Innovations

Challenges Faced by Farmers in Adopting ICT Tools in Agriculture: A Case Study of Haryana

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Abstract

The use of Information and Communication Technologies (ICTs) is well recognized in modern times for its crucial role in providing information and digitizing agricultural companies. The focus of this study was to identify the obstacles encountered by young farmers, specifically those residing in rural regions of Haryana. A descriptive study was undertaken with an interview schedule including of both open-ended and close-ended inquiries. The study respondents were selected using a multistage probability (simple random) sampling procedure. Data was obtained from 480 young farmers who rely on agriculture for their livelihoods. In order to obtain a dependable conclusion, the captured data was analysed via SPSS. The results indicated that most of the participants were mature and skilled agriculturalists with limited land ownership. The majority of respondents had a monthly family income that fell within the moderate category. Respondents extensively utilised a wide range of information sources. The farmers emphasised social limitations such as insufficient knowledge, communication obstacles, stereotyped conduct, and irrelevant content. The economic limitations revolve around inadequate information and communication technology infrastructure. The technical restrictions were the farmers' inability to utilise ICTs, restricted internet connectivity, doubts regarding the authenticity of information, and a deficiency of essential skills. The study suggests the creation of a durable ICT network to efficiently provide information to a larger percentage of the rural farming community. A policy framework consisting of four main elements is proposed to include rural farmers in agriculture through the use of ICTs.

Key Words: *ICTs in agriculture and Challenges in the adoption of ICT by Farmers.*

Introduction

Agriculture is a substantial contributor to India's economy, serving as the source of over 18% of the country's gross domestic product (GDP) and providing employment for one third of the country's labour force (Government of India, 2019). The agriculture industry supports most people living in rural areas. Although it requires the cooperation of the farming community, research organisations, and agricultural extension agencies, technology transfer is an essential component in the process of enhancing the quality of life in rural areas. Facilitating the dissemination of agricultural technology plays a vital role in enhancing the well-being of rural communities (Guillaume et al., 2019). Both the critical function that agricultural extension services play and their partnership with research organisations are essential to the widespread adoption of innovative agricultural technology among farmers. This is primarily dependent on the fact that agricultural extension services. However, the transfer of agricultural information from extension professionals to farmers, particularly in emerging and undeveloped countries, often faces delays and lacks efficacy (Belay and Abebaw, 2004). The utilisation of ICTs by farmers is essential in the current technological era to augment agricultural production (Rao, 2008). The traditional extension systems encounter difficulties in meeting the increasing food demands of rapidly growing populations due to insufficient connections between extension professionals and farmers (Aker, 2010).

The transmission of information via a computer-based economy is swifter and more effective in comparison

to conventional approaches. Information and Communication Technologies (ICTs) enable bi-directional communication, allowing farmers to engage with researchers and vice versa (World Bank, 2011). The worldwide need for Information and Communication Technologies (ICTs) in several areas of life, such as agriculture, is increasing (Zhang et al., 2016). The updated information and communication technology (ICT) applications aim to tackle future issues in agriculture by providing support to developing and undeveloped countries, enabling them to compete with rich nations (Zahedi and Zahedi, 2012). Information and Communication Technologies (ICTs) possess the capacity to tackle various concerns in agricultural communities, including marketing communication, technological requirements, and marketing obstacles. Integrating computers into crop production and marketing procedures can optimise and accelerate these activities (World Bank, 2011).

The incorporation of cutting-edge technology in agriculture presents significant potential for the farming community and subsequent generations. Field agents, namely extension professionals, can utilise sophisticated technology to improve the learning process for the farming community (Afolabi, 2012). ICTs have the ability to greatly enhance farm output by effectively utilizing land, water, fertiliser, and other resources (Deloitte, 2012). There is a gradual rise in the worldwide number of young farmers, specifically those between the ages of 15 and 24, which indicates a significant change in demographics. Nevertheless, rural youth, including young farmers, encounter a significant obstacle in the form of restricted availability of information and expertise (FAO, 2014). Nevertheless, young individuals residing in rural regions are actively adopting diverse ICT tools, integrating them into contemporary farming methods (Aker, 2011). However, the actual situation on the ground shows that farmers in general, and young farmers specifically, face numerous obstacles when it comes to implementing information and communication technologies (ICTs) in agriculture (Shanthya and Elakkiya, 2017). In India, where more than 50% of the population is under the age of 24, with a substantial number living in rural areas and relying on farming for their income (FAO, 2018; Hassan et al., 2016), young farmers are progressively utilising different ICT tools to promptly obtain farming-related information and knowledge. Nevertheless, the utilisation of ICTs by young farmers, particularly in the field of agriculture, is still at a nascent phase. Their use of ICTs in agriculture has not yet realised its full potential, mainly due to various interconnected circumstances. The objective of this study is to investigate the obstacles and difficulties encountered by young farmers in implementing ICTs to enhance agricultural practices, with the ultimate aim of maximizing farm profitability.

