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Determinants influencing the adoption of climate resilient agriculture for scaling up sustainability: A study in Southern Coastal District of Odisha

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Abstract

The climate changes create an alarming situation for the farmers which only solution is the adoption of climate resilient agriculture. The study was done in the Ganjam district of Odisha with the respondent number 120. The comparison analysis of the NICRA beneficiary farmers and non-beneficiaries were done and presented in the paper. The results from table of agronomic practices found that most of beneficiary farmers have adopted the summer ploughing (mean = 2.91) and followed by crop rotation with pulses (mean =2.78). There was high adoption rate of organic farming (mean=2.76) and green manuring (mean=2.83) by NICRA beneficiaries. The beneficiaries also get medical services and nutritional feed for their livestock timely and easily. The water management practices showed the results that the beneficiary farmers used the proper drainage system and mulching practices as compare with the non- beneficiaries. The beneficiary farmers were getting the timely inputs in the project. The non-beneficiaries were facing a lot of problems while selling of their products after the natural calamities. The extension personnel should create more awareness among the farmers for high adoption of the climate resilient practices.

Keywords: Conservation, climatic hazards, NICRA, adoption

Introduction

Agriculture is mostly depended on the climatic conditions, weather and other natural resources like soil, water and precipitation. India is considered as most suitable subcontinent for agriculture due to monsoon sub-tropical climate. But now-a-days the Indian agriculture is facing diversified and uncertain weather condition which is horrified by the climate change. There is decrease in yield and sinking of the natural resources due to effect of climate change like drought, floods, cyclones, change in precipitation and temperature. To conserve and improve the production and productivity for the future populations we need the climate resilient agriculture system which is sustainably exploiting the natural resources already available through crop and livestock production systems.

Climate-resilient agriculture techniques, particularly those that are sustainable, have the power to change the situation and maintain agricultural productivity on a local, national, and international scale. Resilience here refers to a system's capacity to foresee, prepare for, adopt to, absorb, and recover from the effects of climate changes and harsh weather climate resilience is a fundamental concept of climate risk management.

Materials and Methods

Due to geographical location and meteorological differences of Odisha, it is most vulnerable to cyclones, floods and other climatic changes. That's why the study was undertaken in Ganjam, which is southern costal districts of Odisha and about thirteen cyclones made landfall in this district. Two blocks from the above districts were selected purposively from which one was under NICRA project and there was no implementation of project in other block and then from the selected blocks four villages were taken for obtaining the respondents. The *ex-post-facto* research design was used for the study. A sample of 120 respondents from NICRA implemented villages and 60 farmers from non-NICRA implemented villages were selected randomly for the study. Secondary data collected from the Farmers Science Centre (KVK). Through personal interview method, the primary data was collected, then tabulated and analysed by the use of statistical tools.

Results and Discussion

The farmers were aware about different practices that can helpful for them to face the climatic hazards. They have adopted some of the practices in their crop cultivation practices.

But for better understanding of the cultivation practices or new technology which were recommended, the respondent's adoption category was divided in to three types such as fully adopted, partially adopted and not adopted and scaled as 3, 2,1 respectively. After getting the frequency and percentage, mean score was decided and rank was given to the farming practices accordingly. Agronomic practices include methods of land preparation, sowing, nutrient management of the crop, pest and disease control, water management and harvest. The ultimate aim of NICRA is to maximize crop yields while mitigating the environmental damage and ensuring the sustainability of the system. The agronomic practices include adoption of SRI, alternate wetting and drying, direct seeded rice, adoption of improved land levelling, summer ploughing, use of rotary weeder, adoption of herbicides, crop rotation with pulses.

