

Original Research Article

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Farmers' Awareness and Adoption Level Regarding Usage of ICT for Crop Production

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ABSTRACT

The study reveals that about half of the respondents (53.75%) majority of them (78.78%) were general caste, more than half of respondents (68.75%) were having small holding (>2.5-5 acres). As for as farming system is concerned, a majority (93.75%) of them have livestock as a secondary profession with agriculture and two-third of them (67.50 %) practicing cotton-wheat cropping system.

Introduction

The study insights into the awareness levels of various ICT tools among farmers and their application in agriculture, data is categorized into four main sections: the mean awareness score of smart device usage was 59 (73.75%), mean awareness score of social media usage was 54 (67.50%), the mean awareness level score for print technology usage was 48 (60.00%). The mean awareness level score about Technological understanding of ICT was 40.40 (50.50%). About ICT Usage in Agriculture, the mean awareness level score of 43 (53.75%) and the mean awareness score of respondents about Impact of ICT in Agriculture was 47.14 (58.93%).

The data indicates a gap in understanding the distinction between agricultural hardware and software applications, as well as integrating ICT tools into crop management practices and utilize specialized software and applications (Sube Singh and Balwan Singh Mandal, 2023).

However, there is a need for increased access to resources, to fully implement precision agriculture technologies. Soil sensors, remote sensing technologies, and internet access are essential for efficient farm management. The mean awareness level score about the impact of ICT in agriculture is 47.14, indicating moderate awareness among farmers. Technologies such

as GIS, drones, AI, mobile payment systems, VR, AR, IOT, and big data analytics were recognized for their potential benefits. Farmers were aware of the concept of smart farming and its integration of ICT for optimized farm management. ICT also plays a role in promoting climate-smart agriculture practices, gender equality, sustainable energy solutions, and agricultural insurance schemes (Sube Singh, *et al.*, 2025).

The overall awareness level of ICT for crop production by the respondents showed 57.61 per cent, However, and there was considerable portion of farmer who has less aware or not fully utilizing these technologies.

Materials and Methods

The study was conducted during the year 2023-24 in Haryana state which is comprises of 22 districts. Out of these Hisar and Kaithal district were selected randomly. Four villages i.e., Chandana & Devigarh villages from Kaithal block of Kaithal district and Dhigtana and Behbalpur villages from Barwala block of Hisar district were selected randomly for data collection. Thus, a total of 80 farmers were selected/interviewed (20 farmers from each village) through random sampling technique to collect the information regarding awareness level of farmer about Information and Communication Technology and their adoption for crop production at their fields. Appropriate statistical measures like mean, frequency, percentage and rank orders were applied to draw meaningful inferences.

Results and Discussion

The results so obtained were presented in the following heads and subheads and discussions were made to improve the adoption of Information and Communication Technology (ICT) in agriculture for crop production. The results of the study are as under:

Age: The data presented in table 1 indicates that 53.75 per cent of respondents belong to middle age group followed by young age group (28.75%) and old age group (17.50%) i.e., above 50 years of age.

Education: As for as education level of respondents is concerned, the data presented in table 1 predict that near about half of respondents (46.25%) were educated up to matric while 26.25 per cent respondents were having educational qualifications up to higher secondary, whereas 15.00 per cent of respondent farmers were

having educational qualification of graduation level and post graduate educational qualifications. Very less percentage of only 07.50 per cent of respondents having middle class education and remaining 5.00 per cent of them were having education up to primary school (5th class).

Caste: The data pertaining to caste distribution of respondent presented in table 1 indicates that a majority (78.787%) of respondents belongs to general caste followed by other backward class (13.75%) and scheduled caste (07.50%).

Land holding: The data about land holding of the respondents presented in table 1 predict that about one third (37.50%) of respondents belong to small farmer category followed by medium farmer category (31.25%) and nearby one fourth (23.75%) having marginal farmer category.

Irrigation Sources: The data presented in table 1 also indicates that approx. two-third of respondents (66.25%) having canal as a source of irrigation, whereas 61.25 per cent farmers had tubewell as source of irrigation. 63.75 per cent respondents had both the sources of irrigation i.e., canal and tube well.

Farming System: The data in table 1 reveals that a massive majority (93.75 %) of respondents were doing livestock practices in their farming system followed by organic farming (11.25%), poly house vegetable production (6.25%).

