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Assessing and identifying the factors influencing utilization of CSA technologies among farmers of agro-climatic zones of Tamil Nadu

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Abstract

Climate change acts as a major threat to agriculture by causing severe drought, change in rainfall pattern, increase in temperature and much more which lead to drastic reduction in yield. To ensure food security for the growing Indian population and to increase income for the farmers, a farmer has to tackle the climate changes by utilizing climate smart agricultural technologies rather than adopting for instance and discontinuing it later. Hence, this study aims to assess the objective of adoption of CSA technologies, extent of utilization of CSA technologies and the factors influencing utilization of CSA technologies among the adopters of CSA technologies. From each agro-climatic zone, thirty progressive farmers were selected for the study and their utilization behaviour is assessed against the documented CSA technologies. The findings of the study revealed that, farmers adopt CSA technologies to mitigate climate change rather than improving productivity and resilience of the ecosystem. Further, Villupuram, Namakkal, Tiruvarur and Ramanathapuram farmers had medium level of utilization behaviour; Coimbatore and Kanyakumari farmers had high level of utilization behavior and Nilgiris farmer's exhibit low level of utilization behavior towards CSA technologies. Eventually, it is recommended that financial status, situational factors, and technical knowledge of farmers determines the extent of utilization of CSA practices despite of the importance of the technology. Hence, these factors should be critically examined before promoting CSA technologies and formulating policies.

Keywords: CSA technologies, climate smart agriculture, agro-climatic zones, Tamil Nadu, utilization behaviour, factors influencing

Introduction

Being the backbone of India, agriculture sector provides employment to nearly three-fifth of the Indian population (Manida and Nedumaran, 2020) [4]. Apart from ensuring food and nutritional security and providing employment opportunities, agriculture sector provides raw materials for the industrial sector for further means of production and plays a vital role in indirect means of socio-economic development of the Nation. As farmers largely depends on healthy soil (Roseel and Bouma, 2016) [8], good quality irrigation water (Perry *et al.*, 2009) [6], favorable weather conditions (Grotjahn, 2021) [3], quality seed (Gough, 2020) [2] and improved agricultural implements (Mehta *et al.*, 2014) [5] to carry out agricultural activities in an effective way, changes in weather conditions causes variations in climate which leads to negative consequences such as increased rainy days, increased rainfall intensity, prolonged and severe drought, increased flood and so on. Though agriculture is a significant contributor to climate change, it is greatly affected by its effects and results in reduced crop yield.

FAO (2016) [1] pointed out that, if the various sources contributing to climate change continues, by 2100 there will be a decline in production of maize yield (20-45%), wheat yield (5-50%) and rice yield (20-30%). This would result in reduced agricultural production, increased food prices and threaten accessibility and availability of food for the growing population. In order to overcome the consequences of climate change and to ensure food security for the growing population, the farmers can adopt Climate Smart Agricultural (CSA) technologies. World Bank (2023) defined CSA as, 'set of agricultural practices and technologies built on existing agricultural knowledge, technologies and sustainability principles which boost productivity, enhance resilience and reduce GHG emissions'. In this context, adaptation refers to adjustment to consequences of climate change; mitigation refers to interventions that reduce sources of climate change and

resilience refers to the ability of the system to cope with the consequences of climate change and bounce like prior system. Adaptation and mitigation strategies provides short term solutions; whereas, resilience works for long term goals.

Statement of the problem

Since adoption of a technology depends on the technology, resource availability among farmers and existing Government policy; the extension agents act as a linkage between the research and farmer to create awareness and to disseminate technology among farmers; thereby, increasing the knowledge level of the farmers, rate of adoption of the technology and improving the productivity of crops. But information gap between the extension agents and the farmers hinders the success of the sector by delaying the dissemination of information as the farmers could lose best opportunities to adopt the practices that can significantly increase the productivity and income (Kumar and Ansari, 2023) [7]. Though farmers adopt technology as a result of increased knowledge due to several trainings and demonstrations, the extent of utilization of the technologies depends on the financial, situational and technical factors associated with the technology. Hence, this study aims to assess the objective of adoption of CSA technologies, extent of utilization behavior of CSA technologies and the factors influencing the utilization behavior of CSA technologies among farmers in Agro-Climatic Zones of Tamil Nadu.

