Constraints perceived by the farmers regarding opportunity and challenges of climate smart agriculture in Central Plain Zone of Uttar Pradesh, India

Abstract

This research article discussed about the constraints faced by farmers in the adoption of climate smart agriculture in the Central Plain Zone of Uttar Pradesh. Climate Smart Agriculture (CSA) is basically a management strategy for agriculture in the face of climate change. Farmers face obstacles to adopting diverse Climate Smart Agriculture practices. Farmers face many barriers when it comes to adopting new or unfamiliar practices, such as Climate Smart Agriculture. These include lack of awareness, high cost of machines and input, and insufficient knowledge and guidance. Garrett's ranking technique is used to determine the most important factor influencing the response. The major constraints faced by the farmers in their knowledge and adoption of Climate Smart Agriculture were ‘lack of awareness', 'uncertain returns', 'limited extension activities’ common problems in the study area having the Garrett rank of first (Average Value 114.95), second (Average Value 113.26) and third (Average Value 101.22) respectively, and so forth the other constraints too. The study sought to identify the barriers to Climate Smart Agriculture adoption as well as potential solutions.

Keywords: Constraints, adoption, Climate Smart Agriculture, Garret ranking.

1. INTRODUCTION

“Climate-Smart Agricultural (CSA) practices are essential for handling the climatic shocks that farmers encounter worldwide, not only in India. However, there is still little information available on the socio-psychological factors that influence farmers' adoption of CSA techniques. Climate-smart agriculture refers to practices that increase productivity and income, build farm resilience and mitigate climate change by reducing greenhouse gas emissions” (FAO, 2013). Climate-smart agriculture is not a single technology or practice that can be applied worldwide. It is an approach that helps guide activities to change agri-food systems towards the green, ecological and climate resilient practices. Climate-smart agriculture deals with functions in agriculture fields, pasture lands, forest areas, oceans and freshwater ecosystems. This includes the evaluation and application of technologies and practices, the creation of a supportive policy and the formulation of investment strategies in the agriculture.

“The goal of climate-smart agriculture is to accomplish the following three pillars: (1) sustainably increase crop production and incomes; (2) improve farmers' adaptive capacity and create resilience; and (3) reduce the emission of greenhouse gases (GHGs)” (FAO, 2010 and Lipper *et al.,* 2014). Understanding the heterogeneous effects of climate change on productivity is one of the key challenges in designing agricultural policies. Another important category of behavioural choices is decisions about technology adoption, which includes irrigation, seed varieties, and production practices. Farmers' access to weather forecasts and longer-term climate predictions will also affect their ability to respond to climate change. Therefore, CSA provides a technique to explicitly include the effects of climate change in the constraints of this dynamic optimization issue. Expansion and promotion of ex post coping methods or ex ante risk management measures can reduce household vulnerability and enhance system resilience. This research article is an attempt to identify the constraints and display them in accordance with the goals and concerns that have been assigned to it. As such, Garrett's Ranking Technique is used to identify constraints facing farmers in the adoption of climate smart agriculture in the Central Plain Zone of Uttar Pradesh. Garrett's ranking technique was used to rank the preference indicated by the respondents on different factors. As per this method, respondents have been asked to assign the rank for all factors and the outcomes of such ranking have been converted into score value.

METHODOLOGY

The present study was conducted at the Chandra Shekhar Azad University of Agriculture and Technology in the district of Kanpur, Uttar Pradesh. Central plain Zone of U.P. selected purposely for the study because it is among the larger and favourable land for the agriculture. Prayagraj and Kanpur Nagar district of Central Plain Zone was selected for this study because of its convenient accessibility and good number of farmers adopting climate smart agriculture. Three blocks from each district selected randomly, so six blocks from two districts were selected for the study. For selecting the villages, a list of all the villages in the each block was prepared, and two villages from each block were selected randomly. Thus a total twelve villages selected for the study. Twenty farmers from each village and a total 240 farmers were selected as sample a size for the study. "The simple random sampling technique was used to select 240 farmers. A semi-structured interview schedule was used to collect primary data from the farmers. In this study, information was collected about the constraints faced by the farmers in the adoption of climate smart agriculture. Farmers were asked to list the difficulties they confront according to their own experiences. Garrett's Ranking Technique was used to convert preferences, changes in constraint ordering, and benefits into numerical scores". [16]

