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Farmers' Perception about Climate Change and Response Strategies

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ABSTRACT

The crop production response strategies to climate change and variability vis-à-vis their socio-personal characteristics in North-Eastern Karnataka region were identified and analysed. A multi-stage random sampling technique was employed to elicit information from 120 respondents. Ex-post-facto research design was adopted as manifestation of event was already accrued. Data were collected through a pre-tested semi-structured questionnaire Total 52 strategies were collected from different literature, website, thesis etc., and tested among the respondents. The study revealed that there were eight commonly adopted crop production response strategies which were scrutinsed from the 30 selected strategies using principal component analysis namely, soil-water retention and integrated farming, followed by, contingency crop planning, crop diversification and risk aversion strategies, seeking advice from extension personnel and others, improving irrigation facilities, maintaining livestock, crop insurance, and migration to cities. The farmers' education, mass media use and source of weather information were significantly contributed in their perception about climate change and variability at 5% level of probability.

INTRODUCTION

Climate change refers to any change in climate over the time either due to natural variability or as a result of human activity stated by Intergovernmental Panel on Climate Change (IPCC, 2007 and Fusel, 2007). The changes occur due to variation in different climatic parameters such as precipitation, temperature and increase in Green House Gases (GHGs) emission through human activities. Due to global warming climate is changing rapidly with adverse effects including excessive and uneven rainfall, floods, droughts and cyclones (Baul et al., 2013). The climate change is major threat to livelihood of rural people (Rakib et al., 2014).

In India, climate change is already being experienced by the communities in the form of irregular rainfall and snowfall, increasing temperature and decreasing moisture content. Crop productivity has been also decreased because of low soil fertility and higher incidences of diseases (Rawat et al., 2013). The adverse effects of changing weather patterns and climate have extended beyond crop cultivation and influence livelihoods of people. Due to rising in temperature, agriculture production is expected to decline by 2050 in Himalaya region and will lead food insecurity (Dahal, 2008). Changes in weather patterns also result in reduction in availability of fuel wood, grass for fodder, spring water (Gene, 2012). Increasing disturbances of forests (forest fire, heavy lopping and logging, etc.) accompanied by increased human population resulting increasing in number of factories and motor vehicles, are some of the causes that lead to climate change and variability (Arya, 2010). Even the knowledge of extension professionals low to moderate in respect of climate change impacts on agriculture (Ghanghas et al., 2015). In order to support farm level decisions and minimize the loses in adverse climatic and weather conditions farmers' understanding about interaction of climate and agro-ecosystem need to be bridged through inclusion of farmers' communication network (Ravikumar et al., 2015) The perceptible change in climate due to anthropogenic

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activities started with industrialization in the modern era has aggravated in recent times. The negative impacts of the climate change on human life, flora, fauna, seasons, water, and air is witnessed all over the world and discussions around controlling and combating the unabated climate change are taking place from school-village global level. It has been realized now that if the climate change phenomenon is left uncontrolled, the survival of human being and the globe is at stake. With the threat of climate change looming large on the crops' productivity, which have an important role in food, feed and fodder security in dryland agriculture (Chapke and Tonapi, 2018). However, before taking controlling measures, it is necessary to understand the phenomenon properly. Because, people vary with their perception about the change that is happening around them and sometimes attribute the causes for change to unrelated reasons. Hence, it is essential to understand level of farmers' awareness and perception about climate change parameters and nature of crop production response strategies were adopted by the farmer in view to climate change and variability to sustain their farming based livelihood.

METHODOLOGY

The research study on farmers' perception of climate change and variability vis-a-vis socio-personal characteristics were study to know the social condition of the farmers whether there are financially stable or not and agricultural adaptation strategies were responsive in North-Eastern Karnataka during the year 2018-19, which had impact on their agriculture. Multi-stage random sampling method was used. The data pertained to drought-affected blocks during 2001 to 2018 namely, Bellery and Hoovina hadagali in Bellery district; Kusthagi and Yelburga in Koappal district; Lingasugur and Manvi in Raichur district; Aland and Jewargi in Kalburgi district; Shahapur and Yadgir in Yadgir district; Aurad and Bhalki in Bidar district were collected from Karnataka State Natural Disaster Monitoring Center (KSNDMC) which was the base of selection of the districts. Ten respondents from each village were selected based on simple random sampling procedure. This study comprises of 120 respondents. As which were selected from two villages of each district, total 12 villages. Ex-post-facto research design was adopted as manifestation of event was already accrued. Required data were collected using personal interview method with the help of semi-structured interview schedule, which was pretested with a few experts. In total 55 strategies were enlisted related to the crop production response strategies with respect to climate change and variability from the KSNDMC. Out of 55 strategies, 30 strategies were selected as they had more than 50 per cent response from the respondent farmers of the study area. Further, with an objective of reducing these 30 strategies to a few important one by allowing similar sources, there were clustered together using appropriate statistical tools like mean, principal factor analysis (PCA), correlation, frequency and percentage.

