Impact of Climate Resilient Technologies in Nandyal District of Andhra Pradesh

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ABSTRACT

Climate change refers to a significant and lasting alteration in the statistical distribution of weather patterns over periods ranging from decades to millions of years. In developing countries, crop yield declines are expected in several important crops, with South Asian nations projected to be particularly hard hit. Climate-smart agricultural technologies proved to be the best adaptation strategies followed by farmers for achieving sustainable crop yields. A study on Impact of climate resilient technologies (CRTs) and factors associated in adoption of the technologies was conducted in Nandyal district of Andhra Pradesh. The results of the study indicated that conservation furrows helped in increasing the yield of setaria by 28% (1,418 kg/ha) and castor by 32% (1,332 kg/ha) and in cotton it was 51% higher and in red gram it was 44% higher (1,024 kg/ha). With micro-irrigation yield was enhanced by 35% in sweet orange (27 t/ha), tomato 32% (64 t/ha) and in brinjal, it was 41 % higher than control. In the intercropping system of setaria with red gram in 5:1 ratio 28% more yields was recorded. In case of groundnut and red gram intercropping in 7:1 ration the yield recorded was 30% more than the control. Drought tolerant varieties of castor, Bengal gram and groundnut recorded enhanced yield by 25%, (1,330 kg/ha), 23% (1,513 kg/ha) and 50% (1,020 kg/ha) respectively along with additional net returns. Short duration varieties of setaria, groundnut and green gram yielded 32%, 58% and 9% more, respectively, than traditional varieties. Certain characteristics viz., mass media exposure, capacity building programmes attendance, extension contact, perception on climate change and perception on climate resilient technologies had a significant correlation with the adoption of CRTs among the farmers.

Keywords: Climate resilient technologies (CRTs), Economic Impact and Personal Characteristics.

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Introduction

Climate change is a significant and lasting alteration in the statistical distribution of weather patterns over periods ranging from decades to millions of years. The fact that climate influences the development and development influences the climate has come to be known universally during recent times. In developing countries, declines in crop yields are expected and South Asian countries will be particularly hard-hit. Studies in the past have indicated that India is likely to face the highest agricultural productivity losses in accordance with observed climate change patterns and projected scenarios. Projections of climate change made up to 2100 for India reveal an overall increase in temperature by 2–4°C without a substantial change in precipitation quantity (Kavi Kumar, 2009). Climate-smart agricultural technologies have proven to be effective adaptation strategies adopted by farmers for sustainable crop yields (Nayak et al., 2023). It was also recorded that some personal characteristics are associated with the adoption of the technology. In this context, it is necessary to evaluate the impact of climate resilient technologies and factors associated with the adoption of these technologies in the scarce rainfall zone of Andhra Pradesh. Hence, the study is designed with the following objectives.

- To study the economic impact of adopting climate-resilient technologies in agriculture.
- To understand the factors affecting the adoption of climate-resilient technologies by farmers in rainfed areas.

Methodology

The study was conducted in the Nandyal district of Andhra Pradesh, India, with 180 respondents, to assess the economic benefits of adopting crop production technologies and to identify the factors influencing their adoption in three villages adopted under the NICRA Project. Data on farmers were obtained from KVK records, and response data were collected using a structured interview schedule. The t-test was used to analyze the results pertaining to yield and economic returns, and the correlation coefficient was used to examine the factors influencing the adoption of climate-resilient technologies. Sample farmers who had adopted each technology and implemented it during the reference year (2021–22) were considered to assess changes in net returns and yield levels. Therefore, the number of farmers who adopted each technology varied from one technology to another.