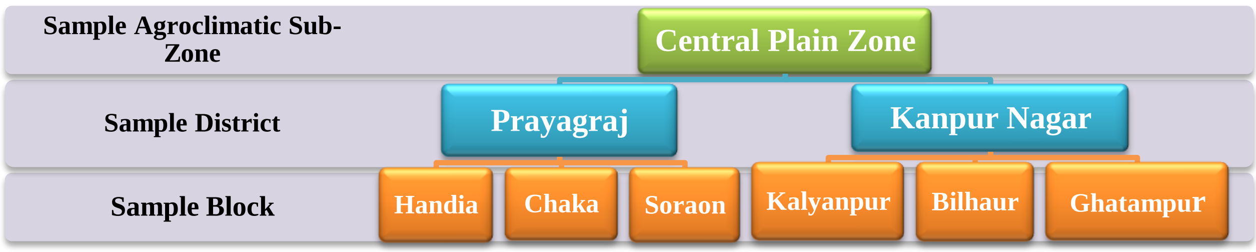

Figure 1. Sampling procedure of selection of districts and Blocks

1. RESULTS AND DISCUSSION

1.1 Constraints in the adoption of climate smart agriculture

A farmer faces so many problems when adopting climate smart agricultural practices. More than one problem has been shown by the farmers. So they ranked the problems according to their severity. Table 1 shows the various problems in the adoption of climate smart agriculture and the rank given by the farmers to each problem. This data was recorded by the field survey.

Table 1: Constraints in the adoption of climate smart agriculture

S.No.	Constraints in the adoption of Climate-Smart Agricultural	Rank given by the respondents									
		I	II	III	IV	V	VI	VII	VIII	IX	X
1.	Uncertain returns and the result of technology	48	35	22	19	27	17	31	14	16	11
2.	Lack of awareness about Climate Smart Agricultural technologies	37	36	31	35	17	37	21	8	8	10
3.	Small size of land holding	21	22	18	22	35	32	11	24	22	33
4.	Non-availability of laser land levelling (LLL) machines.	29	24	25	18	21	24	19	22	35	23
5.	Lack of institutional support	23	21	21	23	21	25	33	22	34	17
6.	High Cost of machine/input	18	21	30	39	21	21	23	25	18	24
7.	Limited extension activities about Climate Resilient agricultural technologies	17	23	27	31	30	22	31	16	30	13
8.	Insufficient knowledge and guidance about the Climate smart	24	26	17	23	25	17	19	32	28	29

	agricultural Technologies										
9.	Unavailability of labour for adoption of Climate Smart Agricultural practices.	11	19	25	17	22	25	25	36	21	39
10.	Lack of advanced and Inadequate training of smart practices.	12	13	24	13	21	20	27	41	28	41

1.2 The Percent Positions and Garret Values

The Garret ranks had been calculated through the usage of suitable Garret Ranking formula. The based on the Garret ranks, the garret value was calculated through Garret Ranking Table.

$$\text{Percent position} = \frac{100\,(\mathrm{R}ij - 0.5)}{\mathrm{Nj}}$$

Where,

Rij = Rank given for the i^{th} variable by j^{th} respondents

Nj = Number of variable

Table 2: Percent positions and Garret Values

S. No.	100(Rij-0.5)/ Nj	Calculated Value	Garret Value
1.	100(1-0.5)/10	5	82
2.	100(2-0.5)/10	15	70
3.	100(3-0.5)/10	25	63
4.	100(4-0.5)/10	35	58
5.	100(5-0.5)/10	45	52
6.	100(6-0.5)/10	55	48
7.	100(7-0.5)/10	65	42
8.	100(8-0.5)/10	75	37
9.	100(9-0.5)/10	85	30
10.	100(10-0.5)/10	95	18

1.3 Calculation of Garret Value and Ranking

The Garret tables and scores of each problem in Table 1 were multiplied by the Garret value to record scores for each rank and constraint in Table 3, and finally, by adding each row, the total Garret score was obtained. Total Garret scores were divided by the number of respondents, i.e., 240, to calculate the average, and the ranking was given on the basis of the average value. The Garret value calculation and ranking of problems encountered by farmers when adopting climate smart agriculture are shown below.

Table 3: The calculation

Constraints in the adoption of climate smart agriculture	Rank given by the respondents										Total	Average	Rank
	I	II	III	IV	V	VI	VII	VIII	IX	X			
Uncertain returns and the result of technology	3936	2450	1386	1102	1404	816	1302	518	480	198	13592	113.26	II
Lack of awareness about Climate Smart Agricultural technologies	3034	2520	1953	2030	884	1776	882	296	240	180	13795	114.95	I
Small size of land holding	1722	1540	1134	1276	1820	1536	462	888	660	594	11632	96.93	VIII
Non-availability of laser land levelling (LLL) machines.	2378	1680	1575	1044	1092	1152	798	814	1050	414	11997	99.97	V
Lack of institutional support	1886	1470	1323	1334	1092	1200	1386	814	1020	306	11831	98.59	VI
High Cost of machine/input	1476	1470	1890	2262	1092	1008	966	925	540	432	12061	100.50	IV
Limited extension activities about Climate Smart Agricultural technologies	1394	1610	1701	1798	1560	1056	1302	592	900	234	12147	101.22	III
Insufficient technical knowledge and guidance about the Climate Smart Agricultural Technologies.	1968	1820	1071	1334	1300	816	798	1184	840	522	11653	97.10	VII
Unavailability of labour for adoption of Climate Smart Agricultural practices.	902	1330	1575	986	1144	1200	1050	1332	630	702	10851	90.42	IX
Lack of advanced and Inadequate training of smart practices.	984	910	1512	754	1092	960	1134	1517	840	738	10441	87.00	X

It was observed from Table 3 that, based on Garret's Ranking Technique, 'Lack of awareness about Climate Smart Agricultural technologies' poses the main challenge to adopting Climate Smart Agricultural practices as perceived by the farmers in the study area. Lack of awareness creates the main problem in adoption because it is the main element in adoption. This constraint had a maximum Garrett score of 13795 and also ranked first (average 114.95) among the problems. This was followed by the constraint 'Uncertain returns and the result of technology', which ranked second with a Garrett score of 13592 and an average of 113.26. It was in agreement with the result of *Panda (2017),* who noted that uncertain results and returns expressed as constraints by 80.00 per cent of farmers would have caused huge losses during crop harvests due to low prices. The 'Limited extension activities about climate smart agricultural technologies' were the third most common problem in the adoption of climate smart agriculture, with a Garret score of 12147 and an average of 101.22. Similar results were also reported by *Singh et al. (2019),* who noted that restricted access to agricultural extension services was one of the biggest obstacles to adaptation across regions. The outcomes of the study were in line with *Autio et al. (2021),* who reported that the extension services provided by the country were considered inadequate and recognized as a main challenge in climate smart agriculture. The result was also consistent with the findings of *Jasna et al. (2016)* on constraints in the adoption of Climate technologies in rain-fed agro-ecosystems. Accordingly, 'High Cost of machine/input' with Garrett scores of 12061 and an average of 100.50 represented the fourth rank. It was also in line with *Manjunath (2018),* who reported the high cost of inputs as a head-reach constraint. The 'Non-availability of laser land levelling (LLL) machines' had Garret scores of 11997, and an average of 99.97 represented the fifth rank. Similar findings were also reported by *Sapkal (2018),* who suggested that to minimize risk and become climate resilient, farmers should adopt lazer land laser land levelling (LLL) machines in paddy fields throughout the whole farm. The calculation with Garrett scores of 11831 and an average of 98.59 ranked the 'Lack of institutional support' sixth. The finding supported *Chakraborty and Chakravarty (2017),* who reported issues surrounding the enabling institutional framework. 'Insufficient technical knowledge and guidance about the Climate smart agricultural technologies' had a Garrett score of 11653 and an average score of 97.10, representing seventh rank. Similar findings *Warner et al. (2022)* also identified knowledge and awareness of climate information services (CIS) as important factors for agricultural decision-making. It was also in line with *Manjunath (2018).* 'Small size of land holding' had a Garrett score of 11632 and an average of 96.93, representing the eighth rank. Small land holdings were also reported as major constraints by *Singh et al. (2007)*. and *Meena et al. (2009).* Accordingly, 'Unavailability of labour for adoption of Climate Smart Agricultural practices' represented the ninth rank with Garrett's score of 10851 and an average of 90.42. Similar results were also reported by *Kandpal (2022),* who noted that the shortage of labour was one of the constraints faced by mushroom cultivators. The outcomes of the study were in line with *Kumar et al. (2005),* who reported that a high rate of labour wages was the major constraint to the adoption of quality seed. 'Lack of advanced and inadequate training of smart practices' was ranked tenth, with a Garrett score of 10441 and an average score of 87.00. It was in agreement with the result of *Panda (2017),* who found a lack of advanced training promoting constraints in climate smart agricultural technologies in rice pulse cropping systems by extension workers.