Methodology

The technique of a research project involves a systematic approach to collecting and analysing data in a scientific manner. This entails providing a comprehensive description of the research domain, identifying the variables under investigation, establishing the procedure for selecting samples, clearly defining the process of collecting data, doing data analysis, and evaluating the obtained results and drawing conclusions. Research is a systematic approach that allows researchers to tackle recognised issues within a study (Nachmias & Nachmias, 1996). The research was carried out in Haryana, India, renowned for its exceptionally fertile farmland in comparison to other states in the northern region. The area cultivates a wide variety of crops, fruits, and vegetables. The research design is a predetermined framework that prioritises the presentation of study findings, logical reasoning, and problem-solving methodologies. It encompasses several procedures including data collection, analysis, and interpretation. The present study utilises a descriptive design, which is commonly used in social research, to describe correlations among variables using collected data. Sampling is an essential process that acknowledges the impracticality of surveying the complete population owing to limitations in time and finances. In Haryana, a total of six administrative blocks were identified, with two districts chosen from each of the six divisions. In addition, a selection was made of two villages from each district, resulting in a total of 24 villages for the purpose of data collecting. Initial assessments of these villages were carried out, in conjunction with the agricultural extension department personnel in the Haryana district, to gather information on the farmers' demographics. For the final phase, a total of nine villages were used and 480 respondents were picked at random, using the methodology proposed by Yamane (1967). The purpose of this sampling method was to

provide a dataset that is both representative and statistically reliable for the research project. This was achieved by employing a sample size determination formula.

The sample size in each village, represented by n, was calculated using the formula n = N / (1 + N(e)^2), where N denotes the total number of farmers in each village, and e is the sampling error fixed at 15%. A study instrument, in the form of an interview schedule, was devised to gather data through face-to-face interviews. The research instrument's validity was evaluated by a group of specialists, who offered suggestions for improvement. Afterwards, the instrument was modified according to the recommendations given by the expert panel. In order to guarantee the efficacy of the study tool, a preliminary test of 50 farmers from Hisar, Haryana, was carried out before to the actual data collecting. The objective of this pre-test was to detect any possible concerns and enhance the instrument's accuracy. The researchers utilised a systematic technique to improve the dependability and accuracy of the research results.

Results and Discussion

Demographics of Farmers

The collected data on specific demographic features of respondents, such as age, education level, land holding, farming experience, and monthly income, has been compiled and shown in Table 1 below:

Table 1. Demographic characters of farmers

Socioeconomic characters	%	Socioeconomic characters	%
Age		**Farming experience of household head**	
Upto 25 years	13.80%	Upto 5 Years	20.00%
25 to 45 years	49.30%	5-15 Years	32.00%
More than 45 years	36.90%	15-25 Years	38.00%
Education		25 Years or above	10.00%
Upto Primary	28.00%	**Monthly family income**	
Matriculation	36.00%	Upto 30,000 rupees	15.00%
Intermediate	26.00%	30001 to 45,000 rupees	24.00%
Graduation or above	10.00%	45001-60000 rupees	36.00%
Size of family landholding		60001 rupees and above	25.00%
Upto 1Hectares	47.60%	Total	100.00%
1 to 3 Hectares	35.00%		
3 to 5 Hectares	9.80%		
5 Hectares or Above	7.60%		
Total	100.00%		

Source Primary Data

Table 1 presents a comprehensive analysis of the demographic features of the respondents. It uses percentages to illustrate the distribution patterns among the surveyed population. Every category reflects a significant socioeconomic component, and the percentages provide valuable information about the makeup of the sample. The age distribution demonstrates that 13.80% of participants are aged 25 years or younger, 49.30% are between the ages of 25 and 45, and 36.90% are beyond the age of 45. This classification allows for a detailed analysis of the age distribution among farmers, facilitating the recognition of age-related patterns and preferences. The agricultural expertise of the household leader is divided into three distinct categories, with specific percentages allocated to each. For example, 20.00% of the participants possess farming experience of less than or equal to 5 years, whereas 38.00% have experience spanning from 15 to 25 years. This split enables a thorough comprehension of the skill levels found within the surveyed families, providing significant insights for further investigation.

The table captures the educational backgrounds, showcasing the diversity present within the sample.

Significantly, 36.00% of the participants have successfully finished matriculation, while 10.00% have attained education at the graduation level or beyond. This data facilitates understanding the educational structure of the farming community, which might impact decision-making processes and agricultural methods. Family income, a crucial socioeconomic indicator, is divided into four categories on a monthly basis. For example, 15.00% of the participants had a monthly household income of up to 30,000 rupees, while 36.00% belong to the income group of 45,001-60,000 rupees. By conducting this breakdown, we may thoroughly examine the range of financial situations among the surveyed individuals, providing significant insights for focused investigations. The table displays the size of family landholding, which is a crucial determinant in agricultural settings. For instance, 47.60% of participants had land holdings that are equal to or less than 1 hectare. Segmentation allows for a comprehensive assessment of how land resources are distributed among the surveyed farmers, enabling a better comprehension of the size of agricultural activities.

The data unequivocally demonstrates that farmers in the younger age groups are more likely to actively employ Information and Communication Technology (ICT) tools to improve their farming methods. This finding highlights the significant impact of different generations on the acceptance and implementation of technology in the agricultural sector. The association between age and ICT tool utilisation indicates that younger farmers are more open to incorporating technological improvements into their farming practices (Saidu et al., 2017). The alignment can be ascribed to variables such as early exposure to technology, heightened knowledge with modern farming practices, and an inherent inclination towards innovation among younger persons.

