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Knowledge level of farmers on climate resilient agro-technologies curtail the climatic change effect in the NICRA district of Odisha

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Abstract
Knowledge is the real power for farmers to boost their agrarian economy. Without the proper knowledge, farmers can do things, but not in an effective manner. Knowledge brings a desirable change among the farmers towards achieving their own goals. Farmer's knowledge is essential in agriculture to accelerate their income as well as better livelihoods. Over the years climate change adversely exaggerated the economic growth of farmers due to the climate change effects. With this background, three NICRA districts namely Kendrapara, Jharsuguda and Kalahandi were selected based on the different agro-ecological situations of Odisha. The mean knowledge score is 69.96 ± 5.88 and that of non-NICRA farmers was 37.71±2.67. The mean difference between the NICRA and non-NICRA farmers was -32.25 and the significant p=0.000. The knowledge score of NICRA farmers on CRA was found to be highly significant. It is invariable found that in all the districts the NICRA farmers have got substantially higher knowledge of CRA than the non-NICRA farmers. The highest score was seen in the Kalahandi district i.e., 72.13±7.33 and the lowest score was found in the Kendrapara district. There was a significant difference in the mean knowledge score (p=0.015).

Keywords: Knowledge level of farmers, climate resilient agro-technologies, climate change

1. Introduction
Indian agriculture as well as that of Odisha is a paradox in many ways. It has the support of abundant natural resources, paramount ecology, a large pool of technical manpower, a process thriving agro-industry, but it is vulnerable to frequent visiting of natural calamities, the threat of climate change, etc. Over the years, Indian agriculture has become more diversified and gradually shifted to high-value crops, livestock, fisheries and farm mechanization. Agriculture and related sectors impact the lives and livelihoods of millions of Indians. It not only provides food security but also ensures livelihood security of 58 percent population (APEDA-Union Budget 2018–19**,** Ministry of Commerce & Industry, Govt. of India). However, agriculture is vulnerable to existing climate variability (Ochieng *et al*., 2016) [9] and is further aggravated due to the impacts of climate change. India faces the twin challenges of increasing agricultural production to feed its growing population and containing the emission of Green House Gases (GHGs) and thereby protecting agriculture from the adverse impacts of climate change. Therefore, sustainable agriculture required more innovative ideas and knowledge on climate-resilient agro-technologies to ensure the food and nutritional security of the Nation **(**Abdullah and Samah 2013) [1].

Farmer's knowledge is essential on agriculture and CRA practices to accelerate their income as well as better livelihoods. Over the years climate change adversely exaggerated the economic growth of farmers due to change effects. With this background, National Innovation on climate resilient agriculture (NICRA) is operating in five climate vulnerable districts of Odisha. NICRA is a network project of the Indian Council of Agricultural Research (ICAR). The project aims to enhance the resilience of Indian agriculture to combat climate change and climate vulnerability through strategic research and technology demonstrations. Therefore, sustainable climate-resilient management practices are to be experienced and adopted to ensure the food and nutritional security of the Indian population (Gardezi and Arbuckle 2020) [4].

Odisha agriculture is dominated by small and marginal farmers. They required more agricultural information and knowledge on appropriate climate-resilient agro-technologies

including good agriculture practices (GAP), climate-smart agriculture (CSA), conservation agriculture (CA), recent technologies, farm mechanization and institutional innovations to minimize the climate change effects (Nyasimi *et al*., 2017) [8].

Climate Change has special relevance for Odisha because of its geographic location. Odisha has a tropical climate having high temperature, high humidity, medium to high rainfall and short and mild winters. As per Koppen's climatic classifications, most of Odisha comes under the AW having a tropical Savannah type of climate. The south-west monsoon normally sets in between 5th June to 10th June in the coastal plain, and by 1st July the whole of the state is under the full sway of the south-west monsoons. By 15th October, the southwest monsoon withdraws completely from Odisha. These are the normal dates that fluctuate from year to year. As per "Thornthwaite's classification", Odisha comes under the "Subhumid" category, implying deficient winter rains. Based on climate form, Odisha has been divided into ten agro-climatic zones. The normal rainfall of the state is 1451.2 mm where man temperature goes up to 49^0C and the minimum temperature is 4^0C. About 75% to 80% of rainfall is received from June to September. Floods, droughts and cyclones occur almost every year with a varying intensity that devastated the economic condition of people. Climate change can derail the current growth strategies and deepen poverty in the state due to poor knowledge of climate-resilient agro-technologies (Chowhan 2021) [3]. The majority of the population depends upon agriculture for their income and livelihood. Climate change would have a large impact on the agriculture and allied sectors and the life and livelihood of the population. Therefore, knowledge among the farmers on agro-technologies will mitigate the climate change effects and minimize crop losses (Popoola *et al*., 2020) [10].

2. Materials and Methods

A research design that combined both qualitative and quantitative research techniques was deployed in this study. This is a test-control study, where the comparison is made between the NICRA- farmers (Test) and non-NICRA farmers (Control group). The districts, blocks and villages were selected following a judgment sampling approach to ensure proper representation. The respondents were selected following the random sampling method.

In each district, the only block under the NICRA project was selected. In the block two NICRA villages and one non-NICRA village were selected randomly out of the villages. In the selected villages, 20 farmers were selected proportionately from among different categories of farmers following a random process. In each district, one scientist is selected from KVK. A total of 3 Scientists were covered. In each district, two VAWs, two extension officials of the rank of AAO, DAO, or Chief District Official are selected. In this process, there were 6 VAWs and 6 senior extension officials in the sample in one district. 15 officials each have been taken in the Non-NICRA and NICRA project areas. Out of 30 officials, 6 were scientists, 16 agriculture officers and 8 village-level agriculture staff. A total of 120 NICRA farmers, 60 non-NICRA farmers and 30 Officials were selected in the sample. The five points rating scale was used to get the score.

Primary data was collected through in-depth interviews with farmers by the researchers in the selected villages. Similarly for qualitative research, Focus Group Discussion was conducted with a group of farmers through interviews to capture the information by the researcher. The knowledge score has been obtained from the farmers of NICRA and non-NICRA areas based on the responses to 20 questions administered to them with the help of a structured question.

3. Result Discussion

The profile of farmers has been studied to appreciate the result of the study in a better way. The majority of farmers (71.1%) are in the middle age group; 41-59 years. There are 15.6% farmers in the 60+ year age group whereas 13.3% only belong to below 40 years. Table- 1 presents the overall age distribution by the NICRA/Non-NICRA group of farmers, while Table- 2 presents the district-wise details of age distribution.

Table 1: Age distributions of farmers in the NICRA/ Non-NICRA areas

Age in year	NICRA/Non-NICRA farmer				Total	
	Non-NICRA (n=60)		NICRA (n=120)			
	No.	%	No.	%	No.	%
≤ 40	7	11.7	17	14.2	24	13.3
41-59	43	71.7	85	70.8	128	71.1
60 +	10	16.7	18	15	28	15.6
Total	60	100	120	100	180	100

Table 2: Age distributions of farmers in the NICRA and Non-NICRA areas

Age in year	District											
	Kalahandi				Jharsuguda				Kendrapara			
	Non-NICRA (n=20)		NICRA (n=40)		Non-NICRA (n=20)		NICRA (n=40)		Non-NICRA (n=20)		NICRA (n=40)	
	No.	%	No.	%	No.	%	No	%	No.	%	No	%
≤ 40	4	20	12	30	1	5	5	12.5	2	10	0	0
41-59	16	80	23	57.5	19	95	30	75	8	40	32	80
60 +	0	0	5	12.5	0	0	5	12.5	10	50	8	20
Total	20	100	40	100	20	100	40	100	20	100	40	100

It reveals from the above table-1 & table-2 that the young population ≤ 40 years in the farm sectors is quite low with a show of nearly 1/10th. The farm sector needs young and educated people are to be agriculture to boost crop production through technical know-how and innovation. In the better-up districts like Jharsuguda and Kendrapara, the share of farmers in the sample is lower than Kalahandi. Besides farm activities, they are also managed dairy, poultry, goatery, sheepery, etc. But their engagement is more on labour components than as farmers themselves. It is because of the landholding pattern,

where the ownership lies with the male members.

For, this the social setting and environment need to be tuned suitably to Agriculture becomes highly remunerative and fetches higher income and better livelihood. Young farmers want more and more income from agriculture and allied activities. But they failed due to various reasons like lack of knowledge and poor interest. That's why young farmers are to be trained in various need-based specific areas. The knowledge and technical know-how will help them to our agriculture to be more remunerative and profit-making. That will attract the young farmers including women to retain them in agriculture. The agriculture that attracts the rural youth and women will have to be profitable, competitive, and dynamic (Brooks *et al*. 2013) [2]. The perception of gender towards changes in farming practices, and women's involvement in agriculture are changing due to change context. The agriculture policy issues are to be included for higher profit through need-based & skill-oriented training, gender mainstreaming in research/extension and sensitizing the male (Meena *et al*., 2015) [7].

The mean knowledge score of NICRA and Non-NICRA farmers by the district is presented in Tables 3 and 4. The knowledge score has been obtained from the farmers of NICRA and Non-NICRA areas based on the responses to 20 questions administered to them with the help of a structured question. The score has been converted to a percentage to standardize it. The mean knowledge score is 69.96 ± 5.88 and that of non-NICRA farmers was 37.71±2.67. The mean difference between the NICRA and Non-NICRA farmers was -32.25 and the significant p=0.000. The knowledge score of NICRA farmers on CRA was found to be highly significant in fig-1.

Table 3: Comparison of mean Knowledge score of NICRA and Non-NICRA farmers

NICRA/Non-NICRA farmer	N	Mean	SD	Mean diff.	t	p
NICRA	120	69.96	5.88	-32.25	-50.46	0.000
Non-NICRA	60	37.71	2.67			

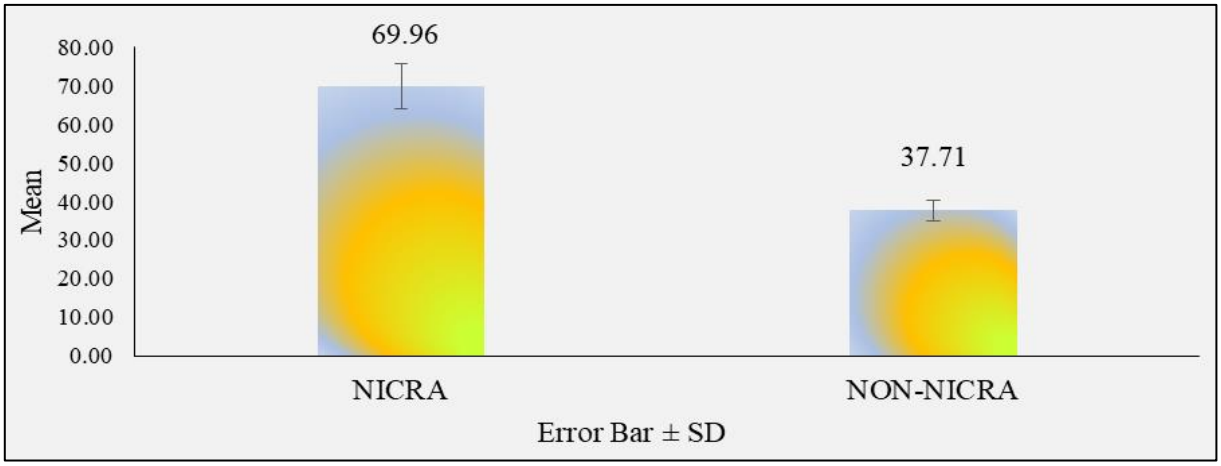

Fig 1: Mean Knowledge score of NICRA and Non - NICRA farmers

Table 4: Comparison of mean Knowledge score of the farmer in NICRA and Non-NICRA districts

Districts	Farmers				Mean diff.	t	p
	NICRA (n=120)		Non-NICRA (n=60)				
	N	Mean ± SD	N	Mean ± SD			
Kalahandi	40	72.13± 7.33	20	38. 63± 3.03	-33.50	-24.94	0.000
Jharsuguda	40	69.06± 4.67	20	36.44 ± 2.76	-32.62	-33.88	0.000
Kendrapara	40	68. 69± 4.79	20	38.06±1.65	-30.62	-36.39	0.000

