, that still farmers are not properly utilizing these sources of information and efforts should be made to increase their utilization in order to provide the relevant information at the proper time. To compare the utilization of information sources on the basis of the land size of the farmers, one-way ANOVA was utilized. According to Ostertag et al.[71], One Way Annova is robust with regard to the assumption of normality. Still, the values of skewness and kurtosis were found to be within acceptable limits to prove normality i.e., for skewness is between −2 to +2 and kurtosis is between −7 to +7)[72,73]. The second assumption was also tested to examine whether variances are equal or not i.e., Levene's Test for Homogeneity of Variances. The findings indicated that only few variables confirm to the requirement of homogeneity of variance with a *p*-value greater than 0.5. So, the robust test of equality of means i.e., Brown Forsythe test for the equal sample was used whose results were similar to the results of

Table 4. Descriptive analysis of utilization of information sources.

Information sources	$\bar{x}$	**Σ**
Other farmers	4.59	1.529
Input dealers/shops/private companies	4.56	1.618
Television	4.25	1.680
Radio	4.10	1.949
Newspaper/magazines	3.33	2.089
Internet on mobile-social media applications like YouTube, Facebook, Instagram, and Twitter	3.28	1.837
Krishi Mela	3.08	1.841
Call and SMS services of mobile phones	2.82	1.420
Internet on mobile phones-agriculture applications	2.72	1.667
KVKs/Research Stations	2.65	1.707
State department of agriculture	2.59	1.666
State agricultural universities	2.58	1.646
Co-operatives	2.02	0.854
Internet on Computer/Laptops-Social media applications like YouTube, Facebook, Instagram and twitter, WhatsApp	1.99	0.739
Internet on Computer/Laptops-Agriculture websites	1.85	0.646
Internet on mobile-agriculture websites	1.79	1.055
NGO	1.78	0.660
Landline phones	1.25	0.555

one-way ANOVA. Results demonstrated in **Table 5** indicate that the use of information sources like Television, Radio, Newspaper/Magazines, and the Internet on mobile-social media applications like YouTube, Facebook,

Instagram, and Twitter, KVKs/Research Stations, Krishi Mela, State Department of Agriculture, other farmers, Input dealers/shops/private companies, and State agriculture universities differ significantly with different farm sizes ($p < 0.05$).

Several previous studies have found that small and large farmers have differences in access to various information sources[29,74–76]. The mean results given in **Table 5** indicate that the sources for which results are significant, utilization of those sources increasing with land size which indicates large farmers utilize more of those sources in comparison to medium, semi-medium, and small farmers. So, utilization of those sources must be increased among small farmers which could be only done by identifying the factors that impact the selection of different sources by the farmers especially small farmers. So, the next goal is to identify the factors that influence the use of Internet sources. As technology plays a major role in the advancement and growth of any type of business, the focus of the study is Internet sources in order to make the scope concise.

Table 5. Annova results of comparison of information sources utilization based on land size.

Information source	Small		Semi-med		Medium		Large		ANOVA	Sig
	$\bar{x}$	Σ	$\bar{x}$	Σ	$\bar{x}$	Σ	$\bar{x}$	Σ		
Television	3.52	1.560	4.10	1.554	4.52	1.624	4.88	1.689	13.221	0.000*
Radio	2.71	1.572	3.84	2.068	4.53	1.547	5.30	1.586	41.461	0.000*
Newspaper/magazines	2.18	1.660	2.59	1.408	3.79	2.119	4.76	2.046	41.024	0.000*
Landline phones	1.29	0.574	1.20	0.512	1.29	0.591	1.22	0.543	0.712	0.545
Internet on computer/laptops-agriculture websites	1.83	0.667	1.80	0.6201	1.91	0.683	1.84	0.615	0.518	0.670
Internet on Computer/Laptops-Social media applications such as Facebook, YouTube, WhatsApp, Instagram, and Twitter	1.99	0.745	1.98	0.738	2.03	0.745	1.96	0.737	0.158	0.925
Internet on mobile phones-agriculture applications	2.58	1.609	2.78	1.691	2.81	1.739	2.70	1.642	0.378	0.769
Internet on mobile-social media applications like YouTube, Facebook, Instagram, and Twitter	1.74	1.260	2.43	0.856	3.65	1.410	5.31	1.368	158.598	0.000*
Internet on mobile-Agriculture websites	1.82	1.095	1.81	1.089	1.70	0.969	1.84	1.070	0.354	0.786
Call and SMS services of mobile phones	2.71	1.452	2.80	1.466	2.95	1.435	2.82	1.336	0.484	0.694
KVKs/Research Stations	1.41	0.933	2.80	1.627	2.81	1.835	3.59	1.538	35.592	0.000*
Krishi Mela	1.56	1.085	3.09	1.664	3.82	2.052	3.86	1.414	45.501	0.000*
Input dealers/shops/private companies	3.63	1.426	3.94	1.536	4.87	1.390	5.81	1.134	50.931	0.000*
Other farmers	3.76	1.342	4.17	1.498	4.87	1.419	5.55	1.218	32.987	0.000*
State agricultural universities	1.43	0.956	2.71	1.552	2.70	1.812	3.48	1.460	33.018	0.000*
State Department of Agriculture	1.45	1.038	2.56	1.659	3.02	1.781	3.32	1.463	29.434	0.000*
NGO	1.75	0.687	1.82	0.657	1.77	0.664	1.76	0.638	0.221	0.882
Co-operatives	1.98	0.899	2.04	0.790	2.00	0.899	2.05	0.833	0.149	0.930