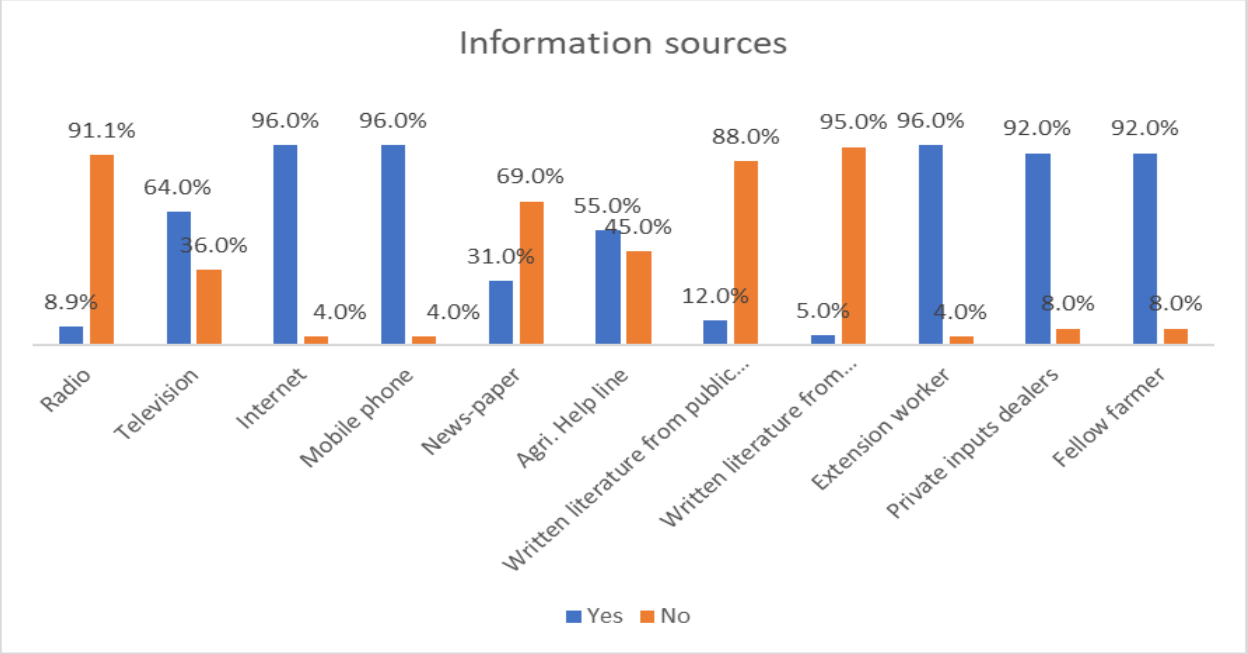

Figure 1. Sources of agriculture information (Source Primary Data)

Figure 1 presents a comprehensive analysis of respondents categorised by their sources of agricultural knowledge. It displays the percentage of those who confirm using each source and those who do not. This extensive distribution provides useful insights on the various avenues via which farmers obtain essential information for their agricultural activities. Around 8.9% of participants indicated that they used radio as a means of obtaining agricultural information. Although the percentage is relatively low, it indicates that radio may be less frequently used as a medium for accessing agricultural information among the examined population (Mittal & Mehar, 2016). 64% of participants reported utilizing television as a primary source of agricultural information. This modest percentage implies that television is a widely used medium, although it is not as broadly embraced as other sources like the internet and mobile phones. Nearly all (96.0%) of the

participants confirmed utilising the internet as a primary source of agricultural information. The significant proportion highlights the widespread influence of internet platforms in providing a wide range of up-to-date agricultural information to most of the individuals surveyed.

In the same way, the cell phone is seen as an essential tool for accessing agricultural information, with 96.0% of respondents using this technology. This is consistent with the extensive utilisation of mobile phones as a flexible and easily available method of communication and distribution of information among farmers. Newspapers are the source of agricultural information for 31% of the respondents. The decreased proportion indicates that newspapers are not as often used among the studied population, possibly indicating a transition towards digital sources of news and information (FAO, 2018). Approximately 55.0% of participants indicated that they utilised agricultural helplines. Although this percentage is moderate, it suggests that a significant proportion of the assessed population depends on specialised support channels for agricultural knowledge. Only a small proportion of respondents, namely 12.0%, make use of printed literature provided by governmental agencies. This lower percentage suggests that official publications from government institutions are less frequently consulted in comparison to other sources. Merely 5.0% of participants indicated utilising written literature sourced from private agencies. This implies that the studied community has a lower tendency to seek information offered by commercial entities.

A notable 96.0% of participants derive advantages from the knowledge and skills of extension workers. The significant proportion mentioned emphasises the crucial function of agricultural extension services in directly interacting with and assisting farmers, establishing them as a highly reliable information provider. 92% of participants indicated that private inputs dealers were a reliable source of information. These findings indicate that dealers have a substantial impact not just on providing inputs, but also on distributing pertinent information to farmers. Moreover, a significant 92.0% of participants indicated that their fellow farmers were an invaluable resource for obtaining information. It is clear that farmers widely and confidently rely on peer-to-peer knowledge exchange as a primary means of obtaining agricultural insights.

The allocation of participants among these diverse channels of agricultural information mirrors the ever-changing terrain of information availability within the farming community. The fluctuating percentages reflect the heterogeneous tastes and dependence on various channels among the questioned population. Comprehending these trends is essential for customising efficient agricultural extension methods that address the particular requirements and information-seeking tendencies of farmers (Agwu et al., 2008). Ani & Correa, (2016) similarly reported similar findings while examining the self-perceived requirements of rural youth in Punjab, India. The researchers determined that a significant proportion of the young population in the rural area had completed their schooling up to the matriculation level. It is frequently observed that university-level education is not highly prevalent in rural areas. The majority of the respondents said that obtaining a university education is unnecessary for individuals involved in farming. Typically, it has been noted that farming in India is marked by a low level of education (Ahmad et al., 2018).

