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A Scale to Measure Climate Resilience Management Level among Farmers and Its Application

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Abstract

An attempt is made in the study to construct a scale to measure climate resilience management level among farmers. The method of summated rating procedure was followed in the construction of climate resilience management scale. All those items with the relevancy weightage of 0.75 and above were selected for the inclusion in the climate resilience management level scale. Sixty items retained in the scale to measure the climate resilience management level. The scale developed was found reliable (0.9223) and valid (0.9603). The results revealed that 43.33 per cent of farmers belonged to medium level of climate resilience management followed by 38.34 and 18.33 per cent had low and high level of climate resilience management level, respectively.

Keywords: Climate change, resilience management level, item analysis, reliability, validity

Climate change is posing biggest challenges facing the world today. The problems of human induced climate change first came into force and drew the attention of the scientist and policy makers when Inter Governmental Panel on Climate change was established. Agriculture in entire world and particularly in India mostly depend on the persisting weather conditions. The alteration in global warming has dramatically affected on agriculture and it's productivity, through serious-erratic monsoon, micro level changes in agricultural zones, spread of tropical diseases, sea level rise, change in availability of fresh water, floods, droughts, heat waves and storms, etc. Analysis of different metrological data from weather stations in the country shows that there is an upward trend in mean temperature and downward trend in relative humidity (RH), annual rainfall and number of wet days in a year. With unpredictable weather, farmers keep changing crop management practices by growing suitable crops, varieties and be prepared for constant change in the farming practices.

Impacts of climate change are diversified and need to be understood, so as to workout pragmatic strategies to mitigate ill-effects of climate change. There is no scale available to measure climate resilience management level; hence, the present study was taken up with following objectives :

1) Developing a scale to measure the climate resilience management level among the farmers.
2) To measure the climate resilience management level among the farmers in eastern dry zone.
3) To document the climate resilience management practices followed by farmers to mitigate climate change.
4) To know the association between Climate resilience management and farmers profile characteristics and.
5) To enlist the constraints faced by farmers due to climate change and their suggestions.

Methodology

The study was conducted in Chikkamagalur district of Karnataka state during 2016-17. Study area was purposively selected because it represents both rainfed and irrigated conditions. Randomly 60 farmers were personally interviewed using the scale developed to measure the Climate resilience management level among the farmers. The collected data was scored and analyzed using frequency and percentage.

Development of scale to measure the Climate Resilience Management level among farmers

Climate Resilience Management level is operationally defined as the capacity for a socio-ecological system to absorb stresses and maintain functional in the face of external stresses imposed by climate change and adopt, reorganize and evolve into more desirable management practices that improve the sustainability of the system and better prepared for future climate change impacts. The method suggested by Likert (1932) and Edward (1969) in developing scale was followed in construction of climate resilience management level among farmers. The procedure followed in construction of the scale is depicted in the following steps.

Table I revealed that 21 dimensions were identified from the literature and discussion with experts in the selected fields. It is apparent that, all

TABLE I

Steps to develop and standardize a scale to measure the climate resilience management level among farmers

Steps	Management level	
	Considered	Retained
Collections of Dimensions	21	4
Collection of items	110	110
Editing of items	110	81
Relevancy Analysis	81	70
Item Analysis	70	60
Reliability and Validity	60	60
Administrating the scale	60	60

the 21 dimensions will not contribute equally towards the climate resilience management level among farmers. Hence, the variation in contribution of each dimension for the resilience management must be represented by assigning different weightage to each of the dimension. Judgment ratings for all the 21 dimensions were obtained and the relevancy weightage were worked out. Based on relevancy weightage more than 0.90 is considered, accordingly four dimensions, namely natural resource degradation management, agriculture resource /non agriculture resource management, environmental protection and ecological security management were identified and included to develop the scale. 130 statements pertaining to Climate Resilience Management level was prepared based on the available literature and discussion with experts from selected areas.