Crop Rotation: The data presented in table 1 also indicates that about two-third (67.50%) farmers have adopted cotton-wheat crop rotation followed by pearl millet/guar/green gram-mustard (45.00%) and rice-wheat crop rotations (41.25%).

It is apparent from table 2 that 72.50 per cent of respondents possessed tractor at their farm among other farm machineries, 67.50 percent of respondents had harrow followed by rotavator (57.50%), seed-cum-fertilizer drill (48.75%), multi crop thresher (42.50%), straw reaper (22.50%), MB plough (20.00%) and Laser land leveler (03.75%) at their farm.

The data in table 3 revealed that among the extension contact of the farmers, the most popular were the progressive farmers with weighted mean score of 2.65 followed by private agencies (input dealers/sales representative etc.) with weighted mean score of 2.47.

ADOs/HDOs, SDAO/SMS and HDOs, Scientists of KVK/Univ. which ranked third, fourth and fifth, respectively.

The data in table 4 revealed that in case of mass media exposure it can be imagined that a majority of the respondent (81.25% & 78.25%) assessed to mobile phone and TV as a source of mass media and half of respondents (50.00%) used newspapers as mass media. The respondents were using farm magazine (45.00%) and internet (40.50%) as mass media and only 10.00 per cent of respondents were availing radio as mass media.

The data presented in table 5 also reveals the extent of mass media utilization. Thus, mobile ranked first with weighted mean score (WMS) of 2.78 followed by viewing television (WMS = 2.48), reading newspaper (WMS=2.31), farm magazine (WMS=2.19), internet (WMS=2.05) and radio (WMS=1.94) which ranked second, third, fourth, fifth and sixth, respectively.

The data presented in the table 6 provides insights into the awareness levels of various ICT tools among farmers and their application in agriculture. The data is categorized into four main sections: Smart Device Usage, Social Media Usage, Print Technology Usage, Technological Understanding of ICT, ICT Usage in Agriculture, and the Impact of ICT in Agriculture. Each section provides mean awareness level scores, reflecting the farmers' familiarity and engagement with these technologies.

The mean awareness level score for smart device usage is 59 (73.75%), indicating a high level of awareness among farmers. Smart devices like smartphones, laptops, desktops, and tablets are being utilized effectively for various farming activities. Smartphones are particularly significant, with a high score as they enable farmers to monitor crops, access agricultural information online, and facilitate communication. Laptops and desktops follow, being essential for managing farm data, using agricultural software for planning and analysis, and handling complex farming tasks. Tabloids are also used for quick access to farm records and monitoring real-time data such as weather forecasts and soil conditions.

The mean awareness level score for social media usage is 54 (67.50%) suggesting moderate awareness. Social media platforms like WhatsApp, Facebook, Instagram, and Twitter are valuable tools for farmers. WhatsApp scores the highest, highlighting its importance for

communication and information exchange among farmers. Facebook and Twitter are also significant, helping farmers to stay updated with the latest trends and technologies. Instagram is used for showcasing farming activities, and video conferencing tools are utilized for attending virtual meetings and conferences. E-mails and the Kisan helpline also play a role in professional communication and seeking guidance.

The mean awareness level score for print technology usage is 48 (60.50%), indicating a relatively lower awareness compared to digital tools. Farmers utilize research bulletins, newspapers, agricultural magazines, posters, and annual reports to stay informed about ICT developments in agriculture. Agricultural magazines score, followed by posters, showing their importance in providing information on ICT tools and technologies. However, there is room for improvement in the awareness and usage of print technologies.

The mean awareness level score for technological understanding of ICT is 40.40 (50.50%) highlighting a need for improvement in this area. Farmers face challenges in browsing agricultural information on the internet, using computers for farm operations, and relying on online platforms for purchases and payments.

The data indicates a gap in understanding the distinction between agricultural hardware and software applications, as well as integrating ICT tools into crop management practices. Training programs and workshops on using ICT in agriculture could help improve farmers' technological understanding.

The mean awareness score for ICT usage in agriculture is 43 (53.75%) suggested that farmers are moderately aware of how to use ICT for various agricultural activities. Farmers use computers, search for information on new agricultural products, and utilize specialized software and applications. However, there is a need for increased access to resources, such as technology and knowledge, to fully implement precision agriculture technologies. Soil sensors, remote sensing technologies, and internet access are essential for efficient farm management.