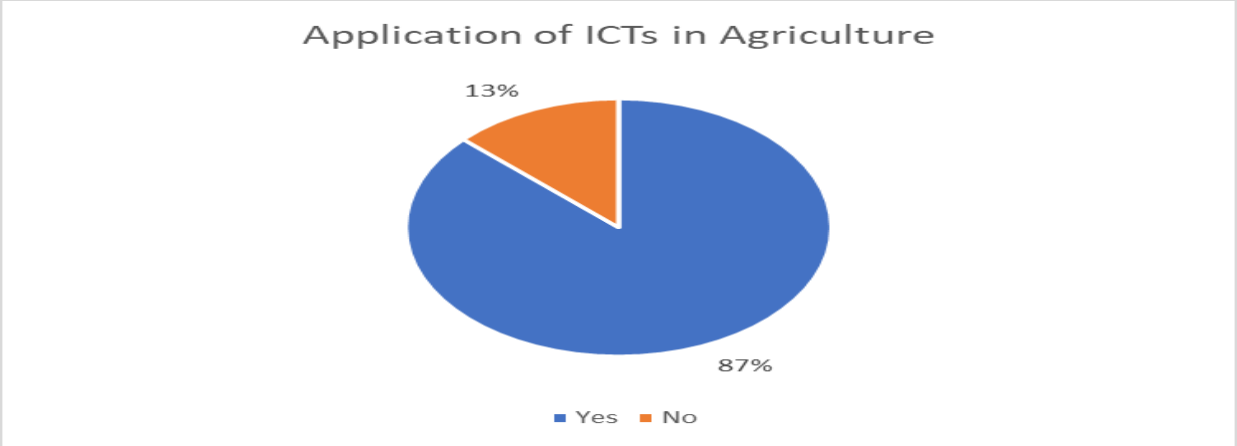

Figure 2 Usage of application of ICTs in Agriculture (Source Primary Data)

The data presented in Figure 2 demonstrates the implementation of ICTs in agriculture. 87% of the respondents confirmed the use of ICTs, while the remaining 13% stated otherwise. The substantial proportion of participants, 87%, affirming the utilisation of ICTs in agriculture underscores the extensive incorporation of technology in the agricultural industry. The favourable reaction indicates that a significant majority of the questioned population recognises and welcomes the advantages that ICTs offer to agricultural practices. ICTs in agriculture comprise a range of technologies, including farm management software, precision agricultural instruments, and mobile applications. These technologies enhance efficiency, production, and decision-making in farming operations. The 13% of respondents who reported a deficiency in the implementation of ICTs in agriculture constitute a minority within the studied population and are impacted by various factors, including restricted technological access, reluctance to embrace change, or the belief that ICTs may not significantly improve their farming methods (Sharma et al., 2019). An analysis of the factors influencing the decision of this minority group to refrain from using ICTs can offer useful insights for policymakers and extension agencies in overcoming obstacles and encouraging wider technology adoption in the agricultural sector. The widespread recognition of the significance of technology in contemporary farming is evident in the highly favourable reception of the use of ICTs in agriculture. The research highlights the importance of ongoing initiatives to close any potential disparities and tackle the obstacles encountered by the minority who have not yet adopted ICTs (Rao, 2006). This will ensure that technology-based agricultural methods are accessible and advantageous to a broader range of farmers. Rashid and Islam (2016) came to the conclusion that socio-economic factors, such as age, the quantity of land holdings, the income of the family, and the number of years of farming experience, do not have any impact on the difficulties that farmers encounter while attempting to implement information and communication technologies in agriculture. However, the educational standing of the respondent played a crucial impact in this matter.

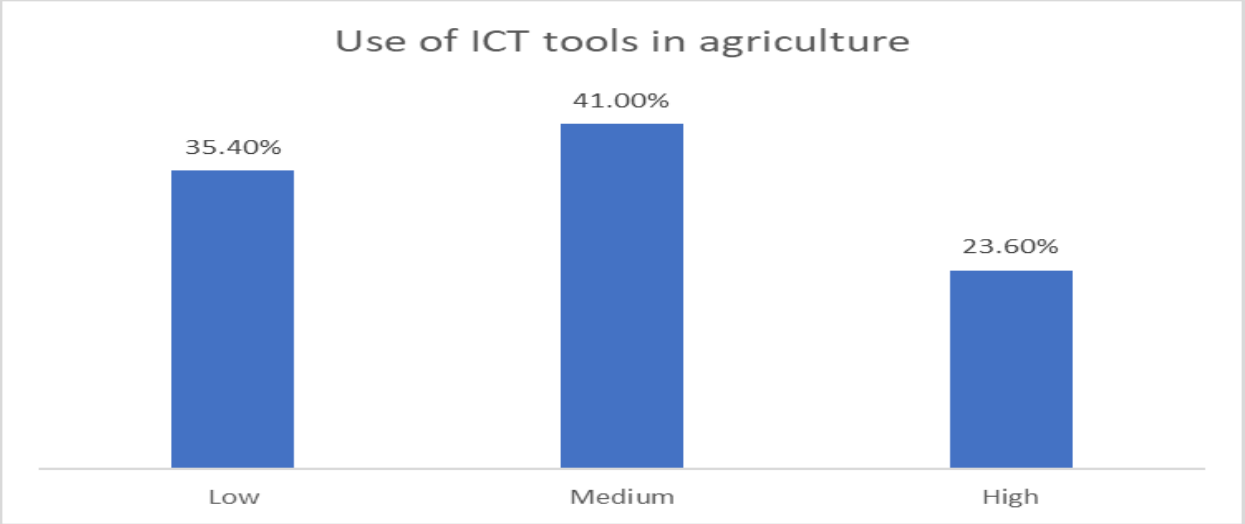

Figure 3 Frequency of using ICT tools in agriculture. (Source Primary Data)

