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Extent of Awareness and Adoption of Climate Resilient Crop Production Practises among Farmers in Haryana State of India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The phenomenon of climate change presents a substantial obstacle to the attainment of food self-sufficiency and the overall welfare of rural communities. Climate change has significantly impacted the agricultural sector in India, with the majority of the population being more susceptible due to their direct or indirect reliance on the sector. The process of adapting to climate change is multifaceted and involves various factors, including economic, cultural, institutional, and biophysical aspects. Long-term climate change could threaten marginalised groups' livelihoods, thus proactive planning is needed. Strategic research that raises awareness and encourages adaptation helps Indian agriculture withstand climatic variability and climate change. This study evaluates farmers'

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knowledge and willingness to adopt climate-resilient agricultural practices in farming activities. The investigation involved 120 farmers from Hisar and Fatehabad districts, randomly selected two villages from each district viz., Sharwa and Chirod, and Gorakhpur and Jandlikalan, to gather data. The study found that farmers have a high level of awareness about climate-resilient crop production practices, with high adoption rates for crop insurance, field sanitation, irrigation scheduling, and seed treatment. However, there are areas where awareness is lacking, such as post-harvest losses, natural resource conservation, cultivation methods, tolerant crop varieties, and credit facilities. To improve awareness, farmers need to promote and enhance less widely accepted practices, such as credit facilities, natural resource conservation schemes, and cultivation methods. The study thus highlights some challenges include lack of knowledge about climate change, labor scarcity, limited resources, inadequate training, and poor institutional financial support.

Keywords: Climate change; climate resilient agriculture; awareness; adoption; conservation practices.

1. INTRODUCTION

The issue of climate change has posed a significant challenge to the endeavours aimed at attaining food self-sufficiency and enhancing the well-being of rural communities [1]. The agricultural sector in India has begun experiencing the adverse effects of climate change. The majority of the Indian population is deemed more susceptible due to their direct or indirect reliance on the agricultural sector. The significance of effectively adjusting to a dynamic climate cannot be overstated in the pursuit of sustainable productivity. The process of adapting to climate change is multifaceted and involves various factors, including economic, cultural, institutional, and biophysical aspects [2]. The process of adapting to current or anticipated climate conditions and its resulting impacts aims to mitigate or prevent negative consequences while also capitalising on potential benefits. According to Osumba and Kaudia [3], it is possible that human intervention could play a role in aiding adaptation to anticipated climate conditions and their associated impacts. Adaptation encompasses modifications in processes, practises, and structures aimed at mitigating potential adverse effects or capitalising on opportunities arising from climate change [4]. The necessity to adapt to rapid and unpredictable climate change has compelled stakeholders in agroecosystems to devise novel agricultural management strategies. These include the cultivation of early maturing crop varieties, the utilisation of drought-resistant varieties, the implementation of crop diversification, the adoption of conservation agriculture practises, the promotion of small livestock breeds that require less feeding, the integration of beekeeping activities, and the implementation of small-scale irrigation techniques for high-value crops [5]. India has experienced substantial effects in its agricultural sector as a result of the changing climate. In recent years, there have been projections indicating that in the event of a temperature increase ranging from 2.5ºC to 4.9ºC in India, there is a likelihood of a decline in rice yields by approximately 32-40 percent and wheat yields by approximately 41-52 percent. A resilient agricultural system is characterised by its ability to effectively address the requirements of food production and development in the short and long run, spanning from local to global levels, while ensuring the stability of the ecosystem remains intact [6]. These practises have the potential to serve as interventions aimed at ensuring food security and generating income for farmers who have limited access to resources. Nevertheless, the aforementioned practises are formulated without significant or negligible participation from the end users, namely the farmers and other pertinent stakeholders [7]. The perspective of and value system towards climate change by humans has drawn increasing interest. According to Sanodiya et al. [8], there exists a limited level of awareness among farmers with regards to climate change. The lack of widespread adoption of these practises has led to farmers persisting in the use of unsustainable and inadequately adaptable production methods, thereby exacerbating issues related to food insecurity and the erosion of livelihoods [9]. Climate change is a multifaceted phenomenon that poses challenges for both the general public and individuals with advanced education, as comprehending its various concepts can prove to be challenging. The majority of farmers lacked a comprehensive understanding of the underlying factors contributing to climate change and the potential ramifications it may have in the future. Indeed, there existed a degree of sceptical thinking among certain farmers regarding the authenticity