* Significant at $p < 0.05$.

3.3. Impact of identified factors on the search attitude of farmers

3.3.1. Analysis of reliability and validity

Cronbach's Alpha is used to measure and verify the reliability of the questionnaire and Exploratory Factor Analysis was used to confirm the data's validity. The table displays the findings of Cronbach's Alpha reliability analysis. Nunnally[77] recommended that if the alpha values are higher than 0.7 then it means that all the items of the construct are reliable. So, the result presented in **Table 6** indicates that all the values are above the recommended limit, so the data is reliable to conduct further analysis. The data was also tested for normality

and for that values of Skewness and Kurtosis were considered. For a large sample size i.e., sample greater than 300, an absolute value of skewness should not be more than 2 and value of kurtosis should not be greater than 7 without considering the *z* values. So, the data is found to be normal as the values of both skewness and kurtosis are within the acceptable range as indicated in **Table 6**.

Table 6. Reliability and normality results.

Variables	Cronbach alpha	Skewness	Kurtosis
Innovativeness	0.923	0.136	−0.848
Information quality	0.900	0.378	−1.239
Perceived usefulness	0.889	0.301	−0.313
Facilitating conditions	0.875	0.031	−0.504
Search effort	0.836	0.385	−0.366
Social influence	0.857	−0.068	−0.807
Ease of use	0.886	0.006	−0.842
Attitude	0.873	−0.012	−0.311

Table 7. Factor analysis results.

Constructs	Items of a scale	Factor loadings	Eigenvalues	Percentage of variance
Innovativeness	INN1	0.819	10.215	12.030
	INN2	0.783		
	INN3	0.835		
	INN4	0.842		
	INN5	0.815		
	INN6	0.812		
Information quality	IQ1	0.848	4.201	9.795
	IQ2	0.790		
	IQ3	0.861		
	IQ4	0.843		
	IQ5	0.849		
Perceived usefulness	PU1	0.674	3.049	9.653
	PU2	0.811		
	PU3	0.760		
	PU4	0.811		
	PU5	0.808		
Facilitating conditions	FC1	0.679	2.718	8.923
	FC2	0.718		
	FC3	0.731		
	FC4	0.756		
	FC5	0.768		
Search effort	SE1	0.726	2.345	8.091
	SE2	0.769		
	SE3	0.816		
	SE4	0.780		
	SE5	0.801		
Social influence	SI1	0.838	1.761	7.603
	SI2	0.835		
	SI3	0.821		
	SI4	0.803		
Ease of use	EOU1	0.786	1.339	7.458
	EOU2	0.663		
	EOU3	0.782		
	EOU4	0.787		
Search attitude	ATT1	0.682	1.202	7.057
	ATT2	0.700		
	ATT3	0.749		
	ATT4	0.774		

The extent to which a scale measures what it is supposed to measure is known to be construct reliability[78]. The construct validity of 38 items was investigated using exploratory factor analysis with principal component extraction and varimax rotation. All items had factor loadings of 0.5 or above, and factor extraction was grounded on Eigenvalues more than one, as projected by Hair[73]. The value of Kaiser-Meyer-Olkin (KMO) is found to be 0.911, which exceeds the 0.5 limitations established by Field[79]. The results of Bartlett's test of sphericity are significant as the chi-square value is 9248.739 at p-value < 0.01. As a result, results confirm that factor analysis is suitable for the data set. **Table 7** displays the factor analysis results for all constructs, together with Eigenvalues and factor loadings. Loading of every item is 0.5 or more, so they are considered as one-dimensional and factor distinct as well as every item loaded on a single factor. The total percent of variation explicated by these six factors is 70.61, showing that the eight factors identified can account for 70% of the total variance shared by the 38 items.