Further, the statements were edited as per the 14 criteria suggested by Edwards (1969), Thurstone and Chave (1929). As a consequence 29 statements were eliminated and the remaining 81 statements were included for the study. Eighty one statements were mailed to experts in the Agricultural Extension and other related fields working in SAUs, ICAR institutions in Karnataka State Department of Agriculture to critically evaluate the relevancy of each component viz., Most Relevant (MR), Relevant (R), Somewhat Relevant (SWR), Less Relevant (LR) and Not Relevant (NR) with the score of 5, 4, 3, 2 and 1, respectively. The 'relevancy weightage' and 'mean relevancy score' were worked out for 81 statements. The statements were analyzed for their relevancy using the following formulae.

$$\text{Relevancy Weightage} = \frac{(MR\times5)+(R\times4)+(SWR\times3)+(LR\times2)+(NR\times1)}{\text{Maximum Possible score}}$$

$$\text{Mean Relevancy Score} = \frac{(MR\times5)+(R\times4)+(SWR\times3)+(LR\times2)+(NR\times1)}{\text{Number of Judges responded}}$$

The results on the relevancy weightage and mean relevancy weightage score obtained after analysis. Accordingly statements having 'relevancy weightage' of more than 0.75 and above and 'mean relevancy score' of 3.65 and above were considered for final selection. Sixty statements were retained after relevancy test and these statements were suitably modified and written as per the comments of the judges wherever applicable.

$$t = \frac{\bar{X}_H - \bar{X}_L}{\sqrt{\dfrac{\left[\Sigma x^2_H - \frac{(X_H)^2}{n}\right] \left[\Sigma x^2_L - \frac{(X_L)^2}{n}\right]}{n\,(n-1)}}}$$

where

Σx^2_H = sum of the square of the individual scores (high group)

Σx^2_L = sum of the square of the individual scores (Low group)

x_H = mean score for the given item for high group

x_L = mean score for the given item for low group

Item analysis

To delineate the statements based on the extent to which they can differentiate the Climate Resilience

Management level as lower or lower management level, item analysis was carried on the statements selected in the first stage. For item analysis, statements were arranged in ascending order based on relevancy score. The 't' value of the statements were calculated by using following formula.

Based on the item analysis (t value), 60 statements which were statistically significant at 5 per cent and 1 per cent were finally retained in the scale to Climate Resilience Management level.

Reliability and validity of the scale

The value of correlation coefficient was 0.8595 and this was further calculated by using Spearman brown formula and obtained the reliability coefficient of the whole test. The value of the scale was 0.9223 which was highly significant at 1 per cent level indicating high reliability of the scale. The validity of coefficient of the scale was 0.9603 which was also statistically significant at 1 per cent level of probability indicates the higher validity of the developed scale. Hence, the scale is said to be valid. Thus the developed scale to measure the Climate Resilience Management level was feasible and appropriate.

Table II indicates that 60 statements which determines the Climate Resilience Management level consist of both positive and negative statements. The

TABLE II

Statement consisted to measure the climate resilience management level among the farmers

Statement	Measurement				
	Fully in Vogue	In Vogue	Un decided	Partially in vogue	Not in Vogue
1	2	3	4	5	6
I Natural resource degradation management					
1. Sustainable and equitable use of resources for meeting the basic needs of the present and future generations without causing damage to the environment					
2. Non-adoption of soil-conservation management practices leads to desertification of the agricultural land					
3. Steps for restoration of ecologically degraded areas and for environmental improvement in our rural settlements					
4. Cost effective and efficient methods of water conservation and use					
5. Encouraging crop rotation patterns					
6. Environmental consciousness through education and mass awareness programs which can reduces the natural resource degradation.					
7. Prevent and control the future deterioration in land, water and air which constitute our life-support systems					
8. Ensure that development projects are correctly sited so as to minimize their adverse environmental consequences					
9. Ensuring land for different uses based upon land capability and land productivity					
10. Encouragement for improvement in traditional methods of rain water harvesting and storage					
11. Developing coping mechanisms for future climatic changes as a result of increased emission of carbon dioxide and greenhouse gases					

1	2	3	4	5	6
12. Development and promotion of methods of sustainable farming, especially organic and natural farming					
13. Raising of green belts with pollution tolerant species can protect the natural resources.					
14. Efficient use of inputs including agro-chemicals with minimal degradation of environment					
15. Inorganic fertilizer ,insecticides and other chemicals used in non-organic farming cause long term harmful effects to the environment					
II Agricultural resource / Non agricultural resource management					
1. Organic farming is effective in increasing the texture and fertility of soil.					
2. Integrated pest management is a boon to reduce the chemical use for plant protection.					
3. Integrated farming system is one of the best method to use the agricultural resource management.					
4. Measures for increasing the efficiency of water-use, water conservation and recycling					
5. Setting up of biogas plants based on cow-dung and vegetable wastes					
6. Restoration and protection of grