Awareness on Climate Resilient Technologies and their Adoption by Farmers of Palakkad and Wayanad District of Kerala State

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ABSTRACT

Increasing incidences of climate change have negative consequences on agricultural production, especially in a state like Kerala which has shown consistent downward trends in area and production. The study analyzed the awareness of farmers on different climate resilient practices and their adoption. Study was conducted in Palakkad and Wayanad districts of Kerala with a sample of 100 farmers. It was found that 92.12 per cent of farmers had awareness on soil and water conservation measures followed by 80.22 per cent with awareness on agronomic practices and 7.27 per cent on institutional measures. Adoption of resilient practices also followed a similar trend, with as much as 81.6 per cent farmers adopting soil and water conservation practice, 72.52 adopting institutional measures and 69.14 per cent adopting prescribed agronomic practices. Rainwater harvesting, water recycling and addition of organic matter were known to all the farmers as effective climate resilient techniques. Awareness on use of breeds/ varieties suitable for climate change and high yielding, drought resistant forage crops production was found to be very low. Of the different climate resilient practices, rain water harvesting structures, integrated weed management practices and community seed bank were found to be adopted more. Farmers in Wayanad were found to have higher mean adoption index (82.83).

***Key words:** Adoption; Awareness; Climate change; Climate resilient agriculture;*

Agriculture contributes roughly 16 per cent of India's GDP. The negative impact of climate change in terms of 4.5 to 9 per cent reduction in production implies losses roughly up to 1.5 per cent of GDP per year (Venkateswarlu et al., 2013; Jasna et al., 2014). Out of the different states in India, Kerala, with its receding share of agriculture is under severe pressure of climate change. For instance, as per projections made in the action plan for climate mitigation by the Government of Kerala, proportion of irrigated to net sown area in the state is 19 per cent and much of this land is located in coastal and low lying regions which are vulnerable to rising sea level, salinity ingress and ground water depletion (*GOK, 2013*). Adding to this, agricultural sector in Kerala is being badly affected by continuous rains. The prolonged wet spell in Kharif (summer crop) and unusual rains have destroyed paddy production to a large extent in Kerala almost every year in the recent past. Records also show that the plantation crops are affected by severe summer spells. Increase in maximum temperature of 1-3° C during summer adversely affects thermo-sensitive crops like black pepper and cocoa in Kerala. Unlike seasonal crops, perennial crops are affected by the impact of weather aberrations as a result of which, the state's economy is adversely affected. In order to meet these challenges, suitable mitigation and adaptation measures are to be undertaken, which have to be mainstreamed in the agricultural development policy of the state, with the objective of promoting climate resilient agriculture.

A resilient system of agriculture is one that meets both food and development needs over both short and long terms, from local to global scales, without destabilizing the ecosystem. From the above description of Kerala's agriculture, it is clear that focused adaptation and mitigation strategies are urgently needed to increase the resilience of the production systems in Kerala, which are predominantly rainfed.

In this regard, several locally relevant resilient practices have been evolved by research institutions in the recent past to suit the diverse agro-ecological situations in the state. It is in view of the above, this study has been envisaged with the following objectives:

i. To assess awareness of farmers on climate resilient practices and their adoption
ii. To compare the level of adoption of climate resilient practices among farmers in two districts which experience climate extremities the most

METHODOLOGY

Based on the frequency and severity of climate change phenomena like excessive rain and/or drought, Palakkad and Wayanad were selected for the study. The study followed ex post facto design and data were obtained through pre- tested structured interview schedule and focused group discussions.

The sample of respondents were drawn randomly from ten Grama Panchayaths which were selected based on the proportion of Grama Panchayaths in the two districts (i.e.; seven out of the 95 Grama Panchayaths in Palakkad and three out of the 27 Grama Panchayaths in Wayanad), From each Grama Panchayath, 10 prominent farmers were randomly selected to make a sample of 100 farmers.