The mean awareness level score about the impact of ICT in agriculture is 47.14 (58.93%) indicated moderate awareness among farmers. Technologies such as GIS, drones, AI, mobile payment systems, VR, AR, IoT, and big data analytics are recognized for their potential benefits.

Table.1 Profile of the respondents

(n=80)

SI. No.	Variable	Category	Frequency	Percentage
1.	Age	Young (20-35 years)	23	28.75
		Middle (36-50 years)	43	53.75
		Old (above 50 years)	14	17.50
2.	Education	Primary	04	05.00
		Middle	06	07.50
		Matriculation	37	46.25
		Higher secondary	21	26.25
		Graduate	08	10.00
		Postgraduate	04	05.00
3.	Caste	General Caste	63	78.78
		Other backward class (OBC)	11	13.75
		Scheduled Caste (SC)	06	07.50
4.	Landholding	Marginal farmers (< 2.5acres)	19	23.75
		Small farmers(>2.5 – 5 acres)	30	37.50
		Medium farmers(>5 - 10 acres)	25	31.25
		Big farmers(>10 acres)	06	07.50
5.	Irrigation sources*	Water Tank	04	05.00
		Tube well /submersible pump	49	61.25
		Canal	53	66.25
		Both (Tube well and Canal)	51	63.75
6.	Farming system*	Livestock	75	93.75
		Poultry	01	02.50
		Fishery	01	01.25
		Beekeeping	01	01.25
		Organic farming	09	11.25
		Mushroom cultivation	01	01.25
		Poly house vegetable production	05	06.25
7.	Crop rotation*	Rice-Wheat	33	41.25
		Cotton-wheat	54	67.50
		Pearl Millet/Guar/Green Gram- Mustard	36	45.00

* Multiple responses

Table.2 Possession of Farm Machinery

(n=80)

Sr. No.	Name of farm machinery	Frequency	Percentage
1.	Tractor	58	72.50
2.	Harrow	54	67.50
3.	Rotavator	46	57.50
4.	MB Plough	16	20.00
5.	Seed-cum-fertilizer drill	39	48.75
6.	Laser land leveler	03	03.75
7.	Straw Reaper	18	22.50
8.	Multi crop Thresher	34	42.50

Table.3 Extension contact by the farmers

(n=80)

Sr. No.	Extension Contact	Frequency of Contact					Total Score	Weighted Mean Score	Rank
		Weekly (4)	Fort nightly (3)	Monthly (2)	Whenever needed (1)	None (0)			
1.	Progressive farmer	25	23	13	17	02	212	2.65	I
2.	Private Agencies (Input dealers/ Sales Rep. etc.)	24	24	11	16	02	206	2.47	II
3.	ADOs/HDOs	14	22	12	23	09	169	2.11	III
4.	SDAO/SMS/ DHO	04	09	23	30	14	119	1.49	IV
5.	Scientists (KVK/Univ.)	04	09	23	26	18	115	1.44	V

Table.4 Mass Media Exposure of farmers

(n=80)

Sr. No.	Mass Media	Used	
		Frequency	Percentage
1.	Mobile	65	81.25
2.	TV	63	78.25
3.	Newspaper	40	50.00
4.	Farm magazine	36	45.00
5.	Internet	32	40.50
6.	Radio	08	10.00

Table.5 Extent of Mass Media Utilization by the farmers

(n=80)

Sr. No.	Mass media	Extent of utilization			Total Score	Weighted Mean Score	Rank
		Daily (3)	Often (2)	Sometimes (1)			
1.	Mobile	52	11	02	180	2.78	I
2.	TV	31	21	04	139	2.48	II
3.	Newspaper	32	23	11	153	2.31	III
4.	Farm magazine	15	13	08	79	2.19	IV
5.	Internet	14	12	12	78	2.05	V
6.	Radio	04	09	05	35	1.94	VI

Table.6 Awareness level of farmers about different practices of ICT for crop production

(n=80)