Methodology

The present study was carried out in seven agro-climatic zones of Tamil Nadu. From each agro-climatic zone, the vulnerable district or the district which has implemented NICRA project was selected for the study. In this regard, Villupuram district of North Eastern Zone, Namakkal district of North Western Zone, Coimbatore district of Western Zone, Tiruvarur district of Cauvery Delta Zone, Ramanathapuram district of Southern Zone, Kanyakumari district of High Rainfall Zone and the Nilgiris district of the Hilly Zone were selected for the study. The CSA technologies adopted by the farmers of each agro-climatic zone were documented by employing Focus Group Discussion & CSA rural appraisal techniques (Sree Madhumitha, 2024) [9]. Later, from each agro-climatic zone, 30 representative farmers accounts for 210 farmers from seven agro-climatic zones were selected for the study and their utilization behaviour towards the documented CSA technologies was assessed against three point continuum, ranging from 'Discontinued' (1), 'Adopted with modifications' (2) and 'Continued adoption' (3). The gathered responses were subjected to cumulative frequency and the findings were presented in graphical form for better understanding. Further, Pearson correlation coefficient and multiple regression analysis was assessed to identify the factors influencing the utilization behavior of farmers towards CSA technologies.

Findings and Discussion

The objective of adoption of CSA technologies among farmers of Agro-Climatic Zones of Tamil Nadu can be understood from table 1 and figure 1.

Table 1: Distribution of farmers in Agro-Climatic Zones of Tamil Nadu based on their objective of adoption of CSA technologies, (n=210)

S. No.	Name of the Agro-Climatic Zone	Name of the District	Objective of adoption of CSA technologies		
			To improve productivity	To improve resilience	To mitigate climate change
1.	North Eastern Zone	Villupuram	7 (23.33)	10 (33.33)	13 (43.34)
2.	North Western Zone	Namakkal	9 (30.00)	9 (30.00)	12 (40.00)
3.	Western Zone	Coimbatore	12(40.00)	4 (13.33)	14 (46.67)
4.	Cauvery Delta Zone	Tiruvarur	5(16.67)	9 (30.00)	16 (53.33)
5.	Southern Zone	Ramanathapuram	6 (20.00)	17 (56.67)	7 (23.33)
6.	High Rainfall Zone	Kanyakumari	15 (50.00)	10 (33.33)	5 (16.67)
7.	The Hilly Zone	Nilgiris	12 (40.00)	6 (20.00)	12 (40.00)

From table 1, the objective of adoption of CSA technologies among farmers in agro-climatic zones of Tamil Nadu can be understood. More than two-fifth of the Villupuram farmers (4.34%), exactly two-fifth of the Namakkal farmers (40.00%), nearly half of the Coimbatore farmers (46.67%) and more than half of the Tiruvarur farmers (53.33%) adopt CSA technologies to mitigate climate change. Meanwhile, more than half of the Ramanathapuram farmers adopt CSA technologies to improve resilience (56.67%) and exactly half of the Kanyakumari farmers adopt CSA technologies to improve productivity (50.00%). Eventually, an equal percentage of the Nilgiris farmers adopt CSA technologies to improve productivity (40.00%) and to mitigate climate change (40.00%).

The above findings emphasize that farmers are aware of climatic change consequences and adapt strategies to mitigate climate change. But, lack of understanding about their ability in use of CSA practices to mitigate climate change, hesitates the adoption of CSA practices.

As Villupuram and Namakkal farmers experiences higher temperature, severe drought and lack of irrigation water, they adopt heat tolerant and drought tolerant varieties to mitigate climate change. Whereas, Coimbatore and Nilgiris farmers experiences increased rainfall intensity and increased pest and disease attack, they adopt water logging resistant and pest and disease resistant varieties to mitigate climate change and improve productivity.

