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Assessing the Adoption of Climate Resilient Agricultural Technologies by the Farmers of Telangana State

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ABSTRACT

In agriculture sector, the effect of climate change seems to have become inevitable during the last few decades. Hence, the technologies for climate-resilient agriculture (CRA) are probably the best adaptation solutions currently available to improve the resilience of agriculture. The study to access the extent of adoption of CRA technologies by the farmers in the National Innovations in Climate Resilient Agriculture (NICRA) project implemented villages of Suryapet and Khammam districts in Telangana state was conducted during 2021-22. Total 200 farmers from these two districts were selected randomly to evaluate the adoption status of recommended CRA technologies and its association with the respondents' profile characteristics. The respondents had adopted CRA technologies at medium to high levels with the majority of beneficiaries adopting technologies like deep ploughing, *in-situ* moisture conservation technologies in cotton and red gram, crop diversification from paddy to jowar and vegetables as a contingent crop, improved variety of paddy Siddhi WGL-44 and improved backyard poultry breeds. The profile characteristics *viz*., education, annual income, land holding, individual and mass media exposure, economic motivation, risk-taking ability, and innovative proneness had a positive and significant association with the extent of adoption of CRA technologies.

INTRODUCTION

Climate change has become a major concern globally, necessitating immediate attention and action due to the rise in global temperatures, extensive melting of ice, changes in precipitation patterns as well as intensity and frequency of occurrence of uncertain events. Due to the prevalence of unpredictable precipitation patterns, increased temperatures, and a lack of adoption of better methods, climate variance remains a major obstacle to achieving food security (IPCC, 2007; World Bank, 2010). Climate variability's impact on agricultural productivity, particularly in developing countries, has been well-documented (IPCC 2007; Di Falco & Veronesi, 2013; Gunathilaka et al., 2018). The prime concern is not that whether climate change will negatively affect agricultural productivity, but rather how much productivity will be lost as a result of climate uncertainty and how the adoption of relevant climate-resilient practices can help to mitigate the negative effects (Vinaya & Shivamurthy, 2021). The integration of adaptability in national development plans has been recommended by international organizations (IPCC, 2007; World Bank, 2010). Due to the farming sector's vulnerability to climate change, adaptation is considered to be extremely important in developing countries (IPCC, 2007; Tibesigwa et al., 2014). According to Tol (2018), one of the crucial steps in climatic mitigation is adaptation. The farming community in developing countries has used a variety of climate-resilient technologies, such as growing drought-resistant varieties, adopting water and soil conservation measures, changing planting dates and introducing new crop varieties, using crop insurance mechanisms, and irrigation practices, to deal with the detrimental effects of climate change and ensuring sustainable

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yields (Di Falco & Veronesi, 2013; Vinaya et al., 2016; Adamson et al., 2017). The countries like India are more vulnerable as a large proportion of the population relies on agriculture for livelihood security. In recent times, India has prioritized research and development to manage climatic variation generally and agriculture specifically. In February 2011, the Indian Council of Agricultural Research (ICAR) launched the National Initiative on Climate Resilient Agriculture (NICRA), which is now known as National Innovations on Climate Resilient Agriculture during XII Plan (NICRA) in 100 districts across the country later it was expanded to 151 districts. The project's objective is to strengthen Indian agriculture's ability to withstand the effects of climate change through strategic research, technological demonstration, capacity building, and sponsored funding. It is crucial to take action to encourage farmers to adopt climate resilient agricultural (CRA) technologies so they can cope with the adverse impacts of climate change and variability (Pabba et al., 2022). The purpose of the current research was to investigate how widely these recommended practices were adopted in the selected villages of the Suryapet and Khammam districts of Telangana and also for this study it was presumed that few socio-personal variables could have affected the adoption pattern of CRA technologies by the farmers of different locations. Hence the association of these variables was also considered with respect to the adoption of CRA technologies.

METHODOLOGY

The study was conducted in the Suryapet and Khammam districts of Telangana as the NICRA has been implemented in these districts since the beginning of the project. Nandhyalagudem, Kotha Thanda, and Boring Thanda from Suryapet district and Nacharam village from Khammam district were purposively selected for the study considering the number of beneficiary farmers under the NICRA project and 50 farmers from each village were selected by simple random sampling method. Thus a sample of 200 respondents was considered to gather the required data on adoption practices of recommended CRA technologies.