RESULTS AND DISCUSSION

Regression analysis of socio-personal characteristic of the respondents

To determine which socio-economic factors influencing to adopt strategies with respect to adverse climate change condition. The regression analysis was done with socio-economic characteristics of the respondents and their perception about climate change and variability (Table 1). The regression analysis (R^2=0.438) revealed Table 1 that 43.8 per cent variation in farmers perception about climate change parameters was explained by 15 independent variables selected under study. It could be observed that education of the respondents was found to be positive and showed significant contribution at 5.00 per cent level of probability fallowed by mass media usage by the respondents which was found to be positive and significant contribution at 5.00 level of probability and source of weather information was also found to be positive and showed significant contribution towards "perception of farmers towards climate change parameters". These findings were in line with the (Johnson et al., 2016).

Table 1. Regression analysis of scoio-personnal characteristics of the respondents and their perception about climate change parameters

S.No.	Coefficients[a]					
	Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
	(Constant)	37.227	11.518		3.232	.002
1	Age	.016	.119	.022	.132	.895
2	Education	-1.510	.629*	-.374	-2.401	.018
3	Family size	-.024	.311	-.009	-.078	.938
4	Farming Experience	-.046	.130	-.058	-.354	.724
5	Occupation	-3.961E-6	.000	-.066	-.413	.681
6	Irrigation source	.629	.529	.116	1.189	.237
7	Land holding	-.070	.178	-.055	-.394	.694
8	Mass media use	1.260	.514*	.416	2.454	.016
9	Extension participation	-.294	.498	-.073	-.589	.557
10	Decision making	-.012	.238	-.005	-.050	.960
11	Source of weather information	-.691	.277*	-.288	-2.492	.014
12	Risk bearing ability	.022	.298	.007	.073	.942
13	Economic motivation	.096	.340	.027	.281	.779
14	Scientific orientation	.011	.037	.028	.310	.757
15	Social participation	.688	.529	.127	1.301	.196

A. Dependent variable: perception of the respondents and their perception about climate change parameters
R^2 = 0.438

The hypothesis formulated based-on the objective was that "Farmers perception about climate change parameters was incomplete and erroneous". The study revealed that most of the farmers were aware of the climate change and its impact on their farming but were found to be lacking to get complete understanding of whole phenomena of climate change. Hence, the hypothesis was accepted and prompted to have study in detail.

Crop production response strategies to climate change and variability

Thirty strategies were selected as they had more than 50 per cent response as mentioned earlier. These were tested with respondent farmers of the study area with three-point continuum scale *i.e.*, most suitable and adopted, suitable and adopted, and not suitable and adopted, with assigning score of 3, 2, and 1, respectively. Table 2 depict that, shifting from agriculture to other earning activities, migration to cities for livelihood earning, construction of rain water harvesting structure, deepening existing well/bore well, better relations developed with extension workers and de-silting of irrigation canal were the major crop production response strategies adopted by the farmers with respect to climate change. Similarly, same crop production response strategies were subjected to principal component analysis which is shown in (Table 3). Hence the hypothesis was accepted.

Factor analysis was used to reduce these 30 strategies further to a few. These 30 strategies were inter correlated and then 30×30 variable matrix of correlation coefficients was subjected to principal component analysis (PCA) with varimax rotation. The total variance strategies which had values more than or equal to 0.6 were selected from rotated component matrix and appeared in each component (Table 3). Cumulative variance was found 66.27% in the PCA analysis. It indicates that there was 66 per cent role of these factors in perception of farmers about climate change. Under PCA, of the rotated factors was achieved by selecting only those strategies, which possessed a significant factor loading (grater or equal to 0.6 absolute without regard to sign Table 3. The first component was named as "soil-water conservation and integrated farming strategies". It consists of four strategies; modifying soil structure through ploughing had highest factor loading (.911) followed by, building of farm storage reservoir (.906), following integrated farming (.795) and shifting from agriculture to other activities (.675). Second component was entitled as "contingency crop planning" which includes shifting from cereal crop to perennial crops (.844), increase in seed rate (.689), changing from long duration to short duration varieties had the highest factor loading (.678) and change in planting dates (.684). Third component was named as "crop diversification and risk aversion strategies". It had four strategies; crop diversification (.876), increase in quantity of fertilizer application (.843), low investment in agriculture (.757) and leased