The data in this instance demonstrates the diverse levels of ICT tool utilisation in agriculture among the examined population. Approximately 35.40% of respondents reported a poor level of use of ICT technologies in agriculture. These findings indicate that a significant proportion of the studied population is not making full use of ICT tools in their farming activities. Possible reasons for this low adoption include be restricted technology accessibility, inadequate awareness, or a preference for conventional farming techniques. Gaining insight into the particular difficulties encountered by this demographic can provide valuable guidance for implementing focused measures designed to encourage greater utilisation of information and communication technology. 41.00% of respondents reported a moderate level of use of ICT technologies in agriculture, indicating a majority. This indicates a moderate, albeit not widespread, incorporation of technology into farming methods. Farmers in this group may be using specific ICT tools to some degree, suggesting a potential willingness to embrace technological progress (Panda et al., 2018). Examining the

particular instruments and methodologies included in this intermediate level might offer valuable understanding into domains where the deployment of technology is comparatively more widespread.

Around 23.60% of participants indicated a significant utilisation of ICT technologies in the field of agriculture. This signifies a significant percentage of the studied population actively adopting and extensively utilising technology in their agricultural activities. Individuals in the high category are probably utilising a wide array of ICT tools, including precision agriculture technologies, farm management software, and other digital solutions. This results in improved production, efficiency, and decision-making. The allocation of participants among low, medium, and high levels of ICT tool utilisation demonstrates the varied panorama of technology implementation in agriculture. Identifying the characteristics influencing each category helps lead targeted measures to overcome impediments, enhance awareness, and support higher utilization of ICT tools across the agriculture industry. According to Waqar et al. (2018), cell phones are widely used among agricultural workers in Haryana. Furthermore, the current findings are corroborated by the outcomes documented by (Ommani & Chizari, 2008). The researchers determined that the internet serves as the primary information source for young people living in rural areas of Haryana district.

Table 2 Challenges faced by farmers in adopting ICTs

Constraints	Mean	S.D	Rank	Constraints	Mean	S.D	Rank
Technical constraint				**Social constraint**			
Incapability to use ICT	3.190	0.190	1	Illiteracy	2.810	0.838	6
Limited availability of internet	3.170	0.390	2	Irrelevant content	3.040	0.648	4
Lack of skills	3.140	0.409	3	Lack of awareness	3.080	0.504	3
Limited knowledge	3.140	0.409	3	Lack of training	3.100	0.478	2
Limited authenticity of agricultural information	3.130	0.429	4	Language barrier	3.010	0.690	5
Internet connectivity issue	3.100	0.511	5	Stereotype behavior	3.150	0.387	1
Low internet coverage	3.090	0.492	6	**Economic constraint**			
Limited availability of computer	3.040	0.710	7	High cost of ICT	2.980	0.599	2
Power issue	2.810	0.883	8	Limited access	2.830	0.864	3
				Poor ICT infrastructure	3.060	0.528	1

Source Primary Data

Table 2 displays an elaborate hierarchy of the limitations encountered by participants while integrating ICTs in agriculture. The restrictions are classified into technical, social, and economic elements, with each factor evaluated using mean scores and standard deviations. The primary technical limitation cited by respondents is the incapacity to utilise ICT, with a mean score of 3.190. This indicates a considerable difficulty in efficiently employing ICT technologies among a major proportion of the assessed population. The Limited availability of internet, with a mean score of 3.170, emphasises the crucial importance of a reliable internet connection for the adoption of ICTs. The challenges pertaining to skills and knowledge, as shown by the lack of skills and limited knowledge, are both ranked third with an average score of 3.140.

Illiteracy is the main difficulty within social limitations, with a mean score of 2.810. Consequently, a specific portion of the agricultural community encounters challenges in adopting ICT due to their restricted levels of literacy. The second most significant societal limitation is irrelevant content, with an average rating of 3.040. This highlights the need to customise the information sent through ICT tools to ensure its relevance. Lack of awareness (mean: 3.080) and Lack of training (mean: 3.100) are ranked third and fourth, highlighting gaps in knowledge and awareness that need to be addressed for effective ICT utilization. The element that ranks highest within the economic restrictions category is the high cost of ICT, with a mean score of 2.980. This suggests that financial obstacles provide a substantial hurdle for certain farmers in obtaining and utilising ICT technologies. The second most significant economic limitation, with a mean score of 2.830, is limited access. This constraint highlights the difficulties associated with the physical availability of ICT resources. The primary technical limitation, with an average rating of 3.060, is the inadequate ICT infrastructure. This

highlights the wider systemic difficulties in the accessibility and standard of technological infrastructure in agricultural environments.