S. No	Statements	Awareness level			
I. Various ICT tools in Agriculture:		Aware		Not Aware	
i. Smart Device Usage:		Freq	%age	Freq	%age
1.	Smart Phone for various farming activities, such as monitoring crops and accessing agricultural information online.	68	85.00	12	15.00
2.	Laptop is essential for managing my farm's data and using agricultural software for planning and analysis.	54	67.50	26	32.50
3.	Desktop computer for more complex farming tasks, like creating detailed farm management plans and analyzing large datasets.	56	70.00	24	30.00
4.	Tablet for quick access to farm records and for monitoring real-time data, such as weather forecasts and soil conditions.	58	72.50	22	27.50
Mean awareness level score of smart device usage		59	73.75	21	26.25
ii. Social Media Usage:		Freq	%age	Freq	%age
1.	WhatsApp to communicate with other farmers and exchange information about farming practices and innovations.	52	65.00	28	35.00
2.	Updates about farm and farming activities on Instagram, showcasing the progress and challenges in agricultural practices.	48	60.00	32	40.00
3.	Connect with farming communities and groups on Facebook to stay updated with the latest trends, technologies, and discussions in the agricultural sector.	56	70.00	24	30.00
4.	Follow agricultural news and updates on Twitter, keeping yourself informed about industry developments, market trends, and new agricultural technologies.	54	67.50	26	32.50
5.	Using e-mails for professional communication related to farming.	56	70.00	24	30.00
6.	Utilize video conferencing to attend virtual meetings and conferences related to agriculture.	58	72.50	22	27.50
7.	Seek assistance and guidance from the Kisan helpline when facing farming challenges.	54	67.50	26	32.50
Mean awareness level score of social media usage		54	67.50	26	32.50
iii. Print Technology Usage:		Freq	%age	Freq	%age
1.	Research bulletins to stay informed about the latest ICT developments in agriculture.	46	57.50	34	42.50
2.	Newspapers to learn about how other farmers are using ICT in their farming practices.	48	60.00	32	40.00
3.	Agricultural magazines to stay updated on the latest ICT tools and technologies for farming.	52	65.00	28	35.00
4.	Posters in farm office that illustrate how ICT can be used to improve crop production.	54	67.50	26	32.50
5.	Agricultural journals to understand the impact of ICT adoption on crop yields and farm efficiency.	46	57.50	34	42.50
6.	Annual reports from agricultural organizations to learn about successful ICT adoption stories in farming.	42	52.50	38	47.50
Mean awareness level score of print technology usage		48	60.00	32	40.00
II. Technological Understanding of ICT:		Freq	%age	Freq	%age

1.	Easily browse agricultural information on the internet without assistance.	46	57.50	34	42.50
2.	Effectively use computers to manage my farm operations.	42	52.50	38	47.50
3.	Rely on online platforms for agricultural input purchases and electronic payments.	38	47.50	42	52.50
4.	Understand the distinction between agricultural hardware and software applications.	36	45.00	44	55.00
5.	Mobile apps to access agricultural information and services.	42	52.50	38	47.50
6.	Regularly update farming practices based on information from digital sources.	42	52.50	38	47.50
7.	Online forums and discussions related to agriculture.	40	50.00	40	50.00
8.	Training programs or workshops on using ICT in agriculture.	38	47.50	42	52.50
9.	Integrated ICT tools into crop management practices.	42	52.50	38	47.50
10.	New ICT solutions to improve farming efficiency.	44	55.00	36	45.00
11.	Cloud computing services for farm data storage and management.	38	47.50	42	52.50
12.	GPS technology for precision farming activities.	36	45.00	44	55.00
13.	Farmers using online platforms or social media groups.	34	42.50	46	57.50
14.	Agricultural influencers or experts on social media for farming tips and advice.	46	57.50	34	42.50
15.	Digital mapping tools for farm planning and monitoring.	42	52.50	38	47.50
Mean awareness level score of technological understanding of ICT		40.40	50.50	39.60	49.50
III. ICT Usage in Agriculture:		Freq	%age	Freq	%age
1.	About modern farming technologies and how they can benefit farm.	42	52.50	38	47.50
2.	Experimenting with new farming methods to enhance the productivity and sustainability of farm.	44	55.00	36	45.00
3.	Computers to manage various aspects of farm business, such as record-keeping, inventory management, and financial analysis.	46	57.50	34	42.50
4.	Search for information on new agricultural products and technologies to stay updated with the latest advancements in the field.	44	55.00	36	45.00
5.	Use specialized software and applications, such as farm management software, weather forecasting tools, and crop monitoring apps.	44	55.00	36	45.00
6.	Internet access is essential for managing farm operations, as it allows to access information, communicate with suppliers and customers, and monitor farm remotely.	42	52.50	38	47.50
7.	Access to the necessary resources, including technology and knowledge, to use precision agriculture technologies on farm.	41	51.25	39	48.75
8.	Soil sensors and remote sensing technologies on farm to monitor soil moisture, nutrient levels, and crop health, allowing for more precise and efficient farming practices.	42	52.50	38	47.50
9.	Internet subscription for farm's needs, ensuring reliable and high-speed internet connectivity for my farm operations.	42	52.50	38	47.50
Mean awareness score of ICT usage in agriculture		43	53.75	37	46.25
IV. Impact of ICT in Agriculture:		Freq	%age	Freq	%age