Meanwhile, Tiruvarur farmers experiences severe flooding due to increased rainy days and increased rainfall intensity; hence, they adopt water logging resistant varieties and farm diversification to mitigate climate change. Whereas, Ramanathapuram farmers experiences higher temperature and they adopt precision based nutrient management and efficient irrigation methods to improve resilience of their ecosystem. As Kanyakumari farmers lacks irrigation water at the critical stages of crop growth due to unpredictable rainfall, they adopt improved crop varieties that requires less water, drought resistant varieties.

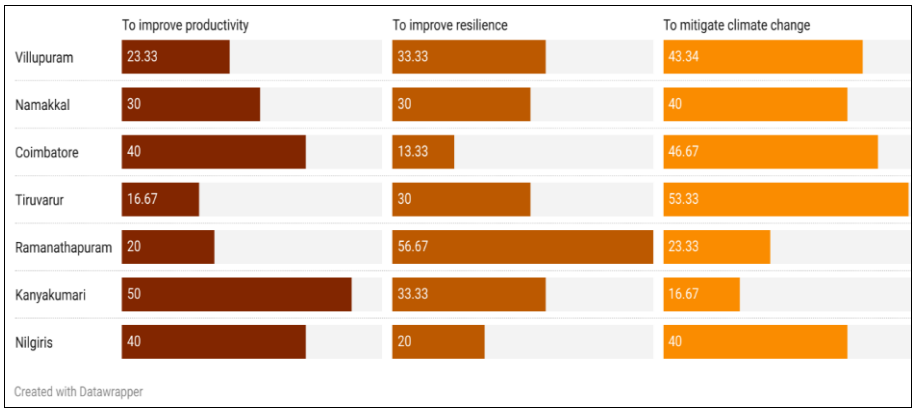

Fig 1: Distribution of farmers based on their objective of adoption of CSA technologies among farmers in Agro-Climatic Zones of Tamil Nadu

The extent of utilization behaviour of CSA technologies among farmers of Agro-Climatic Zones of Tamil Nadu is presented in table 2 and figure 2.

Table 2: Distribution of farmers in Agro-Climatic Zones of Tamil Nadu based on their extent of utilization behaviour of CSA technologies

S. No.	Name of the Agro-Climatic Zone	Name of the District	Extent of Utilization behaviour of CSA technologies		
			Low	Medium	High
1.	North Eastern Zone	Villupuram	8 (26.67)	12 (40.00)	10 (33.33)
2.	North Western Zone	Namakkal	4 (13.33)	23 (76.67)	3 (10.00)
3.	Western Zone	Coimbatore	6 (20.00)	10 (33.33)	14 (46.67)
4.	Cauvery Delta Zone	Tiruvarur	5 (16.67)	21 (70.00)	4 (13.33)
5.	Southern Zone	Ramanathapuram	6 (20.00)	17 (56.67)	7 (23.33)
6.	High Rainfall Zone	Kanyakumari	5 (16.67)	12 (40.00)	13 (43.33)
7.	The Hilly Zone	Nilgiris	15 (50.00)	7 (23.33)	8 (26.67)

Table 2, indicates that exactly two-fifth of the Villupuram farmers (40.00%), more than three-fourth of the Namakkal farmers (76.67%), more than two-third of the Tiruvarur farmers (70.00%), nearly two-fifth of the Ramanathapuram farmers (56.67%) had medium level of utilization behavior towards CSA technologies. Simultaneously, nearly half of the Coimbatore farmers (46.67%) and more than two-fifth of the Kanyakumari farmers (43.33%) had high level of utilization behaviour of CSA technologies. Whereas, exactly half of the Nilgiris farmers (50.00%) had low level of utilization behavior of CSA technologies.

Though the farmers understand the importance of utilizing CSA interventions, their financial status, situational factors, and technical knowledge determines the extent of utilization of CSA practices. Villupuram, Namakkal, Tiruvarur and Ramanathapuram farmers had medium level of utilization behaviour because of the efforts of KVK in the respective districts and their financial status determine the continued adoption of the technologies promoted by the respective KVKs. Whereas, Coimbatore and Kanyakumari farmers had high level of utilization behavior as they continued adoption of CSA technologies based on their own interest despite of assistance from extension agents. But, Nilgiris farmers exhibit low level of utilization since the benefits of adoption of CSA technologies are perceived late.

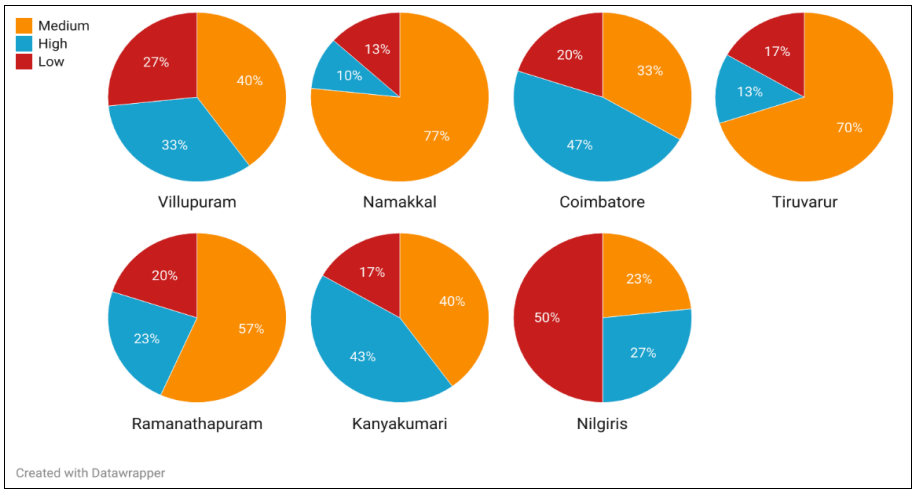

Fig 2: Distribution of farmers based on their extent of utilization behaviour of CSA technologies among farmers in Agro-Climatic Zones of Tamil Nadu

The relationship between farmer's profile such as age, gender, educational qualification, occupation, land holding, family type, family size, farming experience, annual income, social participation, information seeking behavior, extension participation, achievement motivation, risk orientation, scientific motivation and economic motivation with their utilization behavior is assessed and presented in table 3.

Table 3: Association between farmer's profile with their utilization behaviour on CSA technologies

S. No.	Variables	Satisfaction level of fish farmers	
		'r' value	t_{cal}
X_1	Age	-0.120	0.082
X_2	Gender	0.031	0.653
X_3	Education	0.053	0.445
X_4	Occupation	0.072	0.301
X_5	Landholding	-0.027	0.693
X_6	Family type	0.179**	0.009
X_7	Family size	0.171*	0.013
X_8	Farming experience	-0.068	0.329
X_9	Annual income	-0.121	0.079
X_{10}	Social participation	0.162*	0.019
X_{11}	Information seeking Behaviour	-0.061	0.379
X_{12}	Extension participation	-0.033	0.632
X_{13}	Achievement motivation	0.140*	0.042
X_{14}	Trainings attended	0.282**	0.000
X_{15}	Risk orientation	-0.134	0.052
X_{16}	Scientific orientation	0.181**	0.009
X_{17}	Economic motivation	-0.103	0.137

(*- Significant at 5%
**- Significant at 1%)

From table 3, it is found that variables such as family type, training attended and scientific orientation of the farmers had positive and significant association at 1% level of significance, whereas, family size, social participation and achievement motivation of the farmer had positive and significant association with their utilization behaviour at 5% level of significance. Meanwhile, the variables such as age, gender, education, occupation, land holding, farming experience, annual income, information seeking behaviour, extension participation, risk orientation and economic motivation had no significant association with the utilization behaviour of the farmers.