The rankings offer useful insights into the complex array of obstacles that farmers encounter when embracing ICTs. To tackle these limitations, a comprehensive strategy is needed that includes advancements in technology, educational programmes, and efforts to improve financial accessibility (Silvestri et al., 2020). Efforts focused on enhancing skills, raising awareness, and improving infrastructure can help overcome these obstacles, facilitating a more comprehensive and efficient integration of ICT technologies in agriculture. This nuanced understanding of constraints is essential for formulating targeted interventions that cater to the specific needs and challenges faced by the diverse farming community (Alvarez & Nuthall, 2006).

Usage of Various ICTs Initiatives in Agriculture

Rural farmers are enthusiastically using a wide range of ICTs in agriculture, such as radio, television, mobile phones, agriculture helplines, and the internet, as depicted in Figure 4. Based on the data shown in Figure 6, a substantial majority (96%) of rural farmers surveyed use mobile phones as their main ICT tool to get up-to-date agricultural information. The reported adoption rates for different ICT tools are as follows: The allocation of resources is as follows: 8% for radio, 82% for television, 38.21% for agriculture helplines, 36.87% for computers with internet connection, and 22.21% for computers without internet access. Consistent with these results, (Anderson & Feder, 2004; FAO, 2014) highlighted the significant association between the age of farmers and their selection of ICT tools in agriculture. Farmers use mobile phones for agricultural information faster than older farmers. Qualitative interviews showed that young farmers prefer mobile phones and the internet for agricultural information. The research conducted by Saidu et al., (2017) provides empirical evidence that aligns with these qualitative views. They discovered that farmers had a preference for mobile phones because of their user-friendly characteristics. Although farmers, particularly the younger generation, show a tendency to utilise mobile phones for agricultural information, they frequently face numerous challenges and barriers when attempting to integrate cell phones into their farming methods. This sentiment reflects the discoveries of Chhachhar and Hassan (2013), who also emphasized the difficulties encountered by farmers in efficiently utilizing cell phones for agricultural objectives.

The data clearly demonstrates the extensive integration of ICTs, namely mobile phones, among young farmers. Nevertheless, recognizing the difficulties associated with utilizing mobile phones for agricultural purposes implies the necessity of overcoming obstacles in order to achieve smooth integration and fully use the advantages of these technologies in the agricultural industry (FAO, 2018). During interviews, participants were asked about how often they use ICT tools in the agriculture industry, which revealed the common usage patterns. The participants were particularly queried regarding the frequency of ICT tool utilisation, and their responses were documented on a Likert-type scale spanning from 1 (Low) to 3 (High). The majority of respondents displayed a inclination ranging from moderate to extensive use of ICTs. This trend indicates a significant change in the individual strategies of the farming community in Haryana towards contemporary sources of information. Lin et al. (2007) highlighted the important influence of individual preparation on the adoption of technology transfer instruments, which is consistent with the preferences expressed by the respondents. Table 2 provides a comprehensive breakdown of the obstacles that respondents have identified in the use of ICT tools in the agriculture industry. These constraints are divided into three categories, with societal constraints being the first group. The constraints are prioritized based on a numerical ranking, with stereotypical behaviour being the highest-ranked constraint. The average value for this restriction is 2.96, with a standard deviation of 0.197. Respondents recognized that stereotypical behaviour is a substantial obstacle to the implementation of ICT tools in agriculture. The mean number represents the average rating given by respondents, while the standard deviation offers information about the diversity of responses, indicating a rather consistent ranking for this specific constraint. Gaining insight into the limitations in the distribution of ICTs in agriculture is essential for developing focused interventions and strategies to tackle these obstacles. The significance of social limitations, namely stereotypical behaviour, highlights the necessity of addressing both technological

features and social dynamics to promote the successful use of ICT tools in the agricultural field (Mittal & Mehar, 2016).