1.	Use of Geographic Information Systems (GIS) in agricultural mapping and analysis.	46	57.50	34	42.50
2.	Potential of unmanned aerial vehicles (UAVs) or drones for crop monitoring and management.	48	60.00	32	40.00
3.	Artificial intelligence (AI) and machine learning algorithms in optimizing agricultural processes and decision-making.	46	57.50	34	42.50
4.	Mobile payment systems and their use in facilitating financial transactions within agricultural value chains.	44	55.00	36	45.00
5.	Potential of virtual reality (VR) and augmented reality (AR) technologies in agricultural training and simulation applications.	48	60.00	32	40.00
6.	Use digital databases to store and manage information about crops and livestock.	46	57.50	34	42.50
7.	Internet of Things (IoT) and big data analytics can be used in agriculture to optimize farming practices and improve decision-making.	44	55.00	36	45.00
8.	Concept of smart farming and its integration of ICT for optimized farm management.	42	52.50	38	47.50
9.	Precision livestock farming technologies, such as wearable sensors for monitoring animal health and behaviour.	44	55.00	36	45.00
10.	ICT in promoting climate-smart agriculture practices, such as conservation agriculture and agroforestry.	46	57.50	34	42.50
11.	Mobile-based market information systems for accessing market prices and trends.	48	60.00	32	40.00
12.	ICT in promoting sustainable agriculture practices, such as organic farming and integrated pest management.	48	60.00	32	40.00
13.	Agricultural robotics and its applications in tasks such as planting, spraying, and monitoring.	52	65.00	28	35.00
14.	ICT in promoting traceability and transparency in agricultural supply chains.	48	60.00	32	40.00
15.	ICT in promoting gender equality in agriculture through access to information and market opportunities.	46	57.50	34	42.50
16.	Sustainable water management practices in agriculture, such as precision irrigation.	48	60.00	32	40.00
17.	Digital soil mapping and its applications in soil fertility management.	46	57.50	34	42.50
18.	Finance solutions for smallholder farmers, such as mobile banking and digital loans.	48	60.00	32	40.00
19.	Climate resilience in agriculture through early warning systems and climate information services.	52	65.00	28	35.00
20.	ICT in promoting sustainable energy solutions for agriculture, such as solar-powered irrigation systems.	50	62.50	30	37.50
21.	ICT in promoting agricultural insurance schemes for risk management in farming.	50	62.50	30	37.50
Mean awareness level score of respondents about impact of ICT in agriculture		47.14	58.93	32.86	41.07