Table 2. Crop production response strategies to climate change and variability

S.No.	Strategies	Most suitable and adopted (%)	Suitable and adopted (%)	Not suitable and adopted (%)	RE
1	SAOEA	0	33	68	0.911
2	MCL	0	33	68	0.453
3	CRWHS	62	29	9	0.853
4	DEB	0	33	67	0.850
5	BREW	0	43	58	0.847
6	DIC	0	38	63	0.842
7	DNB	0	30	70	0.836
8	OFFP	0	28	73	0.828
9	AFA	0	33	67	0.808
10	BOFR	0	40	60	0.806
11	LIC	62	31	8	0.794
12	CLTOS	65	26	9	0.639
13	IS	0	28	73	0.475
14	CD	0	32	68	0.475
15	APA	52	36	13	0.467
16	DRV	0	43	58	0.458
17	EFPM	0	33	68	0.867
18	SCPC	54	34	12	0.447
19	OM	58	34	8	0.444
20	IQFA	68	25	8	0.444
21	CPD	53	42	13	0.442
22	IF	0	27	73	0.442
23	SL	56	30	14	0.442
24	UCLICF	0	32	68	0.439
25	ACI	75	21	4	0.433
26	LIAML	0	34	66	0.433
27	LOC	0	36	64	0.439
28	IEL	33	27	41	0.428
29	PRV	0	30	70	0.425
30	MSP	67	22	12	0.425

Table 3. Component crop production response strategies with factor loadings

S. No.	Component	Factor loadings
1	Soil-water conservation and integrated farming strategies	
	– Modifying soil structure through ploughing to retain soil moisture	.911
	– Building on-farm storage structure	.906
	– Following integrated farming	.795
	– Shifting from agriculture to other earning activities	.675
2	Contingency crop planning strategies	
	– Shifting from cereal crops to perennial crops	.844
	– Increasing seed rate	.689
	– Change in planting date	.684
	– Changing from long duration to short duration varieties	.678
3	Crop diversification and risk aversion strategies	
	– Crop diversification	.876
	– Increasing quantity of fertilizer application	.843
	– Low investment in agriculture to minimize losses	.757
	– Leased out land for cultivation	.660
4	Seeking advice from extension personal and others	
	– Better relations developed with extension workers	.714
	– Approaching other farmers for farm opinions	.651
	– Desilting of irrigation canal	.616
5	Improving irrigation facilities	
	– Drilling new well/ bore well	.870
	– Deepening existing well/bore well	.770
	– Construction of rain water harvesting structure	.621
6	Maintaining livestock	
	– Using crops as livestock fodder	.911
	– Addition of organic matter	.717
7	Crop insurance	
	– Availing crop insurance	.771
8	Migration to cities for livelihood	
	– Migration to cities for livelihood	.621

out land for cultivation (.660). The farmers adopted crop diversification as a strategy against climate change in view to realize that growing single crop continuously year after year proned to risk and stagnated yields are over a period. Thus, crop diversification can help in gaining better yield than a single crop. Due to heavy rainfall, there is possibility of loss of fertilizers through leaching (Shah et al., 2008). The findings were in line with the (Sangeetha *et al.* 2018).

Fourth component was entitled as "seeking advice from extension personnel and others" in which highest factor loading was to strategy; better relations developed with extension workers (.714). The findings were in line with the (Raghuvanshi et al., 2020). It was followed by second highest factor loading; approaching other farmers for farm opinions (.651) and the last strategy was desilting of irrigation canal (.616). Under fifth component namely, improving irrigation facilities includes; drilling new well/ bore well (.870) followed by, deepening existing borewell/well had highest factor loading (.770) and construction of rainwater harvesting structure (.621). In sixth, "maintaining livestock". consist of using crop as a livestock fodder (.911) and second one was addition of organic matter (.717). It was mainly named as "maintaining livestock" due to the reason that the probability of crop failure under the climate change condition had increased. The results were line with (Brar et al., 2020). If livestock's are maintained, the losses arising out of crop failure can be compensated to some extent and leftover crops of the failure can be utilized as fodder for animals. The litter and the cow dung can be helped to add organic matter in the soil. Crop insurance (.771) and migration to cities for livelihood (.621) were named as seventh and eight components respectively, in the analysis, which had only one strategy as its named. The hypothesis formulated based-on the objective was "Crop production response strategies adopted by farmers in combating climate change was reactionary in nature" was proved false because study revealed that crop production strategies adopted by farmers in combating climate change were not reactionary in nature as most of the response strategies were mainly found to be precautionary and preparatory in nature. Hence, the hypothesis was nullified.

CONCLUSION

The perceived awareness knowledge and impact of climate change and variability by the farmers was well versed and realizing its effect in terms of economic fluctuations, changing agro-climatic factors affecting the crop nature, increased pest and diseases attack, impacting crops yields, water resources, animals, and farmers' psychology in an adverse manner. The various crop production response strategies against climate change were adopted by the farmers were; soil-water conservation related strategies, irrigation facilities related, contingency crop planning related strategies. It need attention of the policy makers for emphasizing on these strategies along with the other recommended strategies in view to empower farmers to adapt to the climate changed scenario. Appropriate system for weather data collection, forecasting and early warning system for climatic extremities should be put in place by the concerned departments like Department of Hydrology and Meteorology. Climate based insect pest and disease forecasting system should be devised by the concerned Department of Agriculture. A multi-pronged strategy needs to be adopted to support the farmers economically through crop insurance, input support, socially by building social capital, creating the farmers organization to facilitate adopting technology like short duration varieties and timely protection management practices, including psychological support so that farmers could cope-up with the climate change impact and earn their livelihood.

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