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Extent of adoption of climate-resilient agricultural practices under the NICRA by farmers in Chikkaballapur district

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Abstract
This study assesses the extent of adoption of climate resilient agriculture practices under the National Innovations on Climate Resilient Agriculture (NICRA) project by the farmers in S. Raghuttahalli (beneficiary village) and D. Nagarajahosahalli (non-beneficiary village) in Chintamani taluk, Chikkaballapur district. A total of 120 farmers, including 80 beneficiaries and 40 non-beneficiaries, were selected randomly. The results reveal significant differences in the adoption of climate-resilient practices, crop production techniques, and fodder and animal health management. Results highlighted the adoption of climate-resilient practices, revealing noteworthy disparities between NICRA beneficiaries and non-beneficiaries:

Adoption of soil and water conservation practices: Beneficiaries exhibited higher adoption rates of climate-resilient practices such as drip irrigation, planting tree species, and trench cum Bunding. In contrast, non-beneficiaries lagged in adoption, indicating the positive impact of NICRA interventions.

Adoption of crop production practices: Beneficiaries showcased higher adoption rates in crop diversification, intercropping, and using high-yielding varieties. Significant differences were observed in nutrient management practices, emphasizing the positive influence of NICRA on enhancing sustainable agricultural practices.

Adoption of fodder and animal health practices: Beneficiaries excelled in adopting health management interventions and establishing fodder banks, a result attributed to the educational efforts of Krishi Vigyan Kendra. Non-beneficiaries showed limited adoption, underscoring the positive role of NICRA in promoting holistic agricultural practices.

In nutshell, NICRA interventions positively influenced the adoption of climate-resilient practices, crop productivity, and livestock management, highlighting the project's effectiveness in enhancing sustainable agricultural practices.

Keywords: Extent of adoption, climate resilient practices, NICRA, beneficiary farmers, non-beneficiary farmers and attitude towards intervention

Introduction

Climate change poses significant challenges to global agriculture, impacting weather patterns, temperature, and precipitation, thereby affecting food and water security (Wheeler and on-Braun, 2013) [9] & (Thornton *et al.*, 2011) [6]. With evidence of rising global temperatures, melting arctic sea ice, and changes in precipitation, the need to address the consequences of climate change on agriculture becomes paramount (Misra, 2014) [2] & (Solomon *et al.*, 2007) [5].

In response to this pressing issue, the Indian Council of Agricultural Research (ICAR) has initiated the National Innovations on Climate Resilient Agriculture (NICRA) project. Launched in 2011 with an outlay of Rs. 350 crores, NICRA aims to enhance the resilience of Indian agriculture to climate change through strategic research and technology demonstration. The Technology Demonstration Component (TDC) of NICRA involves on-farm participatory demonstrations in 121 vulnerable districts across India. In Karnataka, four Krishi Vignyan Kendras (KVKs) are implementing the project, namely KVK Davangere, KVK Belgaum, KVK Hirehalli, and KVK Chintamani in Chikkaballapur district. NICRA comprises four intervention modules: Natural Resource Management, Crop Production, Livestock and Fisheries, and Institutional Interventions. These modules address diverse aspects, from soil and water conservation practices and crop diversification to livestock promotion and institutional strengthening.

In Chikkaballapur district, the study assesses the impact of NICRA interventions on rural livelihood security, comparing beneficiary and non-beneficiary farmers. The interventions include initiatives such as in-situ moisture conservation, contouring, terracing, rainwater harvesting, livestock promotion, and strengthening institutional support. Understanding the effectiveness of NICRA in enhancing rural livelihood security is crucial for shaping future climate-resilient agricultural policies and practices. The study aims to provide insights into the tangible benefits and challenges faced by farmers in the face of climate change, contributing to the broader discourse on sustainable agriculture and climate adaptation strategies.