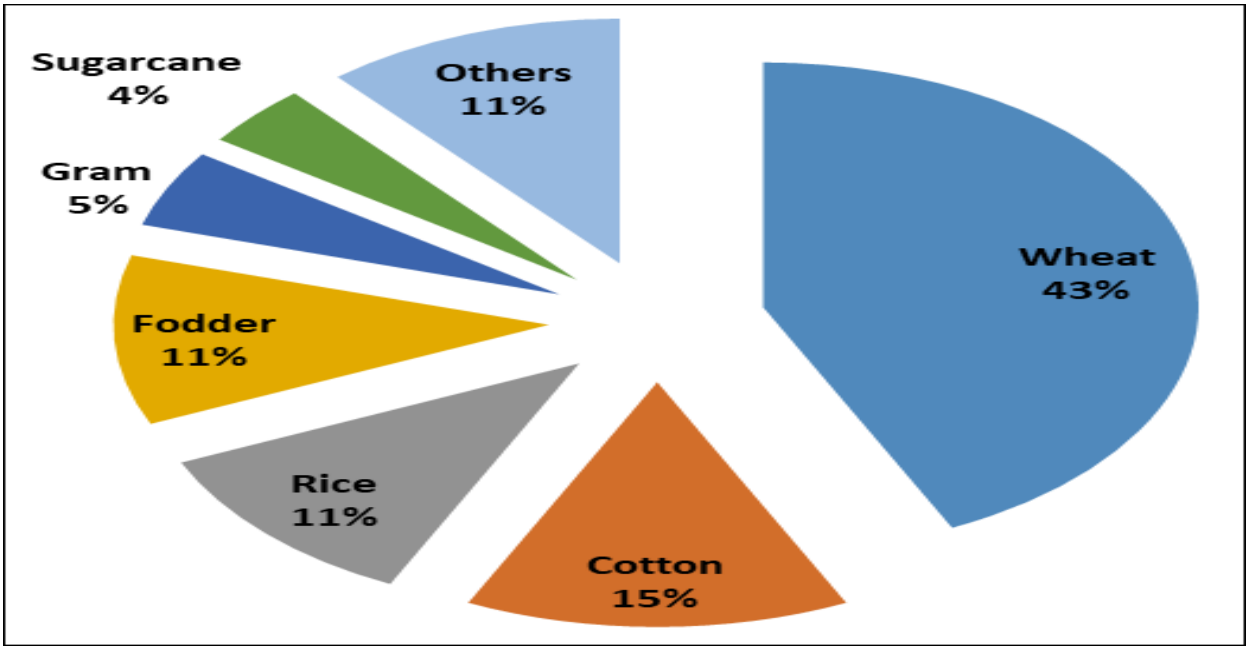

Fig. 4. Share of major crops being grown in the Haryana (Source FAO, 2018 reports)

The data obtained highlights that stereotypical behaviour is the primary obstacle in spreading computer-based technology in agriculture, among other societal restraints. The participants emphasised that the main obstacles in the social restrictions category were the absence of proper training and a lack of awareness. These challenges were rated with mean values of 2.91 and 2.89, respectively. This is consistent with the findings provided by Hosseini et al. (2009), which suggests that similar issues are identified consistently across various agricultural contexts. Within the context of economic limitations, three variables were identified as the primary constraints: inadequate ICT infrastructure, expensive ICT, and restricted access. These factors were ranked with mean values of 2.87, 2.79, and 2.64, respectively. The farmers' comments emphasise that the main limitation hindering the integration of computer-based technologies in the agriculture industry is the inadequate ICT infrastructure. Ani & Correa, (2016) observed similar findings regarding the difficulties faced in implementing ICTs for rural development due to social and financial limits. They highlighted the inadequacy of a dualistic approach in using technology to alleviate poverty. Singh et al. (2018) also emphasised the technical limits, specifically the issue of editing current extension literature, as a significant obstacle in the implementation of ICTs. The third set of limitations concerns technical factors, with nine distinct categories investigated throughout the interviews. A considerable proportion of farmers, with an average value of 3.00, indicated their incapacity to utilise ICTs as a result of inadequate educational and training resources. This suggests a perceived deficiency in educational and training resources available to farmers for the implementation of ICTs in agriculture.

The data uncovers a complex array of limitations in the implementation of ICTs in agriculture. Significant obstacles arise from social limitations, specifically in the form of stereotypical behaviour, insufficient training, and a lack of awareness. The obstacles faced by farmers are exacerbated by economic limitations, including inadequate ICT infrastructure, exorbitant expenses, and restricted availability. Furthermore, significant obstacles arise in the form of technological limits, such as constraints in education and training. Agwu et al., (2008) pointed out that it is crucial to consider these limitations as a whole in order to successfully incorporate ICTs into the agricultural industry, which will ultimately lead to rural development.

Figure 5 depicts the proportionate utilisation of several ICTs in agriculture, offering a concise overview of the prevalence of each technology among the respondents questioned. The mobile phone is the most prevalent ICT tool among the respondents, with a significant 96.00% confirming its extensive use in agricultural practices. The substantial proportion highlighted emphasises the importance of mobile phones

as a favoured and widely embraced technology. Television has an 82.00% utilisation percentage among the respondents. These findings indicate that a substantial segment of the agricultural community depends on television as a primary source of information for agriculture-related programming.

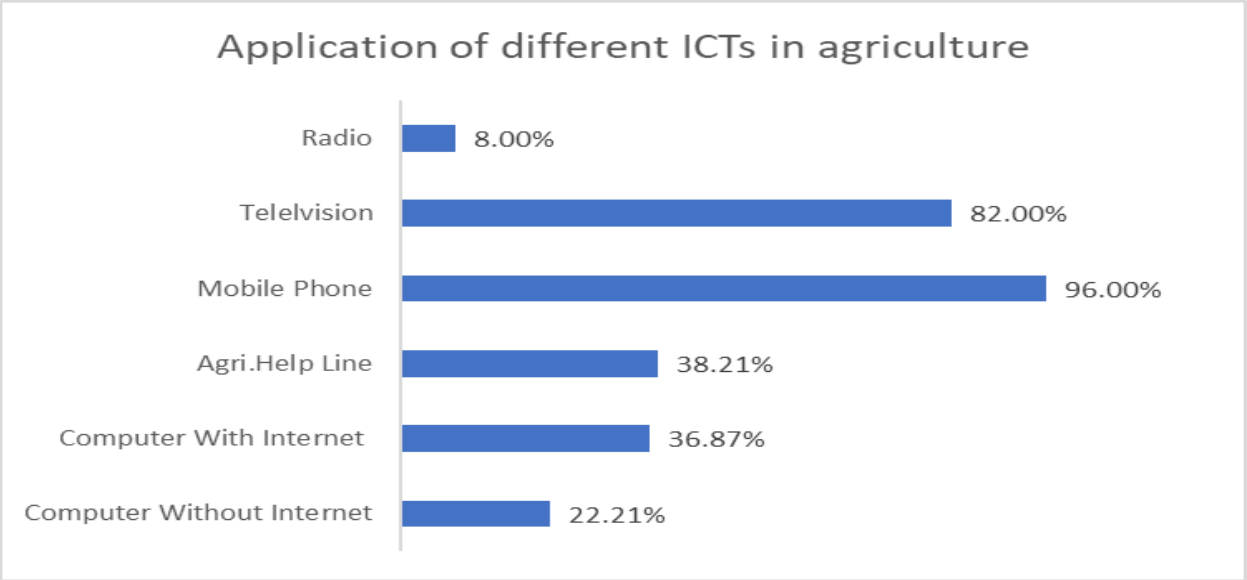

Fig. 5. Application of different ICTs in agriculture (Source Primary Data)

