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Prospects and problems in implementing 4AR innovations in relation to 4IR perspectives

Bornali Saha, Md. Matiul Islam* and Mohammad Bashir Ahmed

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ABSTRACT

The Fourth Industrial Revolution (4IR) and the concept of the Fourth Agricultural Revolution (4AR) are interconnected, as they both refer to the application of advanced technologies. The Fourth Industrial Revolution has the power to revolutionize agriculture, enabling farmers to embrace innovation, increase productivity, and foster sustainable practices. The purpose of this study was to determine the extent of knowledge and attitude of respondents; to determine the familiarity of the respondents with 4AR technologies, to measure the severity of problems perceived by the respondents concerning 4AR, to find out the suitability of solutions for adopting 4AR innovations and to explore the relationship between each of the selected characteristics of the respondents with the focused issues. Primary data were collected from purposively selected 70 respondents during the period of 1 May, 2023 to 9 May, 2023 at Khulna district through face-to-face discussions and online interviews by using a pre-tested interview schedule. Descriptive statistics such as mean, standard deviation, percentage and Spearman Coefficient of Correlation (ρ) were measured for data interpretation by using SPSS. Almost 72.9% of the respondents had low knowledge of 4AR technologies and a proportion of 95.7% of the respondents had a favorable attitude toward 4AR. Maximum respondents are highly familiar with the technology of "Using an automated machine for seedling transplantation" and "Using agricultural drones in applying fertilizers and pesticides in crop fields". The main problem based on the problem severity index was "High initial investment to purchase 4AR technologies". The best possible solutions according to the solution index were making the 4AR technologies available at low prices in the local market" followed by financial support from the Government and other agencies. Knowledge and attitude towards 4AR technologies had a significant positive relationship with the familiarity of 4AR technologies. Training experience had a highly significant relationship with the determination of associated problems in 4AR implementation. Knowledge of 4AR and training experience had a highly significant positive relationship with the measurement of the suitability of probable solutions.

Keywords: Knowledge, Attitude, Familiarity, 4AR

Agrotechnology Discipline, Khulna University, Khulna-9208, Bangladesh

*Corresponding author's email: matiul@at.ku.ac.bd (Md. Matiul Islam)

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Introduction

Agriculture plays a key role in a country's economy as well as the everyday lives of the vast majority of rural people. Agricultural advancement has been acclaimed as one of the essential tools that could be used for putting an end to extreme poverty, therefore enhancing common prosperity, and feeding an estimated world-wide population of 9.7 billion people by 2050. Modern-day agriculture is solely responsible for a huge share of environmental destruction, which leads to the decline of continental and marine ecosystems, diminishing water resources, as well as driving climate change. To reduce these roadblocks, agriculture will need to be modernized via the contribution of technologies that fall under the Fourth Industrial Revolution (4IR).

The term Fourth Industrial Revolution (4IR) comprises a variety of innovative, developing, and breakthrough technologies such as Big Data, the Internet of Things, Artificial Intelligence, Block chain and Drones, to mention a few. Consequently, such technologies can have a positive effect on the efficiency and profitability of the agricultural sector as well as the creation of new-found locally based added value. The main focus of industrial agriculture is to increase technology adoption rates in farming, driving effective and efficient change that increases productivity in a sustainable, profitable and eco-friendly way (Liu *et al.*, 2020). To make autonomous connections of computer-based algorithms for open-field agriculture, industry 4.0 builds intelligent networks among machines, work and systems in general by creating the entire value chain with the help of IoT, which can control themselves and each other (Lasi *et al.*, 2015; Hofmann and Rüsch, 2017).

Bangladesh has a strong agriculture sector, which contributes significantly to the country's economy. Some of the key initiatives in Bangladesh include the adoption of precision farming techniques, the use of drones for crop monitoring and fertilization, and the implementation of smart irrigation systems. In Bangladesh, the 4AR is closely linked to the 4IR, as the country strives to leverage technological advancements to modernize its agricultural sector and address the challenges faced by farmers.

The government of Bangladesh has recognized the potential of technology in transforming the agriculture sector and has taken initiatives to promote the adoption of digital solutions. The Digital Bangladesh Vision 2021, a government program, emphasizes the use of ICT (Information and Communication Technology) to drive socio-economic development, including agriculture.