of climate change. It is crucial to comprehend the dynamics of climate change for the purpose of adaptation [10]. Effective strategic planning is necessary to mitigate the potential adverse impacts of long-term climate change, which have the potential to significantly jeopardise the livelihood security of marginalised populations. The objective of this initiative is to bolster the ability of Indian agriculture to withstand the impacts of climatic variability and climate change. This will be achieved through the implementation of strategic research aimed at increasing awareness and facilitating adaptation measures. The objective of this research is to assess farmers' awareness of climate-resilient agricultural practices and their inclination to implement such practices in their agricultural operations.

2. MATERIALS AND METHODS

The current investigation was carried out in the districts of Hisar and Fatehabad within the state of Haryana. Two villages, Sharwa and Chirod, from the Hisar district, as well as two villages, Gorakhpur and Jandlikalan, from the Fatehabad district, were chosen randomly. In order to gather the necessary data, a random sampling was employed to choose 30 farmers from each of the selected villages. Consequently, a total of 120 farmers were selected as respondents for the present investigation. The study took into account various factors related to the farmers, including their socio-personal characteristics (such as age, education, caste, and land holding), socio-economic characteristics (such as irrigation methods, sources of irrigation, farming systems, crop rotation practises, and farm machinery), and communicational characteristics (such as extension contact and exposure to mass media). Additionally, the study considered the farmers' utilisation of Kisan Credit Card (KCC) and Soil Health Card (SHC), as well as their overall awareness and adoption of digitalization in agriculture for the purpose of sustainable crop production. The study assessed the level of awareness among farmers regarding the digitalization of agriculture for the purpose of achieving sustainable crop production using a 2-point continuum, with 'Aware' being assigned a value of '1' and 'Not aware' being assigned a value of '0'. In a similar vein, the study also assessed the participants' level of adoption, categorising it as either 'Adopted' (coded as '1') or 'Not adopted' (coded as '0'). Data was collected from the sampled respondents using an interview schedule that was deliberately designed and pretested prior to its administration. Meaningful inferences were drawn by employing appropriate statistical measures, such as the mean, frequency, percentage, and rank order.

3. RESULTS AND DISCUSSION

3.1 Profile of Selected Respondents

The data pertaining to socio-personal attributes of respondents indicates that 48.33 per cent of respondents belong to middle age group followed by old age group (26.67%) and young age group (25.00%). Maximum numbers of respondents (37.00%) were educated up to metric while 30 per cent respondents were having educational qualifications up to higher secondary whereas more than 20.00 per cent were having graduate and post graduate level of educational qualifications. A majority of respondents (88.33%) belongs to general caste followed by backward class (6.67%) and scheduled castes (05.00%). A large number of respondents (42.50%) belong to small farmer category followed by medium (31.67%) and marginal farmers (19.17%) on the basis of land holding. A majority (80.00%) of respondents had canal as a source of irrigation, whereas 70.00 per cent farmers had tube well as source of irrigation. Whereas 61.67 per cent respondents had both the sources of irrigation i.e., canal and tube well. A vast majority of respondents (81.67 %) were doing livestock practices in their farming system followed by organic farming (13.33%), poly house vegetable production (06.67%), beekeeping (3.33%) and fishery (01.67%). 71.67 per cent farmers has adopted cotton-wheat crop rotation followed by pearl millet-mustard (23.33%) and rice-wheat (17.50%) crop rotations.