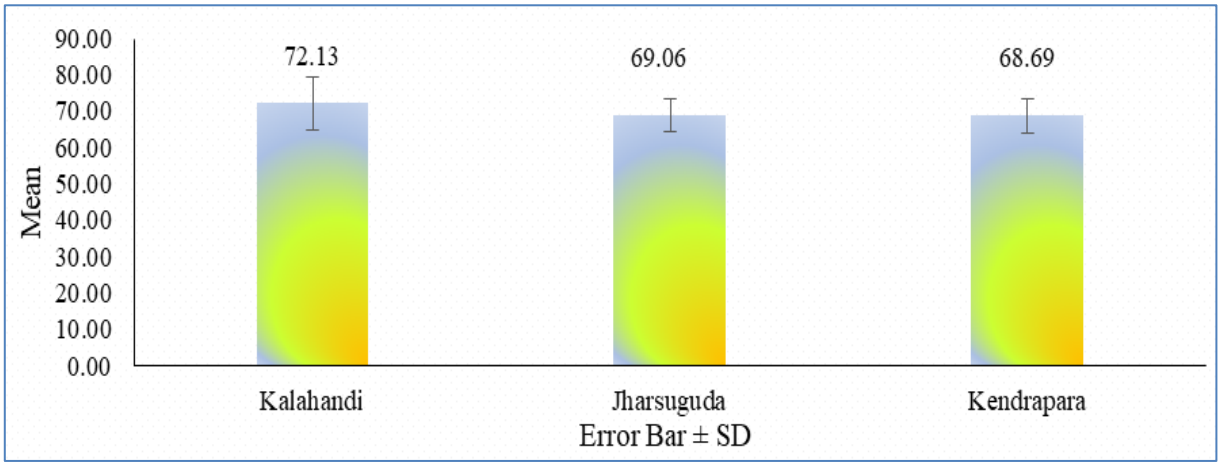

Fig 2: Mean Knowledge score of farmers in NICRA districts

Table 4 revealed the district-wise mean ±SD on knowledge of NICRA and Non-NICRA farmers in respect of three districts. It is invariable found that in all the districts the NICRA farmers (fig-2) have got substantially higher knowledge of CRA than the non-NICRA farmers. The above analysis implied that the NICRA project has a defined impact on the level of knowledge on CRA technologies than non-NICRA farmers.

Table 5: Comparison of Mean Knowledge score of NICRA farmers among districts

District	N	Mean	SD	Lower Bound	Upper Bound	ANOVA p-value
Kalahandi	40	72.13	7.33	69.78	74.47	0.015
Jharsuguda	40	69.06	4.67	67.57	70.56	
Kendrapara	40	68.69	4.79	67.16	70.22	
Total	120	69.96	5.89	68.89	71.02	

Table- 5 shows that the highest score was seen in the Kalahandi district i.e., 72.13±7.33 and the lowest score was found in the Kendrapara district. There was a significant difference in the mean knowledge score (p=0.015).

Table 6: Comparison of mean score of knowledge of officials in NICRA and Non-NICRA areas

Knowledge score						
District		Officials	N	Mean	SD	Mann-Whitney U 'p' value
Jharsuguda	% of knowledge score	Non-NICRA	5	73.3	6.2	0.130
		NICRA	5	78.7	6.1	
Kendrapara		Non-NICRA	5	64.7	9.9	0.011
		NICRA	5	81.3	3.0	
Kalahandi		Non-NICRA	5	64.7	11.7	0.043
		NICRA	5	79.3	7.2	

The percentage knowledge score of officials was found to be higher in the NICRA project area in all three districts. However, the difference was not significant in the Jharsuguda district (p=0.130). In the other two districts Kendrapara and Kalahandi the difference was found to be significant (p=0.011 & p=0.043).

4. Conclusion

Gaining knowledge helps farmers bring a desirable change in agricultural development. Most of the NICRA farmers were benefited through capacity building, various demonstrations programmes and convergence of Govt. schemes to the project areas. Over the years their knowledge level increased considerably than non-NICRA areas. The mean knowledge score has increased 69.96 ± 5.88 and that of non-NICRA farmers was 37.71±2.67. It is invariable found that in all the districts the NICRA farmers have got substantially higher knowledge of CRA than the non-NICRA farmers. Agriculture is facing many challenges including fulfilling the requirement of farmers for technology generation, integration and sharing of knowledge in a flexible mode. Sustainable agriculture required a new facts base, with new content and forms of knowledge and new processes of learning. Knowledge networking and participation of multi-actor knowledge links that facilitate knowledge exchanges, joint learning, and the generation of new more integrated solutions were very crucial if agriculture is to become sustainable and resilient. The NICRA project have a positive impact on shaping the behavioral aspects of farmers towards CRA. This impact has been uniform in all the three NICRA sample districts.

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