The implementation of 4AR innovations in Bangladesh faces several challenges, including limited access to technology and digital infrastructure, financial constraints, lack of awareness and technical skills, a fragmented agriculture sector, policy and regulatory gaps, and inadequate infrastructure and power supply. Overcoming these challenges requires collaborative efforts among stakeholders, targeted investments, policy reforms and capacity-building initiatives. Addressing these issues will be crucial to unlocking the full potential of 4AR innovations and driving sustainable agricultural development in Bangladesh. Regarding these circumstances, the researcher has undertaken the present study entitled "Problems and Prospects in Implementing 4AR Innovations in Relation to 4IR Perspectives.

Objectives of the study

In order to find the proper direction of the present study, the following objectives were formulated:

a) To determine the selected characteristics of the respondents and the extent of knowledge and attitude of agriculturists towards 4AR
b) To measure the extent of familiarity of the agriculturists towards 4AR technologies
c) To analyze the problems associated with the implementation of industrial agricultural technology.
d) To find out the possible solutions to overcome the associated problems.

Materials and Methods

Locale of the study

The research was conducted purposively at different agricultural research and extension organizations of Khulna district. Some responses were also collected remotely from agriculture graduates of Bangladesh through an online survey form.

Population and sampling

Graduate agriculturists of Khulna were primarily regarded as the population of this research. For fulfill the requirement of desired sample size, some interviews were done remotely through online media with agriculture students staying in different portions of the country. A total of 70 respondents were purposively selected for the study.

Selection of variables

For the research purpose "familiarity with 4AR technologies", "Problems associated with the implementation of 4AR technologies" and "Probable solutions for the problems" were selected as the focus issues. Nine socioeconomic characteristics of the graduate agriculturists were selected. The selected characteristics were: age, educational qualifications, service length, training experience, extension media contact, knowledge of 4AR technologies and attitude toward 4AR technologies.

Familiarity with 4AR Technologies

The respondents were asked to indicate their extent of familiarity with selected 20 4AR technologies. Familiarity score of a respondent was determined by using the following formula:

$$FS = N_{hf} \times 3 + N_{mf} \times 2 + N_{sf} \times 1 + N_{na} \times 0$$

Where,

FS = Familiarity Score
N_{hf} = No. of the respondents having high familiarity
N_{mf} = No. of the respondents having moderate familiarity
N_{sf} = No. of the respondents having slight familiarity
N_{na} = No. of the respondents having no familiarity
After calculating the FS, the Familiarity Index was calculated by the following formula:

$$\text{Familiarity Index (\%)} = \frac{\text{Observed Familiarity Score}}{\text{Possible Highest Familiarity Score}} \times 100$$

Problems Associated with the Implementation of 4AR Technologies

The severity of a problem was determined based on the Problem Index (PI). It was measured by using a five point rating scale. The respondents were asked to give their opinions on the extent of severity of the selected 15 problems.

The problem score of a respondent was determined by using the following formula:

$$PS = N_{hs} \times 4 + N_s \times 3 + N_{ms} \times 2 + N_{ls} \times 1 + N_{na} \times 0$$

Where,

PS = Problem Score
N_{hs} = No. of the respondents who marked the problem as highly severe
N_s = No. of the respondents who marked the problem as severe
N_{ms} = No. of the respondents who marked the problem as moderately severe
N_{ls} = No. of the respondents who marked the problem as less severe
N_{na} = No. of the respondents who did not mark the problem at all

After calculating the PS, the Problem Index was calculated by the following formula:

$$\text{Problem Index (\%)} = \frac{\textit{Observed Problem Score}}{\textit{Possible Highest Problem Score}} \times 100$$

Solution for the Implementation of 4AR Technologies

The suitability of solutions was determined based on the Solution Suitability Index (SSI). It was measured by using a five point rating scale. The respondents were asked to give their opinions on the extent of suitability of the selected 15 solutions.

The solution score of a respondent was determined by using the following formula:

$$SS = N_{hs} \times 4 + N_s \times 3 + N_{ms} \times 2 + N_{ls} \times 1 + N_{na} \times 0$$

Where,

SS = Solution Score
N_{hs} = No. of the respondents who marked the solution as highly suitable
N_s = No. of the respondents who marked the solution as suitable
N_{ms} = No. of the respondents who marked the solution as moderately suitable
N_{ls} = No. of the respondents who marked the solution as less suitable
N_{na} = No. of the respondents who did not mark the solution at all

After calculating the SS, the Solution Index was calculated by the following formula:

$$\text{Solution Suitability Index (\%)} = \frac{\textit{Observed Solution Score}}{\textit{Possible Highest Solution Score}} \times 100$$

Data collection

The researcher herself collected data from the respondents through face-to-face interviews and through an online platform using a pre-tested interview schedule. The researcher took all possible care to establish rapport with the respondents. Data collection was started on 1 May, 2023 and completed on 9 May, 2023.