The above findings emphasize that farmer's willingness to achieve to enhance their social status, increased expertise due to the trainings attended and scientific orientation, increased participate in social organizations increase their exposure to CSA technologies and imparts its importance. Further, the number of members in farmer's family and the type of family influences the farmer's decision to continue or discontinue the utilization of any technology as it determines the situational and financial factors of the farmers. These findings again stresses the importance of inclusion of financial, situational and technical factors of the technology in improving the utilization behaviour of the farmers.

In the meantime, the extent of influence of farmer's profile towards the utilization behaviour of farmers on CSA technologies is assessed and presented in table 4.

Table 4: Extent of influence of farmer's profile towards the utilization behaviour of farmers on CSA technologies

S. No.	Variables	Regression co-efficient	Standard error	t-value
X_1	Age	-0.076	0.094	0.453
X_2	Gender	0.015	0.168	0.850
X_3	Education	0.088	0.029	0.006**
X_4	Occupation	0.075	0.054	0.358
X_5	Landholding	0.033	0.074	0.694
X_6	Family type	0.151	0.180	0.020*
X_7	Family size	0.078	0.132	0.545
X_8	Farming experience	0.073	0.094	0.486
X_9	Annual income	0.061	0.000	0.000**
X_{10}	Social participation	0.089	0.055	0.035*
X_{11}	Information seeking Behaviour	-0.050	0.079	0.506
X_{12}	Extension participation	0.023	0.082	0.751
X_{13}	Achievement motivation	-0.117	0.089	0.173
X_{14}	Trainings attended	0.214	0.023	0.023*
X_{15}	Risk orientation	0.051	0.102	0.556
X_{16}	Scientific orientation	0.079	0.091	0.037*
X_{17}	Economic motivation	0.027	0.086	0.001**

R^2= 0.406; F= 2.234
(*- Significant at 5% **- Significant at 1%)

Table 4 portrays that R^2 was 0.406, which reveals that 40.60% of the profile contributes towards the utilization behaviour of farmers on CSA technologies. While, F value was found to be 2.234, which is higher than table value and implies the significant influence of the profile over the utilization behaviour of the farmers. Further, it is observed that variables such as education, annual income and economic motivation of the farmers had significant influence over their utilization behaviour at 1% level of significance. While the variables such as family type, social participation, trainings attended and scientific orientation of the farmers had significant influence over their utilization behaviour at 5% level of significance. The other variables such as age, gender, occupation, land holding, family size, farming experience, information seeking behaviour, extension participation, achievement motivation and risk orientation had no significant influence over their utilization behaviour.

Based on the findings, it is found that education level and scientific orientation of the farmers helps to improve their technical expertise towards the technology; which in turn emphasize the importance of the technology and improves the utilization behaviour of the farmers. Further, farmers thought to earn more economic returns enables them to participate in more trainings and social organizations. As a result, it increases the farmer's exposure to CSA technologies and emphasizes the importance of CSA technologies and improve the utilization behavior of farmers. Though several factors influence the utilization of CSA technologies, annual income of the farmers highly influence their decision to continue or discontinue the utilization of the technology. Thus, it could be understood that education, scientific orientation, annual income, family type, trainings attended and social participation of the farmers influence their utilization behaviour.

Conclusion

As climatic variations reduces the agricultural productivity and threatens food security of the global population, a farmer has to tackle climatic changes by utilizing CSA technologies. Rather than adopting and discounting the technologies, the farmers should utilize CSA technologies to a higher extent, so that it reduces source of climate change. The findings of the study revealed that farmers are aware of climatic change and adopt CSA technologies to mitigate climate change. In addition, the extent of utilization behavior of CSA technologies among farmers is determined by their financial status, situational factors and technical knowledge despite of their understanding towards the importance of utilizing CSA interventions. Hence, these three factors should be considered while formulating or promoting any CSA technologies.

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