Table.7 Adoption level of respondents about ICT for crop production

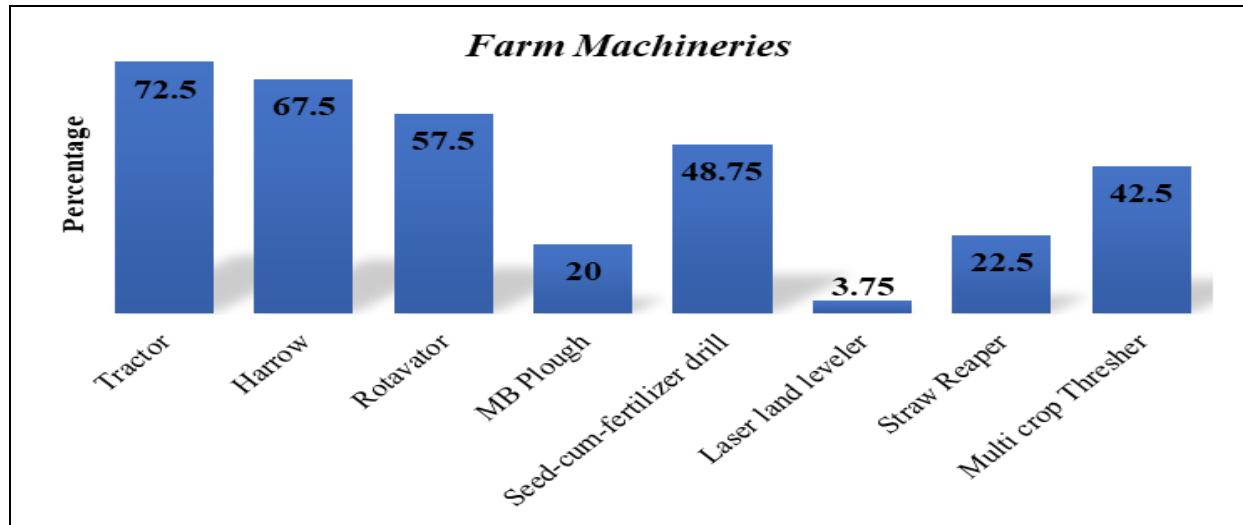
(n=80)

Sr. No.	Statements	Adoption level			
I. Various ICT tools in Agriculture:		Adopted		Not adopted	
i. Smart Device Usage:		Freq	%age	Freq	%age
1.	Smart Phone for various farming activities, such as monitoring crops and accessing agricultural information online.	60	75.00	20	25.00
2.	Laptop is essential for managing my farm's data and using agricultural software for planning and analysis.	50	62.50	30	37.50
3.	Desktop computer for more complex farming tasks, like creating detailed farm management plans and analyzing large datasets.	52	65.00	28	35.00
4.	Tablet for quick access to farm records and for monitoring real-time data, such as weather forecasts and soil conditions.	56	70.00	24	30.00
Average adoption score of smart device usage		54.50	68.12	25.50	31.88
ii. Social Media Usage:		Freq	%age	Freq	%age
1.	WhatsApp to communicate with other farmers and exchange information about farming practices and innovations.	50	62.50	30	37.50
2.	Updates about farm and farming activities on Instagram, showcasing the progress and challenges in agricultural practices.	44	55.00	36	45.00
3.	Connect with farming communities and groups on Face book to stay updated with the latest trends, technologies, and discussions in the agricultural sector.	52	65.00	28	35.00
4.	Follow agricultural news and updates on Twitter, keeping yourself informed about industry developments, market trends, and new agricultural technologies.	50	62.50	30	37.50
5.	Using e-mails for professional communication related to farming.	51	63.75	29	36.25
6.	Utilize video conferencing to attend virtual meetings and conferences related to agriculture.	52	65.00	28	35.00
7.	Seek assistance and guidance from the Kisan helpline when facing farming challenges.	49	61.25	31	38.75
Average adoption score of social media usage		49.71	62.14	30.29	37.86
iii. Print Technology Usage:		Freq	%age	Freq	%age
1.	Research bulletins to stay informed about the latest ICT developments in agriculture.	42	52.50	38	47.50
2.	Newspapers to learn about how other farmers are using ICT in their farming practices.	46	57.50	34	42.50
3.	Agricultural magazines to stay updated on the latest ICT tools and technologies for farming.	48	60.00	32	40.00
4.	Posters in farm office that illustrate how ICT can be used to improve crop production.	49	61.25	31	38.75
5.	Agricultural journals to understand the impact of ICT adoption on crop yields and farm efficiency.	40	50.00	40	50.00
6.	Annual reports from agricultural organizations to learn about successful ICT adoption stories in farming.	38	47.50	42	52.50
Average adoption score of print technology usage		43.83	54.79	36.17	45.21
II. Technological Understanding of ICT:		Freq	%age	Freq	%age
1.	Easily browse agricultural information on the internet without assistance.	42	52.50	38	47.50
2.	Effectively use computers to manage my farm operations.	38	47.50	42	52.50