Statistical analysis

Statistical measures such as number, percentage, mean, standard deviation, minimum, maximum, rank order etc. were used for describing the variables. The coded data were put into the computer for statistical analysis. The analysis was performed using the statistical software Statistical Package for the Social Sciences (SPSS). Spearman Coefficient of Correlation (ρ) was calculated to explore the relationship between the concerned variables. The Spearman rank coefficient of correlation was used as it evaluates the monotonic relationship; the variables (focus issues and other selected characteristics) tend to change together, but not necessarily at a constant rate. The analysis of social data is always not linear and constant. That is the motivation for using the Spearman rank coefficient of correlation in determining the relationships.

Results and Discussion

Selected characteristics of the respondents

Nine characteristics of the graduate agriculturists were selected to find out their contribution to the focused issues of the study (Table 1).

Table 1 represents the age of the respondents which varied from 24 to 50 years with a mean and standard deviation of 30.47 years and 7.01 years respectively. Considering the recorded age, respondents are classified into three age groups namely "young", "middle-aged" and "old".

The findings in Table 1 indicate that the highest proportion (75.7 %) of the respondents were young compared to 24.3 % of them being middle-aged and none of the respondents was old.

Table 1 shows that the mean and standard deviation of respondent's educational qualification scores was 16.71 and 0.45. Based on their educational scores, the respondents were classified into two categories namely undergraduate and postgraduate.

The educational qualification scores vary from 16 to 17. Respondents in the above post-graduate category have the highest proportion (71.4 %) followed by undergraduate category (28.6 %).

The service length score of the respondents ranged from 0 to 22 with a mean of 3.74 years and a standard deviation of 6.50 years. Based on the observed range of service length scores, the respondents were categorized into three categories namely low, medium and high. About 72.9 % of the respondents had low service length scores while 18.6 % of them had medium service length. Only 8.5 % of the respondents had a high service length score.

Only 31.4 % of the respondents have received training on different agricultural topics. The maximum portion of the respondents, about 68.6 % do not have any training experience.

Table 1. Salient features of the respondents with their characteristics (N= 70).

SL No.	Characteristics	Categories	Score	N = 70		(Mean ± SD)	Range	
				F.	%		Min.	Max.
1.	Age (years)	Young	≤ 35	53	75.7	30.47 ± 7.01	24	50
		Middle-aged	36-55	17	24.3			
		Old	> 55	0	0.0			
2.	Educational Qualifications (years of schooling)	Undergraduate (BSc)	16	20	28.6	16.71 ± 0.45	16	17
		Post Graduate (MSc)	17	50	71.4			
3.	Service length (years)	Low	1-5	51	72.9	3.74 ± 6.50	0	22
		Medium	6-15	13	18.6			
		High	> 16	6	8.5			
4.	Training experience	Yes		22	31.4			
		No		48	68.6			
5.	Extension Media Exposure							
5 (a)	Personal contact	Low	≤3	48	68.6	1.82 ± 2.73	0	8
		Medium	4-6	17	24.3			
		High	> 6	5	7.1			
5 (b)	Group contact	Low	≤ 3	48	68.6	2.57 ± 3.72	0	9
		Medium	4-6	4	5.7			
		High	> 6	18	25.7			
5 (c)	Mass media contact	Low	≤ 7	22	31.4	10.54 ± 4.49	5	20
		Medium	8-15	33	47.2			
		High	> 15	15	21.4			
6.	Knowledge on 4AR	Low	≤ 5	51	72.9	4.37 ± 2.16	1	10
		Moderate	6-15	19	27.1			
		High	> 15	0	0.0			
7.	Attitude towards 4AR	Highly unfavorable	0-10	0	0.0	35.78 ± 2.79	29	41
		Unfavorable	11-20	0	0.0			
		Neutral	21-30	2	2.9			
		Favorable	31-40	67	95.7			
		Highly favorable	41-50	1	1.4			

The observed personal extension contact scores of the respondents ranged from 0 to 8 along with the mean and standard deviation of 1.82 and 2.73 respectively. A proportion of 68.6% of the respondents had low personal extension contact compared to 24.3 percent of them having medium personal extension contact. About 7.1% of the respondents only had high personal contact. Thus, the overwhelming majority (92.9%) of the respondents had low to medium personal extension contact.