It is apparent from the study that 56.67 per cent of respondents possessed tractor at their farm along with harrow. Among other farm machineries, 38.33 percent of respondents had seed-cum-fertilizer drill followed by rotavator (30.00%), multi crop thresher (13.33%), MB plough (12.50%), straw reaper (10.00%) and laser land leveller (5.00%) at their farm. The data revealed that among the extension contact of the farmers, the most popular were the progressive farmers with weighted mean score of 2.85 followed by private agencies with weighted mean score of 2.37. ADOs/HDOs, Scientists, and SDAO/SMS ranked third, fourth and fifth, respectively. Numerous studies have been

conducted to examine the various factors that influence farmers' decisions to adopt climate resilient agricultural practises. These factors encompass access to extension services, farmer experience, access to credit, land size, gender, and education, among other variables [11].

The study also revealed that mass media exposure through mobile ranked first with mean score of 2.10 followed by watching Television (WMS = 1.61), reading newspaper (WMS=1.43), Farm Magazine (WMS=0.78) and Radio (WMS=0.34) which ranked second, third, fourth and fifth respectively. The data regarding Kisan Credit Card (KCC) reveals that cent per cent respondents have awareness about KCC and majority of respondents (72.50%) had availed the KCC facility. The data further revealed that more than two third (68.33%) of respondents knows about renewal period of KCC, 51.67 per cent had knowledge regarding interest rate and only 29.17 per cent had knowledge regarding credit limit of KCC. More than half of the respondents have opinion that credit limit sanctioned under KCC is adequate and it is hassling free card. The data from the study indicates that 68.33 percent respondents possessed Soil Health Card (SHC) and were aware that SHC indicates the soil health (75%), encourage judicious use of fertilizers (54.17%). While only 46.67 percent respondents had awareness about SHC tenure.

3.2 Awareness of Farmers about Climate Resilient Crop Production Practices

The data in Table 1 indicates the level of awareness among farmers regarding climate-resilient crop production practices. The findings reveal that over three-fourths of the respondents have awareness about the crop insurance scheme (PMFBY) as a mean to mitigate the impact of climate change. They were also aware of important production practices such as field sanitation, bund trimming, water cleaning and disposal, irrigation scheduling in a changing climate, and suitable irrigation methods like drip and mini sprinkler systems. Additionally, they had knowledge of seed treatment techniques. More than two-thirds of the respondents were familiar with climate-resilient crop production practices like conservation agriculture, in-situ CRM (crop residue management), protected cultivation, integrated weed management, and altering the sowing and transplanting times of crops to mitigate the effects of climate change. More than half of the respondents had awareness about agro advisory services, practices for conserving natural resources, windbreak/boundary tree plantations to control wind speed, organic/natural farming, soil test-based fertilizer application, integrated nutrient management, intercropping, alteration in fertilizer usage, and contingency crop planning to combat the adverse effects of climate change. Numerous authors have asserted that implementing resilient agronomic strategies, such as crop intensification through multi-tier cropping, intercropping, rotation, substitution, and diversification, is crucial for ensuring climate resilience in agriculture [12,13]. However, the respondents were less aware of practices such as post-harvest losses, preservation, and value addition (28.33%).

They also showed less familiarity with schemes promoting the conservation of natural resources like "per drop more crop," UGPL, community tanks, CRM (30.83%), and agro forestry cropping systems to reduce the effects of climate change (35%). Similarly, cultivation methods like ridge planting, raised bed planting, terrace planting holes, etc., were known to only 36.67% of the respondents. Low awareness was observed among the respondents regarding tolerant varieties of crops against adverse climatic conditions (38.33%) and credit facilities in adverse conditions to mitigate the effects of climate change (38.33%). Other practices that had relatively lower awareness levels included schemes promoting crop diversification (40.83%), integrated farming system modules (40%), vermin-compost production technology (42.00%), pest and disease-resistant varieties (45.33%), and water conservation structures such as farm ponds, rainwater harvesting, and groundwater recharge (46.67%). Overall, the respondents' awareness level was found to be 56.45 per cent, indicating the need for improvement in their understanding of climate-resilient crop production practices. The findings of this study indicate that farmers possess a certain level of awareness regarding climate change and its potential consequences. The present study's findings have reaffirmed the conclusions drawn by numerous authors who have previously conducted research in different regions of the country. In previous studies conducted by Dupdal et al., [14], Devegowda et al., [15], Pradhan et al., [16], Sultana et al., [17] and Anseera and Alex [6], similar conclusions were reached.