3.	Rely on online platforms for agricultural input purchases and electronic payments.	34	42.50	46	57.50
4.	Understand the distinction between agricultural hardware and software applications.	31	38.75	49	61.25
5.	Mobile apps to access agricultural information and services.	38	47.50	42	52.50
6.	Regularly update farming practices based on information from digital sources.	40	50.00	40	50.00
7.	Online forums and discussions related to agriculture.	38	47.50	42	52.50
8.	Training programs or workshops on using ICT in agriculture.	36	45.00	44	55.00
9.	Integrated ICT tools into crop management practices.	39	48.75	41	51.25
10.	New ICT solutions to improve farming efficiency.	38	47.50	42	52.50
11.	Cloud computing services for farm data storage and management.	34	42.50	46	57.50
12.	GPS technology for precision farming activities.	32	40.00	48	60.00
13.	Farmers using online platforms or social media groups.	30	37.50	50	62.50
14.	Agricultural influencers or experts on social media for farming tips and advice.	38	47.50	42	52.50
15.	Digital mapping tools for farm planning and monitoring.	39	48.75	41	51.25
Average adoption level score about of technological understanding of ICT		36.47	45.58	43.53	54.42
III.ICT Usage in Agriculture:		Freq	%age	Freq	%age
1.	About modern farming technologies and how they can benefit farm.	38	47.50	42	52.50
2.	Experimenting with new farming methods to enhance the productivity and sustainability of farm.	36	45.00	44	55.00
3.	Computers to manage various aspects of farm business, such as record-keeping, inventory management, and financial analysis.	40	50.00	40	50.00
4.	Search for information on new agricultural products and technologies to stay updated with the latest advancements in the field.	38	47.50	42	52.50
5.	Use specialized software and applications, such as farm management software, weather forecasting tools, and crop monitoring apps.	39	48.75	41	51.25
6.	Internet access is essential for managing farm operations, as it allows accessing information, communicating with suppliers and customers and monitoring farm remotely.	36	45.00	44	55.00
7.	Access to the necessary resources, including technology and knowledge, to use precision agriculture technologies on farm.	39	48.75	41	51.25
8.	Soil sensors and remote sensing technologies on farm to monitor soil moisture, nutrient levels, and crop health, allowing for more precise and efficient farming practices.	40	50.00	40	50.00
9.	Internet subscription for farm's needs, ensuring reliable and high-speed internet connectivity for my farm operations.	40	50.00	40	50.00
Average adoption score of respondents about ICT Usage in Agriculture		36.47	45.59	43.53	54.41
IV. Impact of ICT in Agriculture:		Freq	%age	Freq	%age
1.	Use of Geographic Information Systems (GIS) in agricultural mapping and analysis.	34	42.50	46	57.50
2.	Potential of unmanned aerial vehicles (UAVs) or drones for crop monitoring and management.	40	50.00	40	50.00
3.	Artificial intelligence (AI) and machine learning algorithms in optimizing	34	42.50	46	57.50

	agricultural processes and decision-making.				
4.	Mobile payment systems and their use in facilitating financial transactions within agricultural value chains.	36	45.00	44	55.00
5.	Potential of virtual reality (VR) and augmented reality (AR) technologies in agricultural training and simulation applications.	36	45.00	44	55.00
6.	Use digital databases to store and manage information about crops and livestock.	36	45.00	44	55.00
7.	Internet of Things (IoT) and big data analytics can be used in agriculture to optimize farming practices and improve decision-making.	38	47.50	42	52.50
8.	Concept of smart farming and its integration of ICT for optimized farm management.	38	47.50	42	52.50
9.	Precision livestock farming technologies, such as wearable sensors for monitoring animal health and behaviour.	42	52.50	38	47.50
10.	ICT in promoting climate-smart agriculture practices, such as conservation agriculture and agroforestry.	34	42.50	46	57.50
11.	Mobile-based market information systems for accessing market prices and trends.	34	42.50	46	57.50
12.	ICT in promoting sustainable agriculture practices, such as organic farming and integrated pest management.	35	43.75	45	56.25
13.	Agricultural robotics and its applications in tasks such as planting, spraying, and monitoring.	35	43.75	45	56.25
14.	ICT in promoting traceability and transparency in agricultural supply chains.	38	47.50	42	52.50
15.	ICT in promoting gender equality in agriculture through access to information and market opportunities.	36	45.00	44	55.00
16.	Sustainable water management practices in agriculture, such as precision irrigation.	34	42.50	46	57.50
17.	Digital soil mapping and its applications in soil fertility management.	32	40.00	48	60.00
18.	Finance solutions for smallholder farmers, such as mobile banking and digital loans.	38	47.50	42	52.50
19.	Climate resilience in agriculture through early warning systems and climate information services.	40	50.00	40	50.00
20.	ICT in promoting sustainable energy solutions for agriculture, such as solar-powered irrigation systems.	55	68.75	25	31.25
21.	ICT in promoting agricultural insurance schemes for risk management in farming.	52	65.00	28	35.00
Average adoption level score of respondents about Impact of ICT in agriculture		37.95	47.44	42.05	52.56