The list of CRA technologies under the NICRA project, adopted by the Krishi Vigyan Kendra, Gaddipally and Krishi Vigyan Kendra Wyra were taken into consideration. These technologies were put into practice under four modules: National Resource Management (NRM), Crop production, Livestock and fisheries, and Institutional interventions. The extent of adoption of CRA technologies under four modules by the each respondent was obtained on a three-point continuum (fully adopted, partially adopted, not adopted with scores 2,1,0). Based on the obtained minimum and maximum scores, the adoption status of the respondents were classified into three groups i.e., low, medium, and high using Cumulative Square Root Frequency (CSRF) method. The ranking of all CRA technologies under each module was given based on the mean scores of the extent of adoption by the respondents. The total score of each technology was obtained by multiplying the frequency under each category (not adopted, partially adopted, fully adopted) with their respective scores (i.e., fi *0+fj *1+fk*2). Further, the mean score for each technology was obtained by dividing the total score by the total sample size (200) and the ranks were given accordingly for the technologies under each module. The information on independent variables like Age, Education, Family size, Annual income, Farming experience, Landholding, Material possession was gathered by direct questioning. For measuring Economic motivation, Risk-taking ability and Innovative proneness the scales developed Supe (2007); Supe (2007) & Singh (1977) were used. In the case of mass media exposure the farmers were asked how often they use various sources of information like TV, radio, newspaper, mobile phones, internet and farm literature and the scores were assigned for regular used-2, sometimes used-1 and never used-0. Apart from Cumulative Square Root Frequency method (CSRF) method, appropriate statistical tools like frequency, percentage and Karl Pearson's product movement correlation coefficient was also used.

RESULTS AND DISCUSSION

Extent of adoption of CRA technologies by the Suryapet farmers

Under Natural Resource Management (NRM) module, the ranks assigned to each technology revealed that deep ploughing was highly adopted (I Rank). The probable reason for such high adoption was because the farmers felt that this practice controlled many perennial weeds, and increased soil water retention characteristics over the long term. The majority of the farmers were found to have adopted *in-situ* moisture conservation technologies in cotton and red gram through dead furrows (II Rank) and real-time contingency crop planning for rainfed red chalka soils (III Rank) probably due to the realization of how immensely useful these technologies are. Some of the results obtained were similar to the findings of Brar et al., (2020). On the other hand, de-silt tank and tank silt application and reclamation of low fertile and saline soils (IV Rank) were adopted mostly by the farmers as they felt the importance of water recharge and importance of leaching by application of gypsum to protect the crops from salination. Whereas ranking order of other technologies includes excavation of check dam (V Rank) followed by water management through drip irrigation in chillies (VI Rank), Renovation of farm ponds and Recharge of wells and bore wells–farm ponds (VII Rank), Edification of farm percolation ponds (VIII Rank). The reason for low adoption of these technologies were probably because of high cost.

Under the crop production module, it was observed that the majority of the farmers fully adopted crop diversification practices from paddy to jowar and vegetable as contingent crop (I Rank) because of the protection from pest and disease incident levels followed by crop rotation (II Rank), cultivation of improved varieties in green gram, redgram and paddy (III Rank), intercropping of cotton and pulses (IV Rank) as the farmers felt these practices helped in reduction of soil-borne diseases and pests and also farmers felt they can sustain from the second crop in uncertain weather conditions. The ranking order of other technologies is as follows sucking pest management in cotton (V Rank), inter-cultivation with Danthi to control weeds and create soil mulch (VI Rank), use of magnesium to the improve the productivity of cotton (VII Rank), soil test based nutrient management in cotton (VIII Rank), crop residue incorporation with rotavator (IX Rank) and use of vermicomposting in vegetables and mulberry (X Rank).

Table 1. Adoption of Climate Resilient Agricultural (CRA) technologies by the farmers of Suryapet district