Table 1. Awareness of farmers about climate resilient crop production practices (n=120)

Sr. No	Awareness statements	Awareness Level			
		Aware		Not aware	
		F	%	F	%
1.	Contingency crop planning	68	56.67	52	43.33
2.	Tolerant varieties of crops against adverse climatic conditions i.e., temperature, drought, frost etc.	46	38.33	74	61.67
3.	Pest and disease resistant varieties	55	45.83	65	54.17
4.	By alteration in sowing/transplanting time of crops, we can reduce crop damage to some extent	82	68.33	38	31.67
5.	Alteration in fertilizer usage	71	59.17	49	40.83
6.	Crop rotation to enhance production in changed climate	88	73.33	32	26.67
7.	Intercropping	73	60.83	47	39.17
8.	Seed treatment	89	74.17	31	25.83
9.	Integrated weed management practices	84	70.00	36	30.00
10.	Integrated nutrient management	67	55.83	53	44.17
11.	Soil test-based fertilizer application	73	60.83	47	39.17
12.	Irrigation scheduling in changed climate	92	76.67	28	23.33
13.	Suitable irrigation methods *i.e.,* drip, mini sprinkler etc.	89	74.17	31	25.83
14.	Know about field sanitation-bund trimming, cleaning and proper disposal of water?	95	79.17	25	20.83
15.	Organic/natural farming practices.	64	53.33	56	46.67
16.	Integrated farming system modules	48	40.00	72	60.00
17.	Vermi- compost production technology	51	42.50	69	57.50
18.	Protected cultivation (poly/net house, walk in tunnel, low tunnel and mulching)	83	69.17	37	30.83
19.	Cultivation methods like ridge planting, raised bed planting, terrace, planting hole etc.	44	36.67	76	63.33
20.	Wind break/boundary tree plantation to control wind speed	68	56.67	52	43.33
21.	Natural resources conservation practices	65	54.17	55	45.83
22.	Awareness about water conservation structures *i.e.,* farm pond, rainwater harvesting, ground water recharge, etc.	56	46.67	64	53.33
23.	Conservation agriculture i.e. laser land leveling, zero tillage, DSR, mulching etc.	82	68.33	38	31.67
24.	In situ crop residue management for improving soil health	84	70.00	36	30.00
25.	Introduction of agro forestry cropping system to reduce the effect of climate change	42	35.00	78	65.00
26.	Awareness about post-harvest losses, preservation and value addition	34	28.33	86	71.67
27.	Agro advisory services to mitigate adverse effect of climate change	73	60.83	47	39.17
28.	Crop insurance scheme (PMFBY) to mitigate the effect of climate change?	102	85.00	18	15.00
29.	Credit facility in adverse condition to lower the effect of climate change?	46	38.33	74	61.67
30.	Schemes promoting crop diversification (MIDH, Mera Pani Meri Virasat,)	49	40.83	71	59.17
31.	Schemes promoting conservation of natural resources (micro irrigation scheme like per drop more crop, UGPL, Community tank, CRM etc.)	37	30.83	83	69.17
Mean Awareness Score		17.50			
Overall Awareness (%)		56.45			