The group contact score of the respondents ranged from 0 to 9 along with the mean and standard deviation of 2.57 and 3.72 respectively. According to this score, the respondents were classified into three categories: “low group contact” (up to 3), “medium group contact” (4-6) and “high group contact” (above 6). A proportion of 68.6 % of the respondents had low group contact scores compared to 5.7% of them having medium group contact. About 25.7% of the respondents had high group contact. Thus, the majority (94.4%) of the respondents had low to high group extension contact.

The mean and standard deviation of respondent’s mass media contact scores were 10.54 and 4.49. According to Table 1, the mass media contact score of the respondents ranged from 5 to 20. A proportion of 47.2% of the respondents had medium mass media contact followed by 31.4% of them having low mass media contact. Only 21.4% of the respondents had high mass media contact. Thus, the majority (78.6%) of the respondents had medium to low mass extension contact.

The knowledge scores of the respondents on 4AR have ranged from 1 to 10 with a mean and standard deviation of 4.37 and 2.16 respectively. Considering the recorded value, respondents are classified into three categories namely "low knowledge", "moderate knowledge" and "high knowledge". The findings indicate that the highest proportion (72.9 %) of the respondents have low knowledge compared to 27.1 % of them having moderate knowledge. Data also indicates that the low and medium knowledge categories constitute overall 100 % of total respondents and 0 percent of respondents have high knowledge on 4AR.

Table 1 shows that the mean and standard deviation of respondent's attitude scores were 35.78 and 2.79. The attitude score of the respondents towards 4AR ranged from 29 to 41. Based on their attitude scores, the respondent's attitude was classified into five categories namely highly unfavorable, unfavorable, neutral, favorable and highly favorable.

A proportion of 95.7 % of the respondents had a favorable attitude towards 4AR whereas only 2.9% of respondents had a neutral attitude followed by 1.4 % of them having a highly favorable attitude. Thus, the majority (95.7%) of the respondents had a favorable attitude towards 4AR.

Floridi *et al.*, (2018) and Jobin *et al.*, (2019) also reported that attitudes towards 4IR technologies are multifaceted, reflecting a range of perspectives and concerns.

Focus issues of the study

The extent of familiarity of respondents with 4AR technologies

The familiarity score of the respondents ranged from 6 to 36 with a mean of 14.34 and a standard deviation of 5.49. Based on the observed range of scores, the respondents were categorized into three categories namely less familiar, moderately familiar and highly familiar. The distribution of the respondents according to their familiarity score is presented in Table 2.

Data presented in Table 2 indicates that the majority of the respondents (about 90%) have less familiarity with 4AR technologies. Only 10% of respondents have moderate familiarity. None of the respondents has a high familiarity with the 4AR technologies.

Table 2. Distribution of the respondents according to familiarity score.

Characteristics	Categories	Score	N = 70		(Mean ± SD)	Range	
			Frequency	%		Min.	Max.
Familiarity with 4AR Technologies	Less	≤ 20	63	90	14.34 ± 5.49	6	36
	Moderate	21 – 40	7	10			
	High	> 41	0	0			

Comparative familiarity of the respondents based on the familiarity index

To compare the technologies, a rank order was made based on the Familiarity Index (FI). Familiarity index score ranged from 0 to 91.90, which was represented in Table 3.

Based on Familiarity Index, it was observed that "Using automated machines for seedling transplantation" ranked first followed by "Using agricultural drones in applying fertilizers and pesticides in crop field", "Using mobile apps to capture plant photos for disease diagnosis" and so on presented in Table 3.

Table 3. Rank order of the 4AR technologies according to familiarity index.