Materials and Methods

The study, conducted in S. Raghuttahalli and D. Nagarajahosahalli within Chintamani taluk, Chikkaballapur district, offers a comprehensive assessment of the impact of the National Innovations on Climate Resilient Agriculture (NICRA). S. Raghuttahalli, deliberately chosen as an NICRA implementation site since 2011-12 with the support of Krishi Vignyan Kendra (KVK) Chintamani, served as the focal point for understanding the outcomes of climate-resilient agricultural interventions. In contrast, the neighboring village of D. Nagarajahosahalli, devoid of NICRA implementation, was selected for comparative analysis. The sample size comprised 80 farmers from S. Raghuttahalli (NICRA beneficiaries) and 40 farmers from D. Nagarajahosahalli (non-beneficiaries), randomly selected to form a total sample size of 120. The study adopted an ex-post facto design, a robust research methodology suitable for evaluating the effects of interventions after their implementation. Data collection involved personal interviews, ensuring qualitative insights into the experiences and perceptions of the farmers.

To derive meaningful conclusions, the study employed a range of statistical tools, including frequency analysis, percentage calculations, mean computation, standard deviation assessment, paired t-tests, correlation analyses, and multiple regression models. These analytical methods provided a nuanced understanding of the data, allowing for a comprehensive interpretation of the impacts of NICRA interventions. The research design and methodology were meticulously chosen to facilitate a rigorous assessment and comparison of the livelihood security of farmers in NICRA-beneficiary and non-beneficiary villages. By adopting this scientific approach, the study contributes valuable insights into the efficacy of climate-resilient agricultural practices, offering a basis for informed decision-making in sustainable agricultural development and policy formulation.

In this study the Climate Resilient Agricultural Practices is operationally defined as recommended practices addressing climate change-related challenges. These practices aim to enable individuals to navigate extreme climatic conditions, promoting stability and sustainability.

Results and Discussion

Adoption of climate resilient soil and water conservation practices by beneficiaries and non-beneficiaries

The data in the Table 1 indicated the extent of adoption of climate resilient soil and water conservation practices by beneficiaries and non-beneficiaries. Majority of the beneficiary farmers adopted practices like drip irrigation (80.00%), planting of tree species like mango, tamarind (72.50%) and trench cum bunding (48.50%). Nearly one fifth of the beneficiary farmers adopted percolation pond for ground water recharge (16.25%) and construction of rainwater structures (17.50%). With respect to the non- beneficiary farmers, cent percent of farmers have not adopted percolation pond for ground water recharge. Further, majority of the non-beneficiaries have not adopted practices like construction of rain water structures like farm pond (92.50%), trench cum bunding (87.50%), drip irrigation (67.50%) and planting tree species like mango and tamarind (60.00%).

Table 1: Adoption of climate resilient soil and water conservation practices by beneficiaries and non-beneficiaries N=120

Sl. No.	Practices	Beneficiaries (n_1=80)						Non-beneficiaries (n_2=40)					
		Full-adoption		Partial adoption		Non-adoption		Full-adoption		Partial adoption		Non-adoption	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	Trench cum bunding	39	48.50	0	0.00	41	51.25	5	12.50	0	0.00	35	87.50
2	Drip irrigation	64	80.00	0	0.00	16	40.00	13	32.50	0	0.00	27	67.50
3	Percolation pond for ground water recharge	13	16.25	0	0.00	67	83.75	0	0.00	0	0.00	40	0.00
4	Construction of rain water structures like farm pond	14	17.50	0	0.00	6	82.50	3	7.50	0	0.00	37	92.50
5	Planting tree species like mango and tamrind	58	72.50	0	0.00	22	27.50	16	40.00	0	0.00	24	60.00