3.3 Adoption Level of Farmers towards Climate Resilient Crop Production Practices

The data in Table 2 displays the extent to which farmers have adopted climate-resilient crop production practices. The table offers insights into the number of farmers who have adopted each practice, along with the corresponding percentages of adoption and non-adoption. Notably, certain practices have gained widespread adoption among the respondents. These include the crop insurance scheme (PMFBY) with a high adoption rate of 80.83%, followed by irrigation scheduling (70%), field sanitation (69.17%), integrated weed management practices (62.5%), crop rotation (60.83%), and seed treatment (60%). The findings were in line with the research conducted by Brar et al. [18] and Nyang'au et al. [19]. Furthermore, respondents have also adopted other climate-resilient crop production practices, albeit to a lesser extent. These practices include alteration in sowing/transplanting times of crops (59.17%), conservation agriculture encompassing laser land levelling, zero tillage, DSR, mulching, etc. (53.33%), alteration in fertilizer usage (51.67%), integrated nutrient management (46.67%), agro advisory services to mitigate adverse effects of climate change (45%), pest and disease resistant varieties (43.33%), contingency crop planning (38.33%), in situ crop residue management for improving soil health (35%), soil test-based fertilizer application (34.17%), and tolerant varieties of crops against adverse climatic conditions (32.5%), along with natural resources conservation practices (30%). These findings also have reaffirmed the conclusions of various authors who have conducted studies in different regions of the nation. For example, Pathak [20] and Gopal et al. [21] arrived at a similar conclusion in their respective studies. According to Dhaka et al. [22], farmers primarily implemented climate resilient practises such as adjusting planting time, adopting intercropping techniques, practising soil and water conservation, and cultivating drought tolerant crops.

However, several practices have reported poor adoption rates of less than 30 per cent. These include availing credit facility, schemes promoting conservation of natural resources (Per Drop More Crop, UGPL, community tank, CRM, etc.), cultivation methods (ridge planting, raised bed planting, terrace, planting hole), integrated farming system module, schemes promoting crop diversification (MIDH and Mera Pani Meri Virasat, suitable irrigation methods like drip and mini sprinkler), intercropping, vermi-compost production technology, post-harvest management practices, organic/natural farming practices, protected cultivation, water conservation structures (farm pond, rainwater harvesting, ground water recharge), and establishment of boundary tree plantations to control wind speed.

It is worth noting that certain practices, for instance, agro forestry cropping systems, have not been adopted by any of the respondents. Conversely, practices like the crop insurance scheme (PMFBY) have witnessed a high adoption rate of 80.83%. The overall adoption level was calculated to be 34.49%. It has been observed that farmers exhibit a tendency to adopt a cautious approach towards embracing new agricultural technologies, primarily due to a multitude of limitations that they face. The findings of this study align with the research findings of Naik et al., [23], Chouksey et al., [4], Mohokar et al., [24], Rai et al., [25], and Harikrishna et al., [26]. The study conducted by Sangeetha et al. [27] also provides evidence that aligns with this outcome. These findings emphasize the need for targeted efforts to promote and enhance the adoption of practices that have not acquired significant acceptance among the respondents.

3.4 Constraints Encountered in Adoption of Climate Resilient Crop Production Practices

The data presented in Table 3 regarding the constraints faced by farmers in adopting climate resilient crop production practices reveals that majority of farmers perceived the lack of knowledge about climate change (79.17%) as a "serious" constraint in adopting such practices.

This was closely followed by the lack of timely information related to climate resilient agriculture (CRA) technologies (75%), labour scarcity (74.17%), absence of processing, storage, and transportation facilities (73.33%), and the inability to accept new practices (71.67%).Other constraints identified by the farmers include the lack of owned resources (70%), lack of savings (70%), inadequate need-based training on CRA technologies (69.17%), lack of support from line departments (68.33%), poor institutional financial support (63.33%), poor availability of critical

inputs (62.50%), officials' inability to provide services to farmers during peak periods (60%), limited coverage of crops under insurance schemes (59.17%), high cost of inputs (56.67%), and the lack of encouraging policies and institutional support (54.17%) for the adoption of climate resilient practices. The aforementioned findings have served to validate the assertions

Table 2. Adoption level of farmers towards climate resilient crop production practices (n=120)