S.No.	Recommended Interventions	Mean Adoption score	Rank
A	Natural resource management (NRM)		
1	In-situ moisture conservation technologies in Cotton and red gram (dead furrows)	1.94	II
2	Water management through drip irrigation in Chillies	1.00	VI
3	Real-time contingency crop planning for rainfed red chalka soils	1.89	III
4	Reclamation of low fertile and saline soils	1.33	IV
5	Excavation of check dam	1.32	V
6	Renovation of farm ponds	0.67	VII
7	Edification of farm percolation ponds	0.65	VIII
8	Recharge of wells and bore wells–farm ponds	0.67	VII
9	De silt tank and tank silt application	1.33	IV
10	Deep ploughing	2	I
B	Crop Production and Protection		
1	Soil test-based nutrient management in cotton	1.67	VIII
2	Use of vermicompost in vegetables and mulberry	0.99	X
3	Crop diversification from paddy to jowar and vegetable as a contingent crop	2	I
4	Intercropping of cotton and pulses (green gram/ red gram)	1.89	IV
5	Sucking pest management in cotton	1.88	V
6	Use of magnesium to improve the productivity of cotton	1.81	VII
7	Cultivation of improved varieties in green gram, redgram, and paddy	1.92	III
8	Crop rotation	1.98	II
9	Crop residue incorporation with rotavator	1.40	IX
10	Inter cultivation with Danthi to control weeds and create soil mulch	1.87	VI
C	Live Stock and Fisheries		
1	Back yard poultry farming	1.64	I
2	Adoption of recommended fodder varieties (multi-cut fodder APBN-1)	1.08	III
3	Azolla production	0.78	IV
4	De-worming program for sheep and goat	1.25	II
D	Institutional Intervention		
1	Utilization of custom hiring center/VCRMC	1.11	I
2	Creation of village-level seed bank	0.65	III
3	Creation of fodder bank	0.78	II

The reason for the low adoption of vermicompost in vegetables and mulberry was probably because of the high installation cost.

The results of the ranks assigned to each technology under the livestock and fisheries module revealed that the majority of the farmers adopted backyard poultry farming (I Rank) for generating secondary earnings and getting meat for the household. It was followed by a de-worming program for sheep and goats (II Rank), adoption of recommended fodder varieties (III Rank), and Azolla production (IV Rank). The farmers were found to have low adoption of Azolla production due to the presence of high summer temperatures and water scarcity.

Under institutional interventions, it was observed that utilization of a Custom Hiring Centre (CHC) for timely field operations (I Rank) was highly adopted as it saved up to 80 per cent of field costs and enabled timely field operations for the farmers followed by creation of fodder bank (II Rank) and creation of village level seed bank (III Rank). As most of the farmers were not much interested in creation of community level seed banks and fodder banks.

Extent of adoption of CRA technologies by the farmers of Khammam district

The ranking of adopted CRA technologies under each module by the farmers of Khammam district were presented in Table 2. The ranks given to each recommended technology under the NRM module showed that in-situ moisture conservation technologies in Cotton and red gram were highly adopted by the respondents (I Rank) followed by mulching in chilli crop (II Rank) as these technologies were highly beneficial in decreasing the amount of evaporation from the surface of the land, and in reducing the weed control costs. While the ranking order of other technologies includes shade nets in chilli crop (III Rank) followed by recharge of wells and bore wells (IV Rank).

The results of the ranks assigned to each recommended technology under the crop production and protection module revealed that the majority of the farmers highly adopted an improved variety of paddy Siddhi variety WGL-44 due to higher productivity as compared to the other paddy varieties. On the other hand location, specific intercropping of cotton + pigeon pea (6:1) was mostly adopted (II Rank) followed by adoption of short duration wilt resistant variety of pigeon pea (III Rank), crop rotation (IV Rank), drought resistant black gram variety (V Rank), improved varieties of green gram (VI Rank), drought tolerant pigeon pea variety LRG-41 (VII Rank), direct seeded rice (VIII), the introduction of sorghum crop in rice fallow areas (IX Rank) and stem application in cotton (X Rank). The reason for the low adoption of stem application in cotton was probably the highly laborious nature of the pactices. Under the livestock and fisheries module, it was observed that the majority of the farmers were

Table 2. Adoption of Climate Resilient Agricultural (CRA) technologies by the farmers of Khammam district