2. CONCLUSION

The Central Plain Zone of Uttar Pradesh presents both opportunities and challenges for the adoption of climate-smart agriculture practices. Farmers in this region perceive a range of constraints that affect their ability to harness the full potential of climate-smart agriculture. One of the key challenges faced by farmers is the lack of awareness and knowledge about climate-smart agricultural practices. This points to the need for targeted extension services and capacity-building programs to educate farmers about the benefits and techniques of climate-smart agriculture. Additionally, the availability of suitable and affordable technologies and inputs remains a pressing issue. Furthermore, changing weather patterns and increasing climate variability pose significant challenges to farmers. Adapting to these changes requires a combination of resilient crop varieties, effective water management, and climate information services. Despite these constraints, the Central Plain Zone of Uttar Pradesh offers opportunities for climate-smart agriculture due to its vast agricultural potential. The region can benefit from increased productivity, reduced environmental impacts, and enhanced resilience to climate change through the adoption of sustainable practices. In conclusion, addressing the perceived constraints of farmers in the Central Plain Zone of Uttar Pradesh regarding climate-smart agriculture necessitates a multi-pronged approach that involves government support, access to credit, education, and technology dissemination. By overcoming these challenges, farmers in the region can unlock the full potential of climate-smart agriculture and contribute to food security and environmental sustainability in the face of a changing climate.

REFERENCES

1. **Autio, A., Johansson, T., Motaroki, L., Minoia, P., and Pellikka, P. (2021).** Constraints for Adopting Climate-Smart Agricultural Practices among Smallholder Farmers in Southeast Kenya. *Agricultural Systems*, **194**.
2. **Chakraborty, M. and Chakravarty, D. (2017).** Awareness about climate change adaptation through mobile applications. *MOJ Ecology & Environmental Science,* **2**(7):290–293.
3. **FAO (2010).** Climate-Smart Agriculture: Policies, Practices and Financing for Food Security, Adaptation and Mitigation. Rome, FAO**.**
4. **FAO (2013).** Climate-smart Agriculture: Sourcebook. FAO, Rome, Italy**.**
5. **Jasna V. K., Burman, R. R., Padaria, R. N., Sharma, J. P., Varghese, E., Chakrabarty, B., Loganandhan, N. and Kumar, S. (2016).** Constraints in adoption of Climate Resilient Technologies in rain fed agro-ecosystem. *Indian Journal of Extension Education* **52** (3 & 4) : 30-34.
6. **Kandpal, A. S. (2022).** Adoption Level and Constraints Faced by Mushroom Cultivators in Uttarakhand. *Indian Research Journal of Extension Education,* **22** (3): 110-114.
7. **Kumar, A., Sharma, A.K. and Chauhan, J. (2005)**. Constraints in adoption of quality seeds. *Indian Research Journal of Extension Education*. **5** (1): 69-71.
8. **L. Lipper et al. (eds.), Climate Smart Agriculture, Natural Resource Management and Policy 52, DOI 10.1007/978-3-319-61194-5_2**
9. **Manjunath, K. V. (2018).** Knowledge and adoption of climate resilient technologies among paddy growers in Mandya district. *Unpublished Master's Thesis, University of Agricultural Sciences GKVK, Bengaluru.*
10. **Meena, M.S., Prasad, M. and Singh, R. (2009).** Constraints perceived by rural agro-processors in adopting modern post-harvest technologies. *Indian Research Journal of Extension Education,* **9** (1): 1-5.
11. **Panda, A. (2017).** Awareness and constraints in adoption of climate smart agricultural technologies among rice-pulse growing farmers in Puri district of odisha. *Unpublished Master's Thesis, University of Agricultural Sciences GKVK, Bengaluru.*
12. **Sapkal, S. B. (2018).** Impact of identified climate smart agriculture technologies for adaptation, resilience and profitability in the Indo-Gangetic plains of Haryana and Bihar. *Unpublished Ph.D. Thesis, ICAR-Indian Agricultural Research Institute.*
13. **Singh, D.K., Gautam, U.S. and Pandey, S.N. (2007).** Constraints analysis of technological awareness of the farmers. *Indian Research Journal of Extension Education,* 7(1):60-62.

14. **Singh, N. P., Anand, B. and Khan, M. A. (2019).** Assessment of household perceptions to climate adaptation for resilient rural development planning in India. *Indian Journal of Traditional Knowledge,* **18**(2):376-382.
15. **Warner, D., Moonsammy , S. and Joseph, J. (2022).** Factors that influence the use of climate information services for agriculture: A systematic review. *Climate Services,* **28**: 100336.
16. Rohit PS, Singh HC, Asha K. Constraints Faced by the Farmers in the Adoption of Crop Rotation in Ayodhya District. Age.;25:39.