Figure.1



Farmers are aware of the concept of smart farming and its integration of ICT for optimized farm management. ICT also plays a role in promoting climate-smart agriculture practices, gender equality, sustainable energy solutions, and agricultural insurance schemes. However, there is still a need to enhance awareness and adoption of these technologies to realize their full potential.

The mean awareness score as shown in table 6 of respondents about ICT for crop production was reported 46.09. The overall awareness level of ICT for crop production by the respondents is 57.61%, indicating that while there is a significant awareness of ICT tools and their applications in agriculture, there is still a considerable portion of farmers who are less aware or not fully utilizing these technologies.

The data in the table 7 provides valuable insights into the extent to which farmers are integrating smart devices, social media and print technology. Farmers show a moderate level of adoption of smart devices for agricultural activities. Smart phones have the highest adoption score of 60 (75.00%) among all smart devices, indicating their importance for monitoring crops and accessing agricultural information online. The average adoption score of 54.50 (68.12%) highlights that smart devices are increasingly becoming essential tools in modern farming.

Social media platforms are widely used by farmers to communicate, share information, and stay updated on agricultural trends. WhatsApp, with a score of 50

(62.50%) was the most popular platform for exchanging farming practices and innovations. Facebook and Twitter follow closely, indicating that farmers are actively engaging with online communities and keeping abreast of industry developments.

Print technology adoption shows lower levels compared to smart devices and social media. Agricultural magazines 48 (60.00%) and Newspapers (46 (57.50%)) are the most adopted print resources, suggesting that while digital media is gaining prominence, traditional print media i.e. Posters holds relevance with the score of 49 (61.25%). The average adoption score of 43.83 (54.79%) indicates a moderate reliance on print technology, but it is clear that digital sources are becoming more prevalent.

The Technological understanding of ICT and usage of various ICT tools showed a mixed picture. Farmers demonstrated moderate proficiency in browsing agricultural information on the internet 40 (50.00%) and using computers for farm operations. The adoption levels for ICT usage in agriculture reflect a moderate engagement with modern farming technologies.

Experimenting with new farming methods and using specialized software and applications indicate that farmers are beginning to explore innovative approaches to enhance productivity. However, the overall average adoption suggests that while there is interest in ICT adoption, practical implementation and consistent usage are areas requiring improvement.

The impact of ICT on various aspects of agriculture demonstrates a range of adoption levels. Notably, the use of Geographic Information Systems (GIS) and artificial intelligence (34% each) shows a lower adoption rate, indicating that these advanced technologies are still emerging in the agricultural sector.

The average adoption under the potential of ICT in transforming agricultural practices, though further efforts are needed to increase adoption across all areas. The overall mean adoption level score of 37.95 (47.44%) reflects a moderate adoption rate of ICT tools in crop production among farmers. The adoption rate of 47.44 % compared to 52.56% for non-adoption indicates a balanced yet slightly equal trend towards embracing ICT in agriculture.

The study highlighted a substantial level of awareness among farmers regarding the use of ICT tools in agriculture. However, it also revealed critical areas needing improvement, such as enhancing technological understanding, increasing the adoption of print technologies, and providing more training and resources. By addressing these gaps, farmers can better leverage ICT tools to boost productivity, efficiency, and sustainability in their agricultural practices. Despite the progressive adoption of ICT tools, there remains significant potential to further integrate advanced technologies into agriculture. Enhancing digital literacy, offering trainings on ICT in transforming agricultural practices, and advanced ICT applications in agriculture.

Author Contributions

Sube Singh: Investigation, formal analysis, writing—original draft. P. S. Shehrawat: Validation, methodology,

writing—reviewing. Sandeep Bhakar:—Formal analysis, writing—review and editing. Rati Mukteshwar: Investigation, writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

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