S.No	Recommended Interventions	Mean Adoption score	Rank
A.	NRM		
1.	In-situ moisture conservation technologies in Cotton and red gram (dead furrows)	1.94	I
2.	Recharge of wells and bore wells–farm ponds	0.20	IV
3.	Shade nets in chilli crops	1.00	III
4.	Mulching in chilli crop	1.38	II
B.	Crop Production and Protection		
1.	Use of Direct Seeded Rice (DSR)	0.80	VIII
2.	Use of improved paddy variety -Siddhi WGL-44	2.00	I
3.	Introduction of Sorghum Crop in Rice fallow areas	0.76	IX
4.	Use of improved green gram varieties (MGG- 295/347 and WGG-42)	1.80	VI
5.	Use of drought tolerant pigeon pea variety LRG-41	1.64	VII
6.	Use of short duration wilt resistant variety of pigeon pea (WRG-65)	1.88	III
7.	Location-specific intercropping cotton+ pigeon pea (6:1)	1.92	II
8.	Use of drought-resistant black gram variety	1.84	V
9.	Stem application in cotton	0.26	X
10.	Crop rotation	1.86	IV
C.	Live Stock and Fisheries		
1.	Use of improved fodder (Hybrid Napier CO-4/CO-3)	1.08	II
2.	Improved backyard poultry breed, (Rajashri, Giriraja chicks)	1.76	I
3.	De-worming program for sheep and goat	0.00	III
D.	Institutional Intervention		
1.	Use of Custom hiring facilities/VCRMC	0.50	I
2.	Creation of Village-level seed bank	0.00	III
3.	Creation of Fodder bank	0.40	II

fully adopted the rearing of improved backyard poultry breed, (Rajashri, Giriraja chicks (I Rank) followed by adoption of improved fodder variety (II Rank). due to additional income earned by the farmers from these technologies. The de-worming program for sheep and goats was least adopted by the farmers (III Rank) as most of the farmers were not rearing them.

Under Institutional interventions**,** it was found that utilization of Custom Hiring Centers for timely field operations (I Rank) was highly adopted as it saved field costs and enabled timely field operations for the farmers followed by creation of fodder bank (II Rank) and village-level seed bank (III Rank) as farmers not shown much interest in formation of community level seed banks and fodder banks.

While considering the overall adoption status of the recommended CRA technologies by the respondents, it was found that (Table 3) in Suryapet and Khammam districts, majority of the beneficiaries (53.33% and 56.00%) had medium adoption level followed by high (36.00% and 34.00%) and low (10.67% and 10.00%) adoption level of the technologies. The probable reason for the medium to higher level of adoption of CRA technologies was attributed to the higher information-seeking behavior, innovativeness, economic motivation, and risk-taking ability of the respondents. The satisfying results produced by the CRA technologies in coping with climate change and an increase in the adaptive capacities, and enhanced incomes highly convinced the respondents to adopt the recommended practices at the best.

Association of profile characteristics of the respondents with the adoption of CRA technologies

An overview of the Table 4 showed that in Suryapet and Khammam district, education, annual income, land holding, individual and mass media exposure, economic motivation, risk-taking ability, and innovative proneness showed positive and significant relation with the overall adoption of CRA technologies at a 5 per cent level of significance. The farmers with high landholding and annual income level were having higher adoption levels of CRA technologies compared to the other farmers due to frequent contacts with extension personals, the ability to invest more capital in agricultural practices, and were eager to explore new technology. In contrast, because of a wide range of limitations,

Table 3. Extent of adoption of CRA technologies

S.No.	Categories	Suryapet NICRA farmers (n_1=150)		Khammam NICRA farmers (n_2=50)	
		Frequency	Percentage	Frequency	Percentage
1	Low (Up to 22)	16	10.67	5	10.00
2	Medium (23 to 38)	80	53.33	28	56.00
3	High (39 and above)	54	36.00	17	34.00
	Total	150	100.00	50	33.33

Table 4. Association of profile characteristics of respondents with the overall adoption of CRA technologies

S.No.	Independent Variable	Correlation (r) Values of Suryapet farmers with Overall adoption of CRA technologies	p-value	Correlation (r) Values of Khammam farmers with Overall adoption of CRA technologies	p-value
1	Age	-0.199	0.779	0.094	0.715
2	Education	0.727*	<0.05	0.796*	<0.05
3	Family size	-0.419	0.525	-0.446	0.553
4	Annual income	0.860*	<0.05	0.868*	<0.05
5	Farming experience	-0.340	0.070	0.067	0.091
6	Landholding	0.924*	<0.05	0.748*	<0.05
7	Material possession	0.107	0.291	0.185	0.284
8	Individual and Mass media exposure	0.391*	<0.05	0.434*	<0.05
9	Economic motivation	0.905*	<0.05	0.889*	<0.05
10	Risk-taking ability	0.506*	<0.05	0.796*	<0.05
11	Innovative proneness	0.730*	<0.05	0.873*	<0.05

Note: *Correlation is significant at the 0.05 level

owners of small and marginal farmland tend to take low risks in trying new agricultural technologies. The results are similar to the findings of Chouksey et al., (2021); Mohokar et al., (2019); Rai et al., (2018) & Harikrishna et al., (2019).