To assess the extent of adoption of climate resilient practices by farmers, 42 exclusive practices were identified by means of review of literature and consultation with experts. They were categorized into three, viz., 'soil and water conservation measures', 'agronomic practices' and 'institutional measures' with 11, 24 and 7 items respectively. Awareness and adoption with regard to resilient techniques were found out by separate scales to record responses on a three point continuum with items representing different levels of awareness and adoption. The frequencies of their responses were further used to find out weighted scores which would indicate the importance ascribed to each technique/strategy and the relative importance of different categories of practices. This was done to find out the specific component which requires to be emphasized for developing the content and focus of interventions to mitigate climate change impacts. The adoption index of individual farmer was also calculated using the formula given below:

$$\text{Adoption index} = \frac{\text{Respondents total score}}{\text{Total possible score}} \times 100$$

Based on the mean adoption score obtained and the standard deviation (mean ± S.D), farmers were categorized as low, medium and high in terms of the extent of adoption of climate resilient practices. In order to compare the level of adoption of climate resilient practices by the farmers of Palakkad and Wayanad, 't' test was conducted. Spearman's rank correlation was employed to find the factors affecting awareness and adoption.

RESULTS AND DISCUSSION

Awareness level of individuals regarding a management practice is an important factor that affects its adoption. The weighted scores on awareness and adoption are given in the Table.1.

Awareness on soil and water conservation measures and their adoption: Distribution of farmers based on their level of awareness on soil and water conservation measures showed that 100 per cent farmers were aware of rainwater harvesting, water recycling and addition of organic matter as effective climate resilient techniques. Almost on par with this, as much as 99.34 per cent of the farmers were found to be aware of mulching as an effective technique to mitigate impact of climate change. Similarly, vast majority (98.34%) of the farmers had expressed that they were aware of cover cropping as a climate resilient technique. Cultural practice of digging and maintaining farm ponds and construction of live bunds were found to be known to 93.67 per cent and 86.67 per cent of the respondents respectively.

Adoption of rainwater harvesting was found to be 98.67 per cent followed by water recycling (96%). Practices like mulching, cover cropping, organic matter addition, live bund preparation and check dam construction were also adopted by more than 80 per cent of the farming community. The novel concept of conservation tillage is yet to gain acceptance among farming community, as only 69.34 per cent had any cognizance on this technique and 43 per cent of the farmers had not at all adopted it.

Among different soil and water conservation measures, rain water harvesting and water recycling were ranked first and second in terms of extent of adoption.

Table. 1. Awareness and adoption of climate resilient technologies/ mitigation strategies

Climate resilient technologies/ mitigation strategies	AWS	CMAS	AdWS	CAS
Soil and water conservation measures				
Digging and maintaining farm ponds	93.67		67.34	
Micro irrigation	87.34		70.67	
Rain water harvesting	100		98.67	
Water recycling	100		96	
Mulching	99.34		88.67	
Construction of check dams	100	92.12	84.67	81.6
Cover cropping	98.34		87.34	
Organic matter addition	100		86.67	
Live bunds	86.67		82.34	
Contouring	78.67		77.66	
Conservation tillage	69.34		57.67	
Agronomic practices				
Soil test based fertilizer application	80.67		74.66	
Soil health card based practices	79.67		73.34	
Pest and disease resistant varieties	70.67		59.34	
Drought tolerant varieties	71.67		59.34	
Intercropping	100.0		73.67	
Agroforestry	79.34		65.34	
Alteration in sowing/ planting dates	83.34		84.34	
Integrated farming system approach	86.67		80.00	
Establishing wind breaks	80.34		68.34	
Alteration in fertilizer/ pesticide usage	78.34		73.67	
Integrated nutrient management practices	96.34		89.67	
Crop rotation	90.67		74.67	
Integrated weed management practices	93.67	80.22	93.00	69.14
High yielding and drought resistant forage crops production	49.00		39.67	
Use of suitable breeds/ varieties for climate	46.67		41.67	
Off season cultivation in green house	71.67		39.00	
Rain shelter during rainy season	75.34		56.34	
Mixed farming	94.34		65.34	
Multi-tier cropping	88.67		78.34	
Community nursery for delayed monsoon	89.34		82.34	
Shifting to organic farming	95.34		81.34	
Crop substitution	83.00		73.34	
Use of fertilizers with higher WUE	77.00		71.34	
PPFM(Pink Pigmented Facultative Methylotrophs)	62.67		61.00	
Institutional measures				
Weather insurance	94.34		79.00	
Supply management through market and non-market interventions	86.34		89.67	
Utilizing cold storage facilities	70.34		53.00	
Cultivation according to weather based warning/ forecast	77.00	77.27	77.34	72.52
Custom hiring centers	79.34		76.34	
Seed bank	97.00		94.34	
Fodder bank	36.67		33.67	