SL No.	4AR technologies	Familiarity score of 4AR technologies				Familiarity score	Familiarity index (%)	Rank
		Highly familiar (3)	Moderately familiar (2)	Slightly familiar (1)	Not familiar (0)			
1.	Using AI powered machine in determining soil and crop health	0	3	24	43	30	14.28	10th
2.	Using AI technology to provide fertilizer recommendation	1	19	33	17	74	35.23	5th
3.	Using AI powered technology in monitoring and forecasting weather condition	0	21	46	3	88	41.90	4th
4.	Using mobile apps to capture plant photos for disease diagnosis	25	17	15	13	124	59.04	3rd
5.	Using machines to determine seed rates for specific crops for a particular area.	1	1	5	63	10	4.76	13th
6.	Using machines for seedling transplantation	56	12	1	1	193	91.90	1st
7.	Using AI powered technology to automatically control temperature and light intensity in Greenhouse	1	5	50	14	63	30.00	7th
8.	Using AI for water management in hydroponics.	0	1	19	50	21	10.00	11th

9.	Using agricultural robots in different intercultural operations such as weeding, picking, harvesting etc.	0	2	30	38	34	16.19	9^{th}
10.	Using agricultural drones in applying fertilizers and pesticides in crop field	23	32	14	1	147	70.00	2^{nd}
11.	Placement of chips and body sensors in cattle to get updates about their physical condition through mobile apps	0	1	1	68	3	1.42	15^{th}
12.	Using robots for collecting eggs and waste management in the poultry industry	0	0	0	70	0	0.00	17^{th}
13.	Using automated machines for collecting milk in dairy farm	1	6	33	30	48	22.85	8^{th}
14.	Using big data to get better insight into yield predication and minimize cost	0	1	9	60	11	5.23	12^{th}
15.	Using IoT for tracking, tracing and monitoring farms remotely	0	1	5	64	7	3.33	14^{th}
16.	Using big data analytics for supply chain management	0	1	0	69	2	0.95	16^{th}
17.	Using IoT and smart sensor technology in predictive analysis for smart farming	0	1	1	68	3	1.42	15^{th}
18.	Using sensors in soil to measure different nutrient levels in the soil for fertilizer management	0	12	44	14	68	32.38	6^{th}
19.	Using IoT for smart aquaculture	1	0	4	65	7	3.33	14^{th}
20.	Using wireless sensor network module for real-time data collection and farm monitoring	1	1	2	66	7	3.33	14^{th}

The extent of severity of problems as perceived by the respondents

The severity score of the problems as perceived by the respondents ranged from 40 to 59 with a mean of 47.64 and standard deviation of 3.87. Based on the observed range of scores, the severity of problems was categorized into three categories as presented in Table 4.

Data presented in Table 4 indicates that the majority of the respondents (about 77.1%) have regarded the problems as moderately severe. Only 22.9% of respondents regarded the problems as highly severe. None of the respondents thought that the problems had less severity.

Table 4. Distribution of the respondents according to problem score.

Characteristics	Categories	Score	N = 70		(Mean ± SD)	Range	
			Frequency	%		Min.	Max.
Extent of Problems	Less	≤ 25	0	0	47.64 ± 3.87	40	59
	Moderate	26-50	54	77.1			
	High	> 50	16	22.9			

Comparative Severity of the Problems Based on Problem Index

To compare the problems, a rank order was made based on the problem index (PI). The problem index (PI) of the respondents of the 15 problem items in 4AR technology implementation ranged from 69.64 to 95.35 as presented in Table 5.

Based on PI, it was observed that high initial investment to purchase 4AR technologies ranked first followed by "high maintenance and operating cost" (2^{nd}), lack of knowledge about 4AR technologies to operate and maintain (3^{rd}), lack of training programs and skilled manpower (4^{th}) etc. Preference of farmers to practice traditional farming system (15^{th}) ranked as a less severe problem followed by the unwillingness of rural farmers to adopt new technologies in farming practices (14^{th}), small and fragmented land size (13^{th}), etc.

Bhowmik and Hossain (2020) and Ahmed *et al.*, (2020) also found that limited access to technology and digital infrastructure, financial constraints, lack of awareness and technical skills, and a fragmented agriculture sector are major problems in the implementation of 4AR technologies in Bangladesh. Miah (2021); Rahman (2021) and Mahmud (2020) also found similar results.

Table 5. Rank order of problems based on problem index.