Table 1: Agronomic practices (N=120)

Sl. No	Technologies	NICRA Beneficiaries(n=60)	Non- Beneficiaries (n=60)	Z TEST
		Mean	Mean	
1	Adoption of SRI	2.06	1.08	1.446
2	Alternate wetting and drying	2.08	1.08	
3	Direct seeded rice	2.05	2.13	
4	Adoption of improved land levelling	2.11	1.95	
5	Summer ploughing	2.91	1.28	
6	Use of rotary weeder	2.75	2.81	
7	Adoption of herbicides	2.23	2.76	
8	Crop rotation with pulses	2.78	1.91	
Total mean		2.41	1.98	
Total standard deviation		0.37	0.69	

Maximum Obtainable Score-3

Fig No. 1 Comparison of agronomic practices adoption pattern

It was concluded from the above table that in case of beneficiaries of NICRA the highest mean was 2.91 i.e. summer ploughing that improves soil structure due to alternate wetting and cooling and the lowest mean was 2.05 for direct seeded rice and in case of NICRA-non beneficiaries the highest mean was 2.81 which was for use of rotary weeder that helpful for cultivating of soil and the lowest mean was 1.08 which is for adoption of SRI and alternate wetting and drying. Kalita *et al.* (2020) [8] and Jasna *et al.* (2014) [7] had the similar findings which indicated the highest involvement of the farmers in summer ploughing for removal of the stubbles and prevention of the weed.

The NICRA non-beneficiaries are adopting the use of herbicides and rotary weeders without any proper training so they don't use proper dose of herbicides. More than fitty percent of the farmers were not able to get the weedicides for their crops. Karangami *et al.* (2019) [9]. The NICRA beneficiaries have also adopted the crop rotation system with the pulses for better availability of the nutrients. Under the NICRA scheme summer ploughing is also practiced properly for decomposition of soil organic matter and soil aeration. This finding is line of with the study of Das and Rehman (2018) [2] and Das *et al* (2020) [3].

Table 2: Soil fertility management

Sl. No	Technologies	NICRA Beneficiaries(n=60)	Non- Beneficiaries (n=60)	Z TEST
		Mean	Mean	
1	Use of bio fertilizer	2.08	1.36	0.087
2	Use of organic fertilizer	2.76	2.18	
3	Proper soil testing	2.18	1.16	
4	Use of green manure	2.83	1.81	
5	Use of neem coated urea	2.95	1.21	
6	Use of leaf colour chart	2.08	1.11	
Total mean		2.56	1.49	
Total standard deviation		0.40	0.43	

Maximum obtainable score-3

Fig No. 2 Soil Fertility Management

From the above table it was found that, the highest mean among the NICRA beneficiaries was 2.95 and the lowest mean was 2.08 which was and among the NICRA-non beneficiaries the highest mean was 2.18 and the lowest mean was 1.11 which is from the use of leaf colour chart. Naik *et al.* (2023) [15] and Oraon *et al.* (2018) [16] also found that the farmers were not fully adopted all the soil fertility management practices.

The NICRA beneficiaries adopted the neem coated urea because neem coated urea kills harmful bacteria and check the nitrate formation and conserve nitrate losses. The NICRA beneficiaries are not fully adopted the use of bio fertilizer and use of leaf colour chart due to their ignorance in this above field. Vardhan *et al.* (2022) [20], Verma *et al.* (2015) [21] and Zade *et al.* (2018) [22] had similar findings in which the farmers were not aware about the different climate resilient practices. The organic fertilizer use is easily adopted by the NICRA beneficiaries which improves the soil texture, allowing it to hold water longer, and increase the bacterial and fungal activity in the soil. After soil management practices let's consider about the water management practices. The research findings of Majumder

et al. (2019) [12] and Medhi *et al.* (2020) [14] was also strengthening the findings.

Water management seeks to use water in a way that provides crops and animals the amount of water they need, enhances productivity, and conserves natural resources for the benefit of downstream users and ecosystem services. The data collected from the respondent farmers, calculated and presented in the below table.