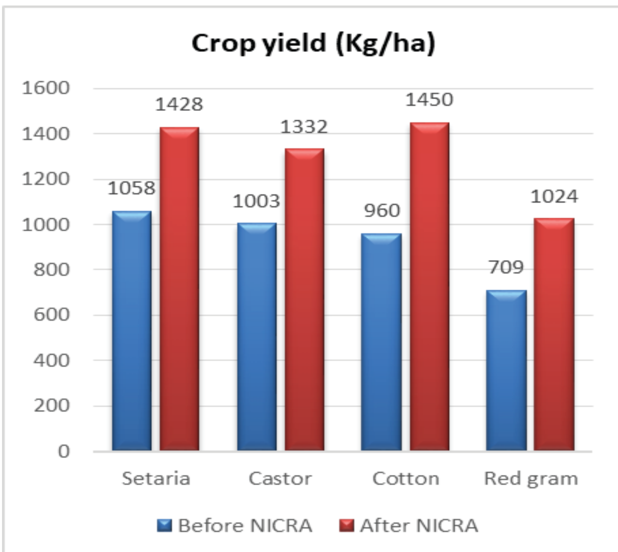
Results and Discussions

I. Economic Impact of Climate Resilient Technologies in Crop Production

1. In-situ Moisture Conservation Measures:

It was noted (Table 1) that a conservation furrow was created after every six rows at 35 days after sowing (DAS) using a blade harrow, which helped shorten the effect of dry spells on the Setaria crop. The yield obtained was 1,418 kg/ha, representing a 28% increase over the control, with incremental net returns of ₹11,955/ha. The t-value was significant at the 1% probability level.

In the case of Castor, conservation furrows were formed after every two rows planted at 90 cm spacing using a blade harrow at 35 DAS. Adoption of this drought management practice resulted in a yield of 1,332 kg/ha, which was 32% higher than the control, with incremental net returns of ₹13,263/ha. For Cotton, cultivation without in-situ moisture conservation practices resulted in a yield of 960 kg/ha and negative net returns. However, with conservation furrows, the yield increased to 1,450 kg/ha, a 51% improvement over the control, accompanied by incremental net returns of ₹13,150/ha. Regarding conservation furrows in Red gram, the yield recorded was 1,024 kg/ha, which was 44% higher than the control, with incremental net returns of ₹11,153/ha. The observed increases in yield and income were significant at the 1% probability level, as indicated by the t-values.



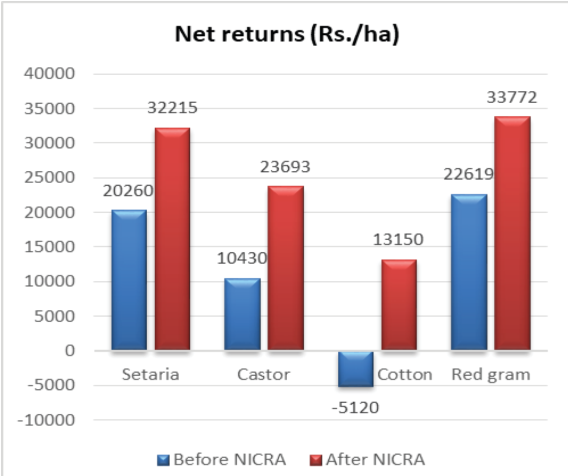
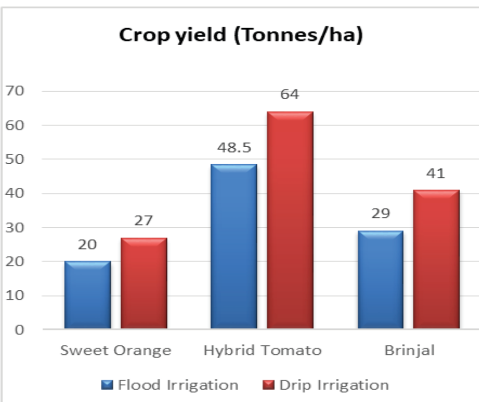


Figure 1. Yield and Net Returns due to In-situ Moisture Conservation in Different Crops

Micro-Irrigation:

With the installation of micro-irrigation, the yield of Sweet orange was 27 tonnes/ha, which was 35% higher than under control conditions, and the incremental net income was ₹143,873/ha. The changes were significant at the 1% probability level, as indicated by the t-values.