3.3.2. Correlation analysis

The average score of several items for a factor was produced in the first step of the statistical analysis and was used to assess correlation as well as multiple regression. To study the connotation amongst the variables, the Pearson correlation analysis technique was used[80]. To avoid multicollinearity, the correlation coefficient should not be greater than 0.8[79]. According to the results presented in **Table 8**, there is no issue of multicollinearity because the maximum correlation coefficient is 0.584.

Table 8. Pearson correlation coefficient analysis.

	INN	EOU	ATT	PU	SE	IQ	SI	FC
INN	1	-	-	-	-	-	-	-
EOU	0.446**	1	-	-	-	-	-	-
ATT	0.335**	0.545**	1	-	-	-	-	-
PU	0.320**	0.496**	0.549**	1	-	-	-	-
SE	−0.047	−0.035	−0.018	−0.017	1	-	-	-
IQ	−0.072	0.062	0.287**	0.160**	0.042	1	-	-
SI	0.149**	0.194**	0.284**	0.205**	−0.012	0.008	1	-
FC	0.433**	0.584**	0.563**	0.500**	0.029	0.122*	0.221**	1

** Significant at $p < 0.01$.

Except for the search effort, all factors were determined to be significant at $p < 0.01$ (**Table 8**). Ease of use ($r = 0.545$, $p < 0.01$), innovativeness ($r = 0.335$, $p < 0.01$), perceived usefulness ($r = 0.549$, $p < 0.01$), information quality ($r = 0.287$, $p < 0.01$), social influence ($r = 0.284$, $p < 0.01$), and facilitating conditions ($r = 0.563$, $p < 0.01$) were discovered to be strongly and positively associated with farmers' attitude towards searching through internet sources. The strongest relationship was found between facilitating condition and attitude, perceived usefulness came next, followed by perceived ease of use.

3.3.3. Multiple regression analysis

The study utilized multiple regression analysis to study the relationship between one dependent variable and a large number of independent variables[65]. It is used to test the various hypotheses developed to analyze farmers' attitudes toward searching for information on the Internet. **Table 9** displays the results of the analysis. The Variance Inflation Factor (VIF) and Tolerance were calculated to test for multicollinearity among the independent variables. The outcomes discovered that the predictor variables' value of VIF was less than 10, and the tolerance indication was larger than 0.1. The findings imply that predictor variables have no

multicollinearity among them.

Findings further suggest that the value of F statistics i.e., 56.573 was significant at $p < 0.01$ which indicated that the model is appropriate. That leads to the conclusion that there is a considerable association between adoption variables and attitudes toward internet sources. The R^2, or coefficient of determination, was 50.3%. In other words, the revealed adoption variables are responsible for 50.3% of farmers' attitudes toward using Internet sources to find agricultural knowledge.

Table 9. Multiple regression analysis.

Predictor variable	Standardized beta	*T*-value	Sig	Tolerance	VIF
INN	0.049	1.187	0.236	0.734	1.363
EOU	0.228	4.812	0.000	0.567	1.763
PU	0.243	5.565	0.000	0.666	1.501
SE	−0.018	−0.497	0.620	0.991	1.009
IQ	0.209	5.697	0.000	0.946	1.057
SI	0.129	3.501	0.001	0.935	1.070
FC	0.234	4.916	0.000	0.560	1.785

Note: Overall model F = 56.573; $p < 0.01$; $R^2 = 0.503$; Adjusted $R^2 = 0.494$.

Multiple regression analysis was used to test hypotheses, and it was discovered that perceived usefulness, ease of use, information quality, social influence, and Facilitating conditions have a significant relationship ($p < 0.01$) with farmers' search attitude toward internet sources, whereas innovativeness and search effort had no significant effect. So, it is concluded that H3, H4, H5, H6, and H7 are accepted.