Table 3: Water management (N=120)

Sl. No	Technologies	NICRA Beneficiaries (n=60)	Non- Beneficiaries (n=60)	Z TEST
		Mean	Mean	
1	Improved drainage system	2.96	2.58	1.166
2	Adoption of rain water harvesting	1.11	1.55	
3	Adoption of residue mulching	1.96	2.86	
4	Thin film of water for suppressing weeds	2.93	1.88	
5	Irrigation at emergency	2.91	1.98	
6	Less water uses at nursery preparation	2.16	2.10	
7	Drip irrigation	2.60	1.63	
8	Sprinkler irrigation	2.08	1.15	
Total mean		2.25	1.87	
Total standard deviation		0.64	0.55	

Maximum Obtainable Score-3

Table No.3 revealed that, among the NICRA beneficiaries the highest mean is of improved drainage system that drains water from the land to improve crop yields which is 2.96 and the lowest mean was for adoption of rain water harvesting (mean=1.11) and among the NICRA-non-beneficiaries the highest mean was for adoption of residue mulching that is 2.86 and the lowest mean for sprinkler irrigation was 1.15. Singh *et al.* (2021) also found similar results.

The NICRA non-beneficiaries have adopted the residue mulching system in which is residues are spread on the soil surface to conserve moisture and suppress weed growth. Patil *et al.* and Phanisri *et al.* (2022) [18] also described about the adoption of mulching in the crops which was helpful for the climate resilient agriculture. Due to the improper communication regarding the effect of improved irrigation practices the NICRA-non-beneficiaries are unable to adopt the drip and sprinkler irrigation whereas the NICRA beneficiaries are able to adopt the different irrigation practices for farming by getting proper training from the KVK personnels and the non-beneficiaries are not getting enough subsidies for initial capital investment.

Table 4: Pest and disease management (N=120)

Sl. No	Technologies	NICRA Beneficiaries (n=60)	Non- Beneficiaries (n=60)	Z TEST
		Mean	Mean	
1	Raising healthy seedling in nursery	2.90	1.11	0.966
2	IPM	2.90	1.61	
3	Use of fungicide treatment in seeds	2.91	2.80	
4	Use of pheromone trap	2.11	1.36	
5	Adopting conserving bio agent	2.85	1.11	
6	Integrated disease management	2.80	1.93	
7	Growing disease resistant varieties	2.93	1.10	
Total mean		2.75	1.65	
Total standard deviation		0.29	0.62	

Maximum obtainable score-3

From the above table we concluded that, among the NICRA beneficiaries the highest mean was from growing disease resistant, which was 2.93 and the lowest mean is from use of pheromone trap which was 2.11 and among the NICRA-non beneficiaries the highest mean was 2.80 from use of fungicide treatment in seeds that helps in seed treatment, improves germination and the lowest mean from growing disease resistant varieties which was 1.10. There was similarity of result found with Harikrishna and Naberia (2021) [6].

The NICRA beneficiaries adopted the disease resistant varieties which is crucial to the reliable production of food, and it provides significant reductions in agricultural use of land, water, fuel. Integrated pest management (IPM) also known as integrated pest control (IPC) is a broad-based approach, this not show the immediate result. Here the NICRA beneficiaries adopt all the technologies and also perform well as they get sufficient training but the NICRA-non beneficiaries are unable to adopt due to poor training from the officials. Kethavath *et al.* (2022) [10] and Lenka *et al.* (2022) [11] found that most of the farmers were unaware about the appropriate application of doses of fungicides and pesticides application. The economic condition of the farmers were affecting the adoption of the pest and disease management practices.

Table 5: Livestock management (N=120)

Sl. No	Technologies	NICRA Beneficiaries (n=60)	Non- Beneficiaries (n=60)	Z TEST
		Mean	Mean	
1	Improved breed of livestock	2.11	2.01	1.165
2	Improved feed for livestock	2.83	2.45	
3	Improved breed of poultry	2.15	2.90	
4	Good fish fingerlings	2.95	1.06	
5	Integrated farming system	2.26	1.96	
Total mean		2.54	2.09	
Total standard deviation		0.39	0.68	

Maximum obtainable score-3

From the above table we concluded that, among the NICRA beneficiaries the highest mean was for 2.95 which was for good fish fingerlings and the lowest mean was for 2.11 and among the NICRA-non beneficiaries the highest mean is for 2.90 improved breed of poultry, bred for meat production and breeds for egg production and the lowest mean was for 1.06.