The hybrid tomato crop under drip irrigation recorded a yield of 64 tonnes/ha, which was 32% higher than under flood irrigation. The net returns obtained were ₹2,96,583/ha, which was 42% (₹88,999) higher than under flood irrigation. In brinjal cultivation (traditional variety), the yield under drip irrigation was 41 tonnes/ha, which was 41% higher than under flood irrigation. The net returns under the drip system were ₹137,273/ha, which was 44.7% higher than under flood irrigation.



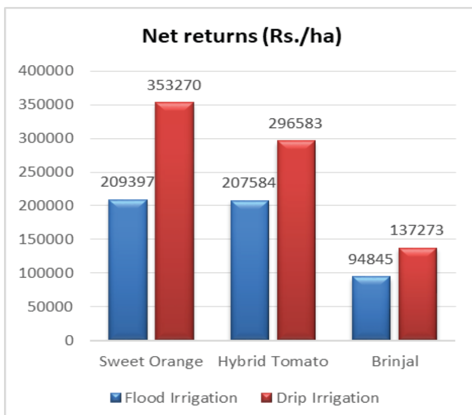


Figure 2. Changes in Yield and Net Returns per Hectare due to Drip

Intercropping

In the intercropping system, after every five rows of Setaria, one row of Red gram was sown (5:1). Sowing was done using a bullock-drawn seed drill. As Setaria was the main crop, its equivalent yield was considered for yield calculation. With this intervention, the yield recorded was 1,830 kg/ha, which was 28% higher than the control. The net returns stood at ₹21,973/ha, representing a 42% increase over the control. The differences were significant at the 1% probability level, as indicated by the t-values. Similar results were reported by Latha et al. (2012).

In another intercropping system, seven rows of Groundnut and one row of Red gram were sown using a bullock-drawn seed drill. As Groundnut was the main crop, its equivalent yield was considered for yield calculation. The yield recorded in this intercropping system was 1,123 kg/ha, which was 29.52% higher than the control, with incremental net returns of ₹12,800/ha. The differences were significant at the 1% probability level.

Farmers opined that crops grown under intercropping experienced lower pest incidence due to crop diversity, reduced weed problems, and improved soil nutrient status through the inclusion of legumes. The system also acted as a form of crop insurance, ensuring that farmers could reap at least one crop even under adverse conditions. This practice proved beneficial for dryland farmers, as it utilized the bimodal distribution of rainfall and enabled more efficient soil utilization through a combination of shallow- and deep-rooted crops.

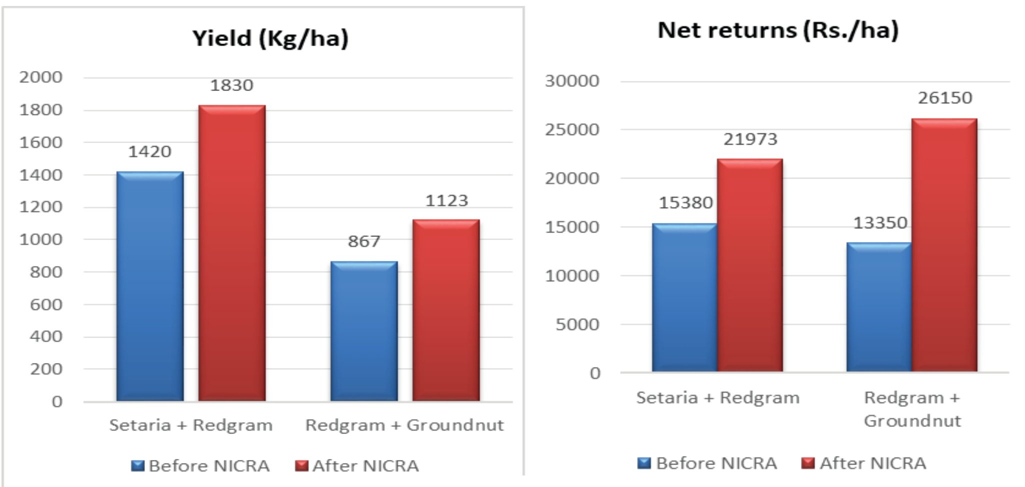
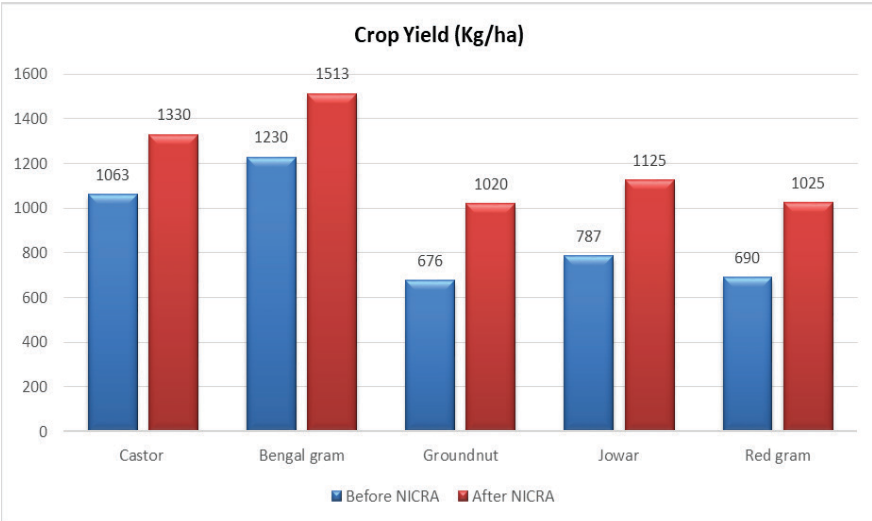


Figure 3. Yield and Net Returns of Crops under Intercropping Systems

Drought Tolerant Varieties

With the cultivation of drought-tolerant varieties of Castor, the yield recorded was 1,330 kg/ha, representing a 25% increase over the control conditions, with an incremental net return of ₹10,082/ha. In the case of Bengal gram cultivation, drought-tolerant varieties yielded 1,513 kg/ha, which was 23% higher than the control, with an incremental net return of ₹8,720/ha. Drought-tolerant varieties of Groundnut produced a yield of 1,020 kg/ha, which was 50% higher than the control, with an incremental net return of ₹15,200/ha.



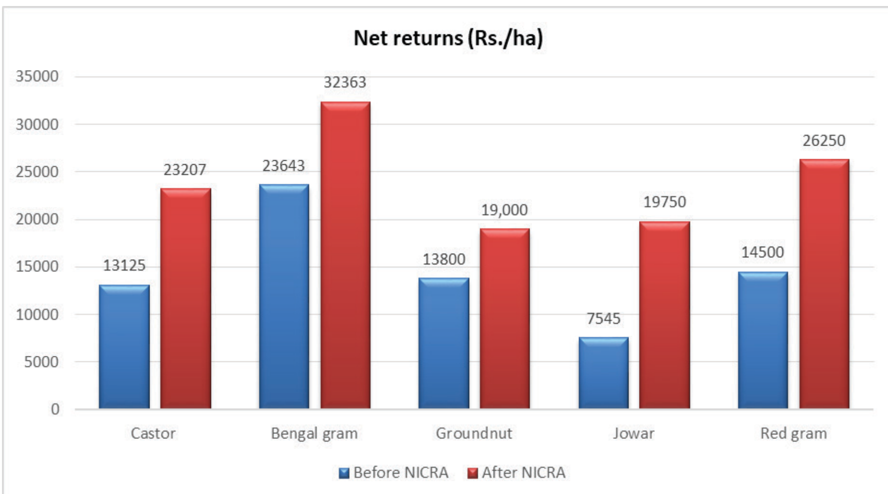


Figure 4. Yield and Net Returns of the Drought Tolerant Varieties

Short Duration Varieties

Short-duration varieties of Setaria yielded 1,423 kg/ha, with an incremental net return of ₹14,412/ha. Red gram produced 1,040 kg/ha, which was 31.8% higher than the long-duration variety, with an incremental net return of ₹12,550/ha. Groundnut recorded a yield of 948 kg/ha, representing a 58% increase over the traditional variety, with a net additional income of ₹14,900/ha. Green gram yielded 957 kg/ha, which was 9.3% higher than the traditional variety.