Sr. No.	Statements	Adoption level			
		Adopted		Not adopted	
		F	%	F	%
1.	Contingency crop planning	46	38.33	74	61.67
2.	Tolerant varieties of crops against adverse climatic conditions i.e., temperature, drought, frost etc.	39	32.50	81	67.50
3.	Pest and disease resistant varieties	52	43.33	68	56.67
4.	Alteration in sowing/transplanting time of crops,	71	59.17	49	40.83
5.	Alteration in fertilizer usage	62	51.67	58	48.33
6.	Crop rotation	73	60.83	47	39.17
7.	Intercropping	16	13.33	104	86.67
8.	Seed treatment	72	60.00	48	40.00
9.	Integrated weed management practices	75	62.50	45	37.50
10.	Integrated nutrient management	56	46.67	64	53.33
11.	Soil test-based fertilizer application	41	34.17	79	65.83
12.	Irrigation scheduling	84	70.00	36	30.00
13.	Suitable irrigation methods *i.e.,* drip, mini sprinkler etc.	21	17.50	99	82.50
14.	Field sanitation-bund trimming, cleaning, and proper disposal of water	83	69.17	37	30.83
15.	Organic/natural farming practices.	11	9.17	109	90.83
16.	Integrated farming system module	26	21.67	94	78.33
17.	Vermi- compost production technology	15	12.50	105	87.50
18.	Protected cultivation (poly/net house, walk in tunnel, low tunnel, and mulching)	08	6.67	112	93.33
19.	Cultivation methods like ridge planting, raised bed planting, terrace, planting hole etc.	28	23.33	92	76.67
20.	Established Wind break/boundary tree plantation to control wind speed	04	3.33	116	96.67
21.	Natural resources conservation practices	36	30.00	84	70.00
22.	Established water conservation structures *i.e.,* farm pond, rainwater harvesting, ground water recharge, etc.	08	6.67	112	93.33
23.	Conservation agriculture i.e. laser land leveling, zero tillage, DSR, mulching etc.	64	53.33	56	46.67
24.	In situ crop residue management for improving soil health	42	35.00	78	65.00
25.	Agro forestry cropping system to reduce the effect of climate change	00	0.00	120	100.00
26.	Post-harvest management practices	12	10.00	108	90.00
27.	Agro advisory services to mitigate adverse effect of climate change	54	45.00	66	55.00
28.	Crop insurance scheme (PMFBY)	97	80.83	23	19.17
29.	Credit facility availed	32	26.67	88	73.33
30.	Schemes promoting crop diversification (MIDH, Mera Pani Meri Virasat,)	24	20.00	96	80.00
31.	Schemes promoting conservation of natural resources (micro irrigation scheme like per drop more crop, UGPL, Community tank, CRM etc.)	31	25.83	89	74.17
Mean adoption score		10.69			
Overall adoption level (%)		34.49			

Table 3. Constraints in adoption of climate resilient crop production practices (n=120)

S. No.	Constraints	Serious		Not serious	
		F	%	F	%
1.	Inability to accept new practices	86	71.67	34	28.33
2.	Small size of the land holding	42	35.00	78	65.00
3.	Resistance to change the conventional practices	48	40.00	72	60.00
4.	labour scarcity	89	74.17	31	25.83
5.	Lack of owned resources	84	70.00	36	30.00
6.	Poor availability of critical inputs	75	62.50	45	37.50
7.	High cost of inputs	68	56.67	52	43.33
8.	Higher investment cost on farm implements	47	39.17	73	60.83
9.	Poor institutional financial support	76	63.33	44	36.67
10.	Getting benefits from climate resilient technologies are not quick	52	43.33	68	56.67
11.	Lack of market access	47	39.17	73	60.83
12.	Lack of savings	84	70.00	26	21.67
13.	Lack of knowledge about climate change	95	79.17	25	20.83
14.	Lack of timely information related to CRA technologies	90	75.00	30	25.00
15.	Insufficient services through CHCs	41	34.17	79	65.83
16.	Poor information accessibility and utilization of weather based agro advisory services	55	45.83	65	54.17
17.	Lack of support from line departments	82	68.33	38	31.67
18.	Inability of the officials to provide services to farmers during the peak period	72	60.00	48	40.00
19.	Inadequate need-based trainings on CRA technologies	83	69.17	37	30.83
20.	Power shortage for following CRA techniques	32	26.67	88	73.33
21.	Improper irrigation scheduling	46	38.33	74	61.67
22.	Lack of credit from banks	34	28.33	86	71.67
23.	Limited coverage of crops under insurance scheme	71	59.17	49	40.83
24.	Absence of processing and storage and transportation facilities	88	73.33	32	26.67
25.	Lack of encouraging polices & institutional supports for adoption of climate resilient practices	65	54.17	55	45.83