SL No.	Problems of 4AR implementation	Score of problems					Problem Score	Problem index (%)	Rank
		Highly severe (4)	Severe (3)	Moderately severe (2)	Less severe(1)	Not at all (0)			
1.	Poverty of rural farmers	18	49	3	0	0	225	80.35	6th
2.	Unwillingness of rural farmers to adopt new technologies in farming practices	5	55	9	1	0	204	72.85	14th
3.	Preference of farmers in practicing traditional farming system	4	48	17	1	0	195	69.64	15th
4.	Lack of knowledge about 4AR technologies to operate and maintain	46	24	0	0	0	256	91.42	3rd
5.	High initial investment to purchase 4AR technologies	59	9	2	0	0	267	95.35	1st
6.	High maintenance and operating cost	52	16	2	0	0	260	92.85	2nd
7.	Lack of training programs and skilled manpower	43	26	1	0	0	252	90.00	4th
8.	Lack of incentives and support from Government Organizations and NGO's	29	28	13	0	0	226	80.71	5th
9.	Lack of expert guidance/ motivation/ extension support for implementation of 4AR technologies	24	31	15	0	0	219	78.21	9th
10.	Weak coordination between Research and Development Organizations	13	41	16	0	0	207	73.92	11th
11.	Small and fragmented land size	7	51	12	0	0	205	73.21	13th
12.	Insufficient network connectivity in rural areas along with a lack of basic computer knowledge and literacy	21	41	8	0	0	223	79.64	7th
13.	Unwillingness of farmers to become increasingly reliant on machines instead of their own knowledge	18	38	14	0	0	214	76.42	10th
14.	Migration of rural people to urban areas and shortage of young labor force in rural area	18	44	8	0	0	220	78.57	8th
15.	Experienced farmers do not transfer their knowledge to any person except their family member	10	46	14	0	0	206	73.57	12th

Extent of suitability of the solutions as perceived by the respondents

The suitability score of the solutions as perceived by the respondents ranged from 47 to 75 with a mean of 62.30 and a standard deviation of 4.42. Based on the observed range of scores, the suitability of solutions was categorized into three categories as presented in Table 6.

Data presented in Table 6 indicate that the majority of the respondents (about 77.1%) have regarded the solutions as highly suitable. About 22.9% of respondents regarded the solutions as moderately suitable. None of the respondents thought that the solutions were less suitable.

Table 6. Distribution of the respondents according to suitability of solutions score.

Characteristics	Categories	Score	N = 70		(Mean ± SD)	Range	
			Frequency	%		Min.	Max.
Suitability of probable solutions	Less	≤ 30	0	0	62.30 ± 4.42	47	75
	Moderate	31-60	16	22.9			
	High	> 60	54	77.1			

Comparative Suitability of the Solutions Based on Solution Index

On the basis of SI, it was observed that "making the 4AR technologies available at low prices in the local market" ranked first according to suitability followed by financial support from Government and other agencies (2nd), providing short-term loan facilities or incentives to the small farmers (3rd), organizing training programs for rural farmers on a regular interval (4th), focus on future research on the adoption of 4AR technologies in every aspect of farming (5th) etc.

Bhuiyan (2019), Hossain (2021), Khatun (2019), Mahmud (2020) and Rahman (2021) have also reported the same findings in their research that improving technology access and infrastructure, strengthening technical education and training, providing financial support and incentives, simplifying decision-making processes, and raising awareness can collectively contribute to the successful adoption of 4AR technologies.

Table 7. Rank order of probable solutions according to solution index.

SL. No.	Probable solutions	Suitability score of the solution					Solution Score	Solution index (%)	Rank
		Highly suitable (5)	Suitable (4)	Moderately suitable (3)	Less suitable (2)	Not at all (1)			
1.	Proper identification and documentation of 4AR technologies	16	54	0	0	0	295	84.57	7th
2.	Building upon local people's knowledge and awareness on 4AR through different extension teaching methods	12	55	3	0	0	289	82.57	9th
3.	Using 4AR technologies in a proper scientific way to get desired results within a short time	18	35	17	0	0	281	80.28	10th
4.	Making the 4AR technologies available at low prices in the local market	43	27	0	0	0	323	92.28	1st
5.	Discovering the ways to increase the use of 4AR technologies by researchers	18	31	20	1	0	276	78.85	13th
6.	Focus on future research on the adoption of 4AR technologies in every aspect of farming	28	38	4	0	0	304	86.85	5th

7.	Financial support from Government and other agencies to adopt 4AR technologies	44	23	3	0	0	321	91.71	2nd
8.	Experts should provide solutions to new problems regarding the use of 4AR technologies	19	48	3	0	0	296	84.57	6th
9.	Govt. officials and educated people should give more importance to 4AR technology using	17	49	4	0	0	293	83.71	8th
10.	Experienced farmers should transfer their knowledge to others during different social gatherings	10	42	15	3	0	269	76.85	14th
11.	Ensuring Proper coordination between Research and Extension Organizations	7	53	10	0	0	277	79.14	12th
12.	Providing short-term loan facilities or incentives to small farmers	36	31	3	0	0	313	89.42	3rd
13.	Organizing training programs for rural farmers on a regular interval	30	38	2	0	0	308	88	4th
14.	Ensuring Sufficient network connectivity and computer learning facilities in rural areas.	5	58	7	0	0	278	79.42	11th
15.	Building awareness among the rural people through different extension programs.	4	58	8	0	0	276	78.85	13th

Relationship between Each of the Selected Characteristics of the Respondents with Focus Issues

Table 8 showed that knowledge and attitude towards 4AR technologies had a significant positive relationship with the familiarity of 4AR technologies. Knowledge of 4AR had a highly significant relationship with the familiarity. That means with the increase of knowledge and favorable attitude the familiarity with 4AR technologies become increased. Other socioeconomic characteristics like age, educational qualifications, service length, personal contact, group contact and mass media contact do not have any significant relationship with familiarity of 4AR technologies.

Table 8. Co-efficient of correlation showing the relationship between each of the selected characteristics of the respondents with focus issues (N=70).

Socioeconomic Characteristics	Familiarity with 4AR Technologies	Associated problems in 4AR implementation	Probable Solutions
1. Age	0.023	-.260*	-.149
2. Educational Qualifications	0.110	-.086	.164
3. Service Length	0.035	-.343**	-.319**
4. Training Experience	-0.078	.377**	.311**
5. Personal Contact	0.131	-.385**	-.272*
6. Group Contact	0.125	-.345**	-.231
7. Mass Media Contact	0.194	-.179	-.182
8. Knowledge on 4AR	0.728**	.084	.356**
9. Attitude towards 4AR	0.235*	.038	.042

*** Correlation is significant at the 0.01 level (2-tailed) * Correlation is significant at the 0.05 level (2-tailed)*

According to Table 8, it was also observed that age, service length, personal contact and group contact had a highly significant negative relationship with the problem associated with 4AR technology implementation. That means people with higher age, high service length, and high personal and group contact assume fewer problems in 4AR implementation. Training experience had a highly significant relationship with associated problems in 4AR implementation. That means people having more training experience can easily analyze and find out the problems associated with 4AR implementation.

Table 8 also indicates that knowledge of 4AR and training experience had a highly significant positive relationship with the solution. That means those who have high knowledge and more training experience can easily find the solution for solving the problems. On the other hand, Age, Service length etc. had a negative correlation with solutions. That may indicate that the people of higher age had high service length but their problem-solving capacity is lower than younger people.

Conclusions

Based on the findings and their interpretations the following conclusions have been drawn:

i. Almost 72.9 % of the respondents had low knowledge of 4AR technologies and a proportion of 95.7 % of the respondents had a favorable attitude towards 4AR. As most of the respondents have favorable attitudes, it will be easier to motivate them to adopt 4AR technologies.
ii. Maximum respondents are highly familiar with the technology of "Using an automated machine for seedling transplantation"; "Using agricultural drones in applying fertilizers and pesticides in crop fields", "Using mobile apps to capture plant photos for disease diagnosis" etc. Through this output, it can be possible to utilize the familiarity of these technologies fully in different farming practices
iii. The main problem according to the extent of severity was "High initial investment to purchase 4AR technologies". The best solutions according to the extent of suitability were making the 4AR technologies available in low prices in the local market" followed by financial support from Government and other agencies and providing short-term loan facilities or incentives to the small farmers. The severe problems should be solved immediately by the GOs and NGOs by taking proper steps.
iv. The findings revealed that Knowledge and attitude towards 4AR technologies had a significant positive relationship with the familiarity of 4AR technologies. Age, service length, personal contact and group contact had a highly significant negative relationship with the problem associated with 4AR technology implementation. Training experience had a highly significant relationship with associated problems in 4AR implementation at 1% level of significance. Knowledge of 4AR and training experience had a highly significant positive relationship with the suitability of probable solutions at 1% level of significance. That means the respondents who have high knowledge and training experience can easily find out the best possible solutions for solving the problems.

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