4. Discussion and implications

The study examined the information sources utilized by farmers in Punjab, India, and then other sources, but not to the full extent. Farmers use numerous sources of information rather than relying on a single one. However, the use of internet technologies has been found to be very low, and in the case of internet sources, they use more social media applications on mobile phones while still not properly utilizing the various applications available related to agricultural issues. The ANOVA results also revealed a significant difference in the utilization of various sources such as television, radio, newspaper/magazines, internet on mobile social media applications, input dealers, other farmers, state department of agriculture, Krishi Vigyan Kendra, Krishi melas, and state agricultural universities. The findings conclude that the use of information sources increases with land size, implying that large farmers use more of each source than small farmers. The results are similar to the findings given by Babu et al.[76], who stated that a larger land area influences the farmers to search for more information which is why he/she use more information sources to search for the required information. The study also identified the factors that influence the attitude of farmers towards searching for information from internet sources and also examined the impact of identified factors on search attitude.

It was discovered that perceived usefulness[81–84], facilitating conditions[85–89], perceived ease of use[19,82–84,90] information quality[38,51], and social influence[28,82,91–94] all have a favorable effect on attitude.

Search effort associated with searching for information through internet sources, on the other hand, was found to be insignificant in influencing search attitude toward internet sources because internet sources make it easy for the users to find information that they need in comparison to other information sources[95–98]. Farmer's Innovativeness was found to have no effect on search attitude toward internet sources which is the opposite in the case of a study[34] that states that if the farmers are more open to new ideas and love to try new

products, services, and technologies and are less resistant to change, their use of the Internet sources will be greater. If properly implemented, contemporary and digital technology has the potential to bring modification in agriculture, from production to commercialization. As a result, to efficaciously implement the adoption of Internet sources among the farmers, the government's programs and policies must prioritize access to the internet and the enhancement of existing infrastructure in the area.

5. Conclusion

The study will assist information providers in the formation of a new or modified system for information dissemination that will take into account these findings related to information sources regularly used by farmers as well as the determinants that influence their search attitude toward internet sources. According to the findings, perceived usefulness and facilitating conditions were the most important factors, indicating that farmers' positive attitudes toward internet sources will emerge when they find them beneficial and proper infrastructure and resources that help farmers in using internet sources are available to them, as farmers believe they are not receiving adequate training for acquisition of knowledge connected to the use of internet sources such as various mobile applications, and there is a lack of proper infrastructure that supports the use of internet sources. As a result, it is suggested that information producers and strategists focus on providing valuable content and that the government ensures that proper technological infrastructure is available in every village because the majority of farmers live in rural areas where these problems still persist. Furthermore, strategists should consider the level of mental effort required to use the technology and must ensure that the sources are simple to use for farmers so that they can easily adopt the technology in their farming activities and should not shift to easy ways of getting information such as input dealers who exploit them by charging high interest.

The information provider must also ensure that the information provided via internet sources is timely available, accurate, reliable, up to date, distributed in a local language, and personalized/modified based on the needs of the specific group of farmers. The study's findings provide a solid empirical foundation for all information providers and strategists who want to fully exploit the power of Internet sources in supplying farmers with need-based information.

6. Limitations and direction of future research

This study has some drawbacks. The sample size is inadequate because the study solely considered Punjab State. Furthermore, a comparative study based on different states and regions within a single state could be conducted to become familiar with the form of knowledge essential for the farmers, as well as the sources and factors influencing their selection of different categories of sources. Finally, while this study has identified only a few factors that influence attitudes toward internet usage, other factors that influence attitudes as well as the intention to use internet sources for acquiring information should be considered in future studies. Additional studies must be conducted to examine the role of demographic variables in farmer technology adoption as well. Last but not least, given farm size has a big impact on crucial decisions made by farmers and small farmers face more problems than large farmers, future studies should focus on small farmer issues and provide specific ways to deal with small farmers separately.

Author contributions

Conceptualization, MK; methodology, MK; software, MK; validation, MK; formal analysis, MK and HS; investigation, MK; resources, MK; data curation, MK; writing—original draft preparation, MK; writing—review and editing, MK and HS; visualization, MK; supervision HS; project administration MK. All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

The authors declare no conflict of interest.

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