put forth by numerous authors who have undertaken research in diverse geographical areas. For example, Antwi-Agyei et al. [28] identified barriers to climate-smart agricultural practices, including pests, diseases, insufficient credit, high costs, and government support. Similarly, Bryan et al. [29] found resource-poor farmers disproportionately affected by climate change due to limited resources, low education, and inadequate technology.

On the other hand, constraints perceived as "not serious" in the adoption of climate resilient crop production practices include power shortage for following CRA techniques (73.33%), lack of credit from banks (71.67%), insufficient s). These through Community Health Centres (CHCs) (65.83%), small size of land holdings (65%), improper irrigation scheduling (61.67%), lack of market access (60.83%), higher investment cost on farm implements (60.83%), resistance to changing conventional practices (60%), the delayed realization of benefits from climate resilient technologies (56.67%), and poor information accessibility and utilization of weather-based agro-advisory services (54.17%). Thus, farmers encounter various limitations when attempting to fully embrace climate resilient technologies. The constraints faced by the farmers on Climate Resilient Agriculture include a lack of knowledge regarding cultivation practices, limited availability of seeds in the market, resistance to deviate from conventional practices, inadequate information on Climate Resilient Agriculture (CRA) technologies and weather statistics for effective farming planning, and the high cost associated with constructing wells or farm ponds. These findings were consistent with the outcomes reported in previous research conducted by Naik et al., [30], Mohokar et al. [24], Nyasimi et al., [31], and Kumar et al., [32]. Thus, these findings highlight the significant challenges that farmers face in adopting climate resilient practices and point to the specific areas that require attention and intervention. The efforts should be made to address knowledge gaps, provide timely information and training, improve access to

resources and institutional support, and develop policies that incentivize and encourage the adoption of climate resilient crop production practices [33].

4. CONCLUSION

On the basis of the above findings, it can be concluded that farmers have a relatively high level of awareness regarding climate-resilient crop production practices. They have good awareness of practices such as crop insurance, field sanitation, irrigation scheduling, and seed treatment. However, there are areas where their awareness is lacking, such as post-harvest losses, conservation of natural resources, cultivation methods, tolerant crop varieties, and credit facilities. The overall awareness level was found to be 56.45%, indicating a need for improvement in understanding climate-resilient practices. The adoption of climate-resilient crop production practices among farmers is varied. The practices like crop insurance, irrigation scheduling, field sanitation, and integrated weed management have achieved high adoption rates. Other practices, such as alteration in sowing/ transplanting times, conservation agriculture, and alteration in fertilizer usage, have also been adopted to a certain extent. However, there are practices with poor adoption rates, including credit facilities, natural resource conservation schemes, cultivation methods, and various other practices. These findings emphasize the need to promote and enhance the adoption of less widely accepted practices. The lack of knowledge about climate change, lack of timely information, labour scarcity and absence of processing and storage facilities are perceived as serious constraints. Other challenges include limited resources, inadequate training, lack of support from line departments, and poor institutional financial support. While some constraints are considered less serious, such as power shortages and lack of credit, they still pose obstacles to adoption. In conclusion, addressing the challenges faced by farmers and enhancing the adoption of climate-resilient crop production practices need concerted efforts to bridge knowledge gaps, provide timely information and training, improve resource accessibility, and develop supportive policies.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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