Short-duration varieties of Setaria (Garuda, Suryanandhi), Red gram (PRG 176), Groundnut (TCG-1704, Narayani), and Green gram (WGG-42) were made available for cultivation. The adoption of these varieties is increasing as farmers choose them based on crop duration, soil type, and rainfall. Some farmers prefer these varieties to grow a second crop of pulses during the Rabi season under rainfed conditions. Short-duration Setaria and Green gram are particularly suitable for intercropping and double-cropping systems.

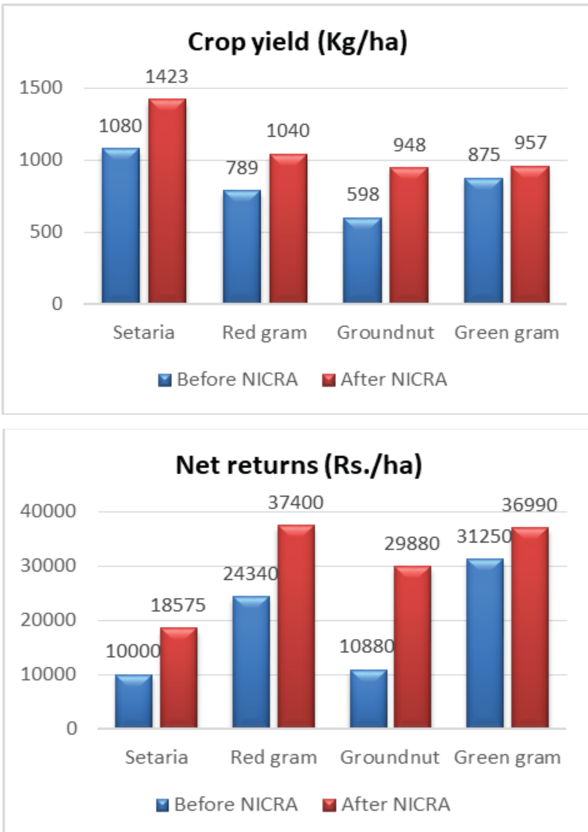


Figure 5. Yield and Net Returns of Short Duration Varieties

Table I. Yield and net returns of various crops due to In-situ moisture conservation measures

Crop/ System	No. of Farmers	Crop Yield (Kg/ ha or tonnes/ha)		t-statistic	Net returns (Rs./ha)		t-statistic
		Before NICRA	After NICRA		Before NICRA	After NICRA	
In-situ moisture conservation measures							
Setaria	33	1058	1428**	11.648**	20260	32215	16.021**
Castor	11	1003	1332**	13.922**	10430	23693	27.136**
Cotton	29	960	1450**	15.102**	-5120	13150	138.593**
Red gram	47	709	1024**	74.504**	22619	33772	23.766**
Micro irrigation							
Sweet Orange	15	20	27	7.646**	209397	353270	60.704**
Tomato Hybrid	19	48.5	64	24.508**	207584	296583	6.640**
Brinjal (Poluru variety)	25	29	41	16.803**	94845	137273	15.373**
Intercropping systems							
(Setaria + Red-gram) Setaria equiva-lent yield	94	1420	1830	38.133**	15380	21973	16.165**
(Red-gram + Ground-nut) ground-nut equiva-lent yield	56	867	1123	22.831**	13350	26150	137.413**