The Agri Help Line is used by 38.21% of respondents, which is a significant but comparatively lower proportion of people using this particular ICT product. Although agricultural helplines are not as widespread as mobile phones and television, the usage % suggests a significant level of acceptance. Around 36.87% of participants indicated utilizing computers equipped with internet connectivity for agricultural activities. Although not as ubiquitous as mobile phones, PCs equipped with internet connectivity nonetheless constitute a substantial proportion of the assessed population. 22.21% of respondents reported using PCs without internet connectivity. The lower percentage indicates a lower frequency of independent computer usage for agricultural tasks among the farmers questioned. The reported usage of radio is at a minimal 8.00%. While the percentage is rather small, it nonetheless indicates that a segment of the farming population depends on radio as an ICT tool for agricultural purposes.

Figure 6 presents a distinct visualization of the diverse rates at which different ICTs are being adopted in agriculture by the respondents who were questioned. Mobile phones and television are the most commonly used technology in the agricultural sector. Other instruments, such as agricultural helplines, computers with and without internet connection, and radio, also play a role in the technical landscape of agriculture. The authors (Panda et al., 2018) and (Silvestri et al., 2020) also investigated similar restrictions.

Future Implications and Suggestions & Recommendations

The high rates of mobile phone and television adoption that are currently being seen in the agricultural sector imply that future initiatives should make use of these technologies that are generally accepted. Incorporating contemporary technologies into conventional farming methods can improve the scope and availability of agricultural extension services. Future projects must fit with the technology preferences of the farming community in order to effectively communicate and disseminate information. It is crucial to overcome social limitations in order to effectively use ICTs into agriculture. Significant issues arose due to stereotypical behaviour, inadequate training, and lack of understanding. To address these issues, future interventions should prioritise extensive social awareness campaigns and specialised training programmes. By promoting a farming community that is more inclusive and well-informed, these programmes can facilitate the adoption of technology on a wider scale (Panda et al., 2018).

Policy initiatives are necessary to improve infrastructure and lower financial obstacles due to economic constraints, such as inadequate ICT infrastructure and excessive expenses. Future ramifications entail the

necessity of economic assistance or subsidies to incentivize broader implementation. By enhancing the accessibility and affordability of ICT infrastructure, the agricultural industry may fully use the technological breakthroughs. The presence of technical limitations, including the recognised inability to utilise ICTs due to a scarcity of educational and training resources, emphasises the significance of implementing educational initiatives specifically designed for farmers (Rao, 2008). Subsequent endeavours should allocate resources into technical education and training programmes in order to equip farmers with the requisite expertise and abilities. This strategy guarantees that farmers are adequately prepared to seamlessly incorporate ICT tools into their routine agricultural activities. Sharma et al., (2019) found that strategically considering the diversification of information sources is based on the differing rates at which various ICTs are adopted. Effective agricultural communication strategies in the future should integrate a combination of mobile-based applications, television programmes, and specialised agricultural helplines. This method, which encompasses a variety of strategies, seeks to meet the interests of various farmer demographics, so assuring wider and more inclusive availability of agricultural information.

Community engagement programmes offer a good solution for addressing stereotypical behaviour. These programmes can promote a favourable impression of ICTs among the farming community by raising awareness about the advantages of technology adoption and debunking prejudices. This strategy promotes the adoption of technology as a valuable instrument in the agricultural activities of community members (Silvestri et al., 2020). Conducting training workshops is crucial for improving farmers' technical proficiency and knowledge. The seminars should focus on the practical application of ICT technologies, offering farmers hands-on experiences that enable them to effectively incorporate technology into their agricultural practices. Continuing training activities help close the gap in knowledge and guarantee long-term use of technology. Promoting government subsidies or financial incentives is essential to mitigate economic limitations related to inadequate ICT infrastructure and exorbitant expenses. Governments can incentivize farmers to embrace and implement contemporary technologies by offering them financial assistance, thereby alleviating any excessive financial constraints. This policy initiative promotes a fair and extensive implementation of ICTs in agriculture (Saidu et al., 2017).

Engaging in cooperation with agricultural extension services is a pragmatic recommendation for effectively spreading knowledge through the selected channels of ICT. By synchronising extension services with the technological inclinations of the farming community, these services become more efficient in providing timely and pertinent information. The cooperative approach improves the overall effectiveness of extension services on agricultural practices. Investing in research and development endeavours is crucial for the creation of user-friendly ICT solutions specifically designed for the agriculture sector. Technological advancements that streamline the utilisation of technology for farmers enhance the rate at which it is adopted and enhance the efficiency of farming activities. By cultivating a culture that encourages innovation, the agricultural sector may remain at the forefront of technological progress. In summary, a strategic integration of these anticipated consequences and recommendations can facilitate the development of a farming community that is more empowered and knowledgeable about technology. Consequently, this contributes to improved agricultural productivity, rural development, and the long-term viability of the agricultural sector.

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