The NICRA project tackles all aspects of development of dry zone area in a holistic approach coming with in ridgeline. In the first instance, soil and water conservation structures and practices were taken up on free of cost. One check dam, two nala bunds checking the rainwater runoff. Initially eight farm ponds were constructed later increased to fourteen, which helped the beneficiaries in storage of rainwater, which can used for cultivation purpose. Thirteen percolation ponds for ground water recharge and trench cum bunding practices was adopted in 15-hectare area which benefited more than two-fifth of the beneficiaries of NICRA village. This has maximized the rainwater storage and conservation of soil and water by preventing the soil erosion and water run- off. It is important to note that more than eighty per cent of the beneficiary farmers have adopted water saving techniques like drip irrigation in horticulture crops. These practices were not adopted or less adopted by non-beneficiary farmers due to low extension efforts in the non-NICRA village and high cost of establishment of those structures. There was neither incentives nor educational efforts to promote soil and water conservation practices in the non-NICRA village. Hence, a distinct difference was observed between beneficiaries and non-beneficiaries. The findings are similar to the findings of Narayana Gowda (1992) [3] & Wezel *et al.* (2014) [8].

Adoption of climate resilient crop production practices by beneficiaries and non-beneficiaries

The adoption of climate resilient extent of adoption of crop production practices by beneficiary and non-beneficiary farmers are presented in the Table 2. The data indicated that crop diversification (72.50%), intercropping system (62.50%), earthling up in redgram (57.50%) and using latest high yielding varieties like ML-365, MR-6 (52.50%) were fully adopted by the beneficiary farmers. With respect to the nutrient management, significant percentage of the beneficiaries have partially adopted soil test based nutrient application *viz* Nitrogen (90.00%), Phosphorous (78.75%), Potassium application (52.50%) and micro –nutrient application (80.00%). More than three-fourth of the beneficiaries (77.50%) have not adopted aerobic /SRI method of rice cultivation. More than two-third of the non-beneficiary farmers have not adopted crop production practices like earthing up (70.00%) and using recent high yielding varieties (67.50%), followed by intercropping system (57.50%), crop diversification (52.50%) and application of micro-nutrients (52.50%). Majority of the non-beneficiary farmers (82.75%), have partially adopted nitrogen application. Whereas, 70.00 per cent of the non- beneficiaries have not applied recommended potash nutrient followed by phosphorous nutrient (55.00%).

Adoption of climate resilient fodder and animal health practices by beneficiaries and non-beneficiaries

The Table 3 revealed the extent of adoption of climate resilient fodder and animal health management practices by beneficiaries and non-beneficiaries. Majority of the beneficiaries (85.00%) have adopted health management interventions, and nearly one- third of them established fodder banks (31.25%), whereas none of the non-beneficiary farmers have established fodder bank. Nearly, two-third of them have adopted health management practices (65.00%).

The adoption of fodder demonstration plots as well as the fodder banks by beneficiaries are mainly due to the efforts of Krishi Vigynan Kendra in the adopted village. KVK has conducted intensive educational activities along with the demonstrations that resulted in higher fodder yield and milk yield. The findings are similar to that of findings of Mani (2016) [1].

Table 2: Adoption of climate resilient crop production practices by beneficiaries and non-beneficiaries N=120

Sl. No.	Practices	Beneficiaries (n=80)						Non-beneficiaries (n=40)					
		Full-adoption		Partial adoption		Non-adoption		Full-adoption		Partial adoption		Non-adoption	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	Use of HYV, Early maturing and HYV drought tolerant varieties like ML-365, MR-6	42	52.50	0	0.00	38	47.50	13	32.50	0	0.00	27	67.50
2	Earthing up in redgram	46	57.50	0	0.00	34	42.75	12	30.00	0	0.00	28	70.00
3	Intercropping system ragi with redgram	52	62.50	0	0.00	28	35.00	17	42.50	0	0.00	23	57.50
4	Crop diversification	58	72.50	0	0.00	22	27.50	19	47.50	0	0.00	21	52.50
5	Aerobic/SRI method	18	22.50	0	0.00	62	77.50	4	10.00	0	0.00	36	90.00
6	Soil test based nutrient application	N 0	0.00	72	90.00	8	10.00	0	0.00	33	82.75	7	17.50
		P 0	0.00	63	78.75	17	21.25	0	0.00	18	45.00	17	55.00
		K 0	0.00	38	52.50	38	47.50	0	0.00	12	30.00	28	70.00
7	Application of micro-nutrients	0	0.00	64	80.00	16	20.00	0	0.00	19	47.50	21	52.50