AWS=Awareness weighted score; CMAS=Category wise mean awareness score;
AdWS=Adoption weighted score; CAS=Category wise mean adoption score;

These results were found to be in line with the inferences drawn by *Jasna (2015) and Ramesh et al. (2015)* who had observed that water-harvesting structures were a popular adaptation strategy by those experiencing the effects of decreased precipitation. Mulching, check dams construction, cover cropping, and live bund preparation were also found to be adopted by more than 80 percent farmers. These observations support the findings of *Shanker et al. (2013)* who established that soil moisture conservation techniques like mulching with organic residues and cover cropping in rainfed agriculture were adopted by farmers to cope with climate change.

Awareness on agronomic practices as climate resilient techniques and their adoption among farmers: Among the 24 agronomic practices listed as climate resilient techniques, all the respondents had expressed awareness on intercropping as a strategy for climate resilience. Distribution of farmers based on the level of awareness on different items listed showed that integrated nutrient management, organic farming, integrated weed management practices, community nursery for delayed monsoon were found to be known to more than 85 per cent. It should be specifically noted that techniques related to soil test based fertilizer application and soil health card based practices, alteration in sowing/planting dates, integrated farming system approaches, crop substitution and smaller/ alteration in fertilizer and pesticide usage had not been fully taken cognizance of by the farming community. About 60-80 per cent farmers were found to be aware of these techniques as effective climate change mitigation practices. About 82 per cent farmers substituted their crops to mitigate climate change. Though crop rotation was found to be known to 90.67 per cent of the farmers, it was regularly adopted by only 74.67 per cent. About 54 per cent farmers had not adopted high yielding drought resistant forage crops and about 78 per cent had not adopted varieties/breeds suitable to the locality. Cultivation of pest and disease resistant and drought tolerant varieties were also found to be not adopted by more than 60 per cent of the farmers. Preparation of community nursery was observed to be a common practice among 82.34 per cent of the farming community during delayed monsoon. Use of PPFM spray during drought, a comparatively new technique to mitigate drought was known to about 62.67 per cent farmers and almost same proportion of farmers had adopted it.

Though many authors had cited that resilient agronomic measures were always the best to make agriculture climate proof, especially crop intensification by multi-tier cropping, intercropping, rotation, substitution and by crop diversification (*Reddy et al., 2015; Singh, 2016*) adoption of agronomic practices is less (69.14%) when compared to soil and water conservation and institutional measures.

Awareness on institutional measures and their adoption by farmers: Institutional measures, which are the key intervention points with regard to climate mitigation, were not widely known to the farming community, as understood from the results. Out of the seven strategies tested, except seed bank, of which 97.00 per cent farmers were found to be aware and 94.34 per cent found to have adopted, all other measures were found to be not widely known to farmers. Fodder bank, another innovative concept was known to only 36.67 per cent farmers out of which only 33.67 per cent farmers had adopted it. No single farmer was found to have fully adopted fodder bank as a resilient measure to mitigate climate change.