Drought tolerant crop varieties							
Castor	16	1063	1330	19.612**	13125	23207	48.772**
Bengal gram	72	1230	1513	15.421**	23643	32363	31.188**
Ground-nut	17	676	1020	23.540**	13800	19,000	35.949**
Jowar	17	787	1125	18.066**	7545	19750	66.073**
Red gram	42	690	1025	18.13**	14500	26250	35.407**
Short duration varieties							
Setaria	66	1080	1423	23.356**	10000	18575	89.552**
Red gram	78	789	1040	18.110**	24340	37400	72.692**
Ground-nut	84	598	948	27.371**	10880	29880	33.810**
Green gram	42	875	957	4.486**	31250	36990	18.281**

*** Significant at 1per cent probability level.*

II. Adoption of CRTs and personal characteristics of Sample farmers

To examine whether there is any relationship between the adoption of CRTs and the personal characteristics of sample farmers, correlation test was used. Adoption of CRTs is reflected by an Index computed for the sample farmer by considering the combined score obtained for the selected variables, based on the nature of their adoption (non-adoption = 0, partial adoption =1, full adoption =2):

The characteristics such as mass media exposure, capacity building programmes attended, extension contact, perception on climate change and perception on CRTs for the sample farmers are reflected by the combined score obtained based on their responses to specific variables under the respective characteristic.

Table II reflects the results of correlation test between the adoption of climate resilient technologies and the personal characteristics of the sample farmers. It may be noted that certain characteristics, viz., mass media exposure, capacity building programmes attendance, extension contact, perception on climate change and perception on climate resilient technologies had a significant correlation with the adoption of CRTs among the sample farmers, as indicated by r value, which is significant at 1 per cent probability level. Other personal characteristics such as age, farming experience, education and landholding size had no significant correlation with the adoption of CRTs among the sample farmers

Thus, it becomes clear that the adoption of CRTs is positively correlated only with those personal characteristics such as mass media contact, capacity building, perception of climate change and CRTs, which have been influenced by interventions made under NICRA project, and not with age, education, farming experience and land holding size. Vijayasarathy (2015), Ashok (2022) reported similar results.

Table II: Results of Correlation test between the Adoption of climate resilient technologies Index and personal characteristics of Sample farmers

S. No.	Personal characteristics	Correlation Co-efficient (r value)
1	Age	0.051
2	Education	0.102
3	Farming Experience	0.122
4	Landholding size	0.123
5	Mass Media exposure Score	0.326**
6	Capacity Building Programmes Attendance Score	0.540**
7	Extension Contact Score	0.459**
8	Perception on Climate Change Score	0.405**
9	Perception on Climate Resilient Technologies Score	0.520**

Note: ** Significant at 1per cent probability level. Other values are not significant.

Policy Implications

Climate resilient seed material is available in the Research Institutes, Universities and KVKs. With the availability of seed material, a greater number of farmers come forward to cultivate the climate resilient varieties. Research Institutes should identify proper nodal agencies at the district level and facilitate seed production by the farmers for horizontal spread of the technology. For reaching a greater number of farmers, the climate resilient varieties should be brought into seed chain and supplied to farmers on subsidy basis. To make availability of the varieties at the mandal or village level, the varieties should be multiplied in seed village programme being organized by state department of agriculture by involving trained farmers in seed production. Involvement of NGOs and FPOs may also be promoted in spread of the technology.

As the country is endowed with rich biodiversity, collection and safe storage of accessions of crops grown in rainfed situation for capturing the diversity in plant should be prioritized at the University and National Agriculture Research System, which would help in further breeding programmes.

As there is a positive and significant relationship between Mass media exposure, capacity building programmes attendance, extension contact perception on climate change, and perception on climate resilient technologies (independent variables) and the adoption of climate resilient technologies among the farmers, these variables should be taken into consideration while planning future programmes

From the above study it can be concluded that adoption of climate resilient technologies have positive impact on yield and income of the farmers. As the adoption is positively related with mass media exposure, capacity building attendance score, extension contact score, perception on climate change score and perception on climate resilient technologies score, farmers capacities should be enhanced to adopt the resilient practices in agriculture continuously.

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