Table 3: Adoption of Climate Resilient fodder and animal health practices by beneficiaries and non-beneficiaries N=120

Sl. No.	Climate Resilient practices	Beneficiaries (n_1=80)						Non-beneficiaries (n_2=40)					
	Fodder and animal health	Full-adoption		Partial adoption		Non-adoption		Full-adoption		Partial adoption		Non-adoption	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1.	Fodder demonstration	4	5.00	0	0.00	76.00	95.00	0	0.00	0	0.00	40	100.00
2.	Fodder bank establishment	25	31.25	0	0.00	55.00	68.75	0	0.00	0	0.00	40	100.00
3.	Promotion of health management interventions	68	85.00	0	0.00	12.00	15.00	26	65.00	0	0.00	14	35.00

Technological impact with respect to crop productivity in ragi and redgram between beneficiaries and non-beneficiaries

The productivity of ragi and redgram was found to be 15.75 and 12.60. Quintal per hectare in case of beneficiaries. Whereas, the productivity of ragi and redgram was found to be 11.50 and 9.84 quintal per hectare in case of non-beneficiaries. There is a significant yield difference in ragi and redgram productivity of beneficiary and non- beneficiary farmers at five per cent level are presented in Table 4.

The possible reasons might be due to adoption of high yielding drought tolerant and early maturing varieties, use of biofertilizers, micronutrients, application of recommended dosage of N, P and K, based on the soil sample analysis and adoption of soil and moisture conservation practices resulted in higher yield among beneficiaries compared to non-beneficiaries. The findings are similar to the findings of Vinay Kumar (2012) [7] & Shashidhar (2003) [4].

Table 4: Technological impact with respect to crop productivity in ragi and redgram between beneficiaries and non- beneficiaries N=120

Sl. No	Components	Crops	Beneficiaries n_1=80	Non-beneficiaries n_2=40	‘t’ value
			q/ha	q/ha	
1	Productivity	Ragi	15.75	11.50	2.76*
		Redgram	12.60	9.84	3.45*

*at 5% level of significance

Notable findings

- **Adoption of climate resilient soil and water conservation practices:** The study assessed the adoption of climate-resilient practices among beneficiaries and non-beneficiaries. Beneficiaries showed higher adoption rates, with 80.00% using drip irrigation, 72.50% planting tree species, and 48.50% implementing trench cum bunding. Non-beneficiaries exhibited lower adoption across practices, indicating the positive impact of NICRA interventions.
- **Adoption of climate resilient crop production practices:** Beneficiaries demonstrated higher adoption in crop diversification (72.50%), intercropping (62.50%), and using high-yielding varieties (52.50%). Significant portions adopted soil test-based nutrient application. Non-beneficiaries showed lower adoption rates in most practices, highlighting the effectiveness of NICRA in promoting climate-resilient crop production.
- **Adoption of climate resilient fodder and animal health practices:** Beneficiaries excelled in adopting health management interventions (85.00%) and establishing fodder banks (31.25%). Non-beneficiaries lagged in adopting these practices, emphasizing the positive impact of NICRA in promoting sustainable fodder and animal health management.
- **Technological impact on crop productivity:** Beneficiaries achieved significantly higher productivity in ragi (15.75 q/ha) and redgram (12.60 q/ha) compared to non-beneficiaries (11.50 q/ha and 9.84 q/ha, respectively). This underscores the technological impact of NICRA interventions on enhancing crop productivity

Conclusion

The study reveals a stark contrast in the adoption of climate-resilient practices between NICRA beneficiaries and non-beneficiaries. NICRA has significantly influenced soil and water conservation, crop production, and fodder and animal health practices, leading to higher productivity among beneficiaries. The findings underscore the importance of targeted interventions and extension efforts in promoting sustainable agricultural practices. NICRA's holistic approach has not only enhanced climate resilience but also improved the livelihoods of farmers in the study area. These results contribute to the broader understanding of the effectiveness of climate-resilient agricultural interventions in addressing the challenges posed by climate change.

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