While weather insurance, a shock absorber in the context of climatic aberration on farming was found to be widely known to the farmers as a strategy for mitigating the impact of climate change other measures like supply management, cold storage practices and cultivation calendar based on weather forecast/ warning and custom hiring centers were found to be known to less than 80 percent of the farmers. However, 86.34 per cent of the farmers were relying on supply management of their produce via institutional mechanism either through market or non-market interventions. Almost 77 per cent of farmers adopted various cultivation practices in response to weather based forecast/ warning. Weather based crop insurance as a means to climate resilience was found to be adopted by 79.00 per cent of the farmers, though majority of the respondents were not satisfied with the insurance scheme.

As water stress has become the greatest concern and there are several localized initiatives giving awareness on importance of rainwater harvesting and water recycling, farmers were well informed about these technologies. Similarly, as a result of soil campaign being organized state wide in collaboration with various national initiatives, farmers were found to be aware of the advantage of addition of soil organic matter.

Awareness on deficit root zone irrigation, especially with micro irrigation techniques is gaining momentum in Palakkad and Wayanad districts as climate change looms and water stress increases. This observation was found to support the inferences by *Yadav et al. (2012)* who reported that drip irrigation technologies adopted were essential to generate income and alleviate poverty of small farmers in frequent drought affected area.

Adoption of altered sowing was found to be adopted as a solution to frequent fluctuations in monsoon. This result has reiterated the findings of several authors, who had conducted studies in other parts of the country. For instance, similar conclusion was drawn by *Pathak (2012)* and *Gopal et al. (2014*) in their studies. Change in planting time, intercropping, soil and water conservation and planting drought tolerant crops were the chief climate resilient practices adopted by farmers according to *Dhaka et al.(2010).* Staggered sowings, change in planting dates, drought resistant crops and construction of water harvesting structures were the major adaptation measures to mitigate changing climate as reported by *Shanker et al. (2013).*

Distribution of farmers based on adoption index: Adoption index of each farmer was calculated by dividing the total adoption score obtained by the farmer with the total possible score. Depending on the mean ± standard deviation (mean ± S.D.) of the adoption score obtained, farmers were classified as low, medium and high categories as shown in the Table No.2.

Table 2. Classification of farmers based on their adoption of climate resilient practices (N=100)

Category	Farmers	
	Score range	No.(%)
Low (<Mean- S.D.)	<61.01	18
Medium (Mean ± S.D.)	61.01-83.79	69
High (>Mean + S.D.)	>83.79	13
Mean= 72.4	S.D.= 11.39	

From Table 2, it is understood that majority of the farmers (69.00%) belonged to medium category with respect to adoption of climate resilient practices. The mean adoption score obtained was 72.4 and adoption index ranged from 49.2 to 93.65. Only 13 per cent and 18 per cent farmers belonged to low and medium categories respectively.

Adoption of climate resilient practices by farmers in the two districts: A comparison: An attempt was made to find out whether any significant difference existed among farmers with regard to adoption of climate resilient practices. In order to compare and find the difference in adoption of climate resilient practices among the farmers of the two districts viz. Palakkad and Wayanad, under study, t-test was conducted. The mean adoption index of farmers in both districts was calculated. The result obtained is given in Table.3.

Table 3. ρ value of t-test on adoption of climate resilient practices by the farmers in Palakkad and Wayanad

District	Mean adoption index	ρ value of t-statistic
Palakkad	67.94	0.0003
Wayanad	82.83	

The probability of the t-statistic obtained (0.0003) indicated high significant difference in the adoption of climate resilient practices among the farmers in Palakkad and Wayanad. Since the mean adoption index was higher for Wayanad (82.83) than that of Palakkad, it was concluded that the climate resilient strategies adopted by farmers in Wayanad was higher than that of the farmers in Palakkad.