The NICRA beneficiaries are adopting the rearing of improved breed of livestock for increasing production, disease resistance, successful reproduction and resilience. The NICRA beneficiaries get the feed, the poultry and the medicines free of cost or at negligible rate as compare to NICRA-non beneficiaries they don't get these things for free and the cost is also high so they are unable to adopt the above.

Table 6: Marketing (N=120)

Sl. No	Technologies	NICRA Beneficiaries (n=60)	Non- Beneficiaries (n=60)	Z TEST
		Mean	Mean	
1	Information availability	2.11	1.90	0.403
2	Market accessibility	2.30	2.63	
3	Proper handling	2.05	2.91	
4	Proper weighment	2.06	2.95	
5	Proper grading	2.08	2.86	
6	Reasonable market charges	2.21	2.35	
7	Price awareness	2.86	2.10	
8	Reasonable method of sale	2.53	2.11	
9	Reasonable rates	2.20	1.38	
10	Price stability	2.11	2.90	
11	Proper payment procedure	2.10	2.91	
12	Honesty in the regulated market	2.41	2.36	
Total mean		2.26	2.49	
Total standard deviation		0.24	0.50	

Maximum obtainable score-3

From the above table we concluded that, among the NICRA beneficiaries the maximum mean is for price awareness that ensures support price to farmers and affordable price to consumer which was 2.86 and the lowest mean for proper handling which was 2.05 and among the NICRA-non beneficiaries the highest mean for proper weighment that reduces wastage that was 2.95 and the lowest mean for reasonable rate which was for 1.38.

Here both NICRA and NICRA-non beneficiaries are well adopting to the marketing channels they have their market near to their village for which they also get good profit. Most of the farmers are not getting the reasonable rate for the for their products and also, they are having lacking in proper handling, grading and price awareness. The study was lined up with Manjunath *et al.* (2019) [13] and Acharitha *et al.* (2022) [1].

Further study was conducted to find out the relationship of adoption of climate resilient agriculture with the different socio-economic attributes of the respondents. The result obtained through correlation coefficient analysis have been presented below table.

There was a significant positive relationship found in between annual income, Cosmo politeness, source of information, extension contact and social participation and the adoption rate of the farmers. the socio-economic attributes like age, education, family types have no significance on the adoption rate of scientific practices under NICRA. Hence, the extension officials have to apply these attributes while fostering new technology on farmers for adequate adoption of the scientific practices. The line departments and extension personnel should adopt adequate teaching methods according to the findings.

Table 7: Influence of socio-economic attributes on adoption

Sl. No.	Independent variables	Adoption
1	Age	0.008
2	Education	0.085
3	Family type	0.070
4	Family size	0.006
5	Income from farming per annum	0.307**
6	House type	0.182*
7	Total land holding	0.087
8	Cosmo politeness	0.918**
9	Source of information	0.556**
10	Extension contacts	0.882**
11	Social participation	0.732**

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

Conclusion

From the above discussion it can be concluded that the farmers who have well aware about the NICRA project have higher adoption rate as compare to non-NICRA beneficiaries. The beneficiaries were adopting agriculture and livestock management practices due to proper knowledge about the advantages about the recommended practices. The NICRA beneficiaries easily get the financial benefits like loans, credits and subsidies for implementation of new and climate resilient practices. The non-beneficiary farmers somehow adopted the climate resilient practices by getting information in their personalised channel. The extension personals who are working under KVKs or other Government extension functionaries should organise more training programmes for creating awareness among the rural farmers about the climatic impacts on production and the different ways to overcome the problems face by the farmers.

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