CONCLUSION

The study found that most respondents from the selected area had medium adoption level of the CRA technologies, followed by a higher adoption and low adoption level. Certain technologies in the four modules *viz*., deep ploughing, in-situ moisture conservation technologies in cotton and red gram, crop diversification from paddy to jowar, improved paddy variety Siddhi WGL-44 and improved backyard poultry in livestock were identified to have a greater adoption rate whereas, other technologies *viz*., vermicompost use in mulberry and vegetables, improvement of farm percolation ponds, Azolla production, recharge of wells and bore wells, cotton stem application, seed bank in the village were less adopted by the farmers. The study's conclusions may be taken into consideration when creating an extension plan, which would allow technologies that are now being implemented to medium and low levels to be scaled up to higher levels to reap more benefits.

REFERENCES

Adamson, D., Loch, A., & Schwabe, K. (2017). Adaptation responses to increasing drought frequency. *Australian Journal of Agricultural and Resource Economics*, *61*, 385–403.

Brar, H. S., Sharma, A., & Gill, J. S. (2020). Adaptation strategies being followed by paddy growers towards climate change in Punjab state. *Indian Journal of Extension Education*, *56*(3), 107-110. http://epubs.icar.org.in/ejournal/index.php/ijee/article/view/ 106996

Chouksey, R., Singh, K. C., Singh, C., & Birle, Y. (2021). Adaptation of farmers regarding climate resilient technologies in Rewa block of Rewa District in Madhya Pradesh. *Indian Journal of Extension Education*, *57*(1), 26-31.

Di Falco, S., & Veronesi, M. (2013). How can African agriculture adapt to climate change? A counterfactual analysis from Ethiopia. *Land Economics*, *89*, 743–766.

Gunathilaka, R. P. D., Smart, J. C. R., Fleming, C. M., & Hasan, S. (2018). The impact of climate change on labour demand in the plantation sector: the case of tea production in Sri Lanka. *Australian Journal of Agricultural and Resource Economics*, *62*, 480–500.

Harikrishna, Y. V., Naberia, S., Pradhan, S., & Hansdah, P. (2019). Agro-economic impact of climate resilient practices on farmers in Anantapur district of Andhra Pradesh. *Indian Journal of Extension Education*, *55*(4), 91-95.

IPCC (2007). Climate Change 2007: Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK.

Mohokar, S. D., Gohad, V. V., Ingawale, P. A., & Holkar, V. V. (2019). Impact of national innovations on climate resilient agriculture (NICRA) project on beneficiaries. *Agriculture Update*, *14*(3), 220-223. https://www.cabdirect.org/cabdirect/abstract/ 20193521498

Pabba, A. S., Naik, V. R., & Rani, V. S., (2022). Adoption of climate resilient agricultural technologies by farmers in Nalgonda district of Telangana state. *Indian Journal of Extension Education*, *58*, 30-34.

Rai, R. K., Bhatta, L. D., Acharya, U., & Bhatta, A. P. (2018). Assessing climate-resilient agriculture for smallholders. *Environmental Development*, *27*, 26-33.

Singh, A. K. (1977). Training needs of farmers. *Rural India*, *40*(4), 78-79.

Supe, S. V. (2007). Measurement techniques in social sciences. Agrotech Publishing Academy, Udaipur.

Tibesigwa, B., Visser, M., & Turpie, J. (2014). The impact of climate change on net revenue and food adequacy of subsistence farming households in South Africa. *Environment and Development Economics*, *20*, 327–353.

Tol, R. S. J. (2018). The economic impacts of climate change. *Review of Environmental Economics and Policy*, *12*, 4–25.

Vinaya Kumar, H. M., & Shivamurthy, M. (2021) Factor influencing fishery-based farmers' perception and their response to climate-induced crisis management. *Environmental Development and Sustainability*, *23*, 11766–11791. https://doi.org/10.1007/s10668-020-01141-x

Vinaya Kumar, H. M., Shivamurthy, M., Biradar, G. S., & Govinda Gowda, V. (2016). Fishery based farmers' perception of climate change in coastal Karnataka (India). *International Journal of Agriculture Sciences*, *8*(53), 2646-2650.

World Bank (2010). The costs to developing countries of adapting to climate change: New methods and estimates. http://www.worldbank.org/eacc