Relationship between awareness on climate resilient practices and its adoption: Since adoption is influenced by level of awareness, an attempt was made to find out whether farmers' level of awareness on climate resilient technologies was related to adoption. The correlation obtained showed that awareness level was significantly (Table 4) influencing the extent of adoption of climate resilient practices.

Table 4. Relationship between awareness and adoption of climate resilient practices

Variables		Spearman Rank Correlation (ρ)
Awareness on climate resilient practices	Adoption of climate resilient practices	0.667**

** Sig. at 0.01 level

CONCLUSION

With the perils of climate change looming large, there is every need to adopt climate resilient practices or mitigation measures. The study focused on the awareness of farmers on various climate resilient practices and adoption of these practices by them.

In view of the positive and significant relationship between awareness on climate change and adoption, farming community in Kerala requires to be intensely trained on the theory and practice of climate resilient agriculture. The results have indicated the areas that are to be emphasized and the strategies with which resilience could be mainstreamed into the extension system.

REFERENCES

Dhaka, B.L.; Chayal, K. and Poonia, M.K. (2010). Analysis of farmers' perception and adaptation strategies to climate change.

GOK (Government of Kerala). (2013). Response to climate change: Strategy and action, Department of Environment and Climate Change, Trivandrum, 36p.

Gopal, S.P. V.; Siresha, K., and Vijayabhinandana, B. (2014). Adaptation and mitigation measures for climate change by the dry land farmers. *Curr. Biotica* **8** (3):278-287.

Jasna, V. K. 2015. Impact of climate resilient technologies in rainfed agro-ecosystem. MSc (Ag) thesis, Indian Agricultural Research Institute, New Delhi, 97p.

Jasna, V. K; Som, S. R.; Roy, B.; Padaria, R. N. and Sharma, J. P. (2014). Socio economic impact of climate resilient technologies. *Int. J. Agric. Food Sci. Technology* **5** (3):185-190.

Libyan Agric. Res. Cent. J. Int. **1** (6): 388-390.

Pathak, H.; Aggarwal, P.K., and Singh, S.D. (Eds). (2012). Climate change impact, adaptation and mitigation in agriculture: Methodology for assessment and applications. Indian Agricultural Research Institute, New Delhi.

Reddy, G.R.; Prasad,Y.G.; Osman, M.; Himabindul, T.; Raju, B.M.K.; Sudhakar, N. and Rao, C.S.(2015). Climate resilient intercropping systems for rainfed black soils of Andhra Pradesh and Maharashtra. *Indian J. Dryland Agric. Res. & Dev.* **30** (1):35-41.

Shanker, R.K.; Nagasree, K.; Sankar, M, G.R.; Prasad, M.S.; Raju, B .M. K.; Rao, S.A.V.M. and Venkateswarlu, B. (2013). Farmers perceptions and adaptation measures towards changing climate in South India and role of extension in adaptation and mitigation to changing climate. Extension Bulletin No.03/2013. Central Research Institute for Dryland Agriculture, Hyderabad, 28p.

Singh, R.P. (2016). Increased yield and crop diversification through adoption of climate resilient varieties among pulse crops in India: an appraisal. *Clim.Change Environ. Sustain*. **4**(1):47–59.

V.P.; Dixit, S. and Sikka, A.K. (2013). National Initiative on Climate Resilient Agriculture (NICRA), Research Highlights 2012-13. Central Research Institute for Dryland Agriculture, Hyderabad.

Venkateswarlu, B.; Maheswari, M.; Rao, S.M.; Rao; V. U. M.; Rao; S. Ch.; Reddy, K. S.; Ramana, D. B. V.; Rao; R. C. A.; Kumar,

Yadav, R.K.; Kalia, P.; Singh, S.D. and Varshney, R. (2012). Climate change impact, adaptation and mitigation in agriculture: Methodology for assessment and application. Division of Environmental Sciences, Indian Agricultural Research Institute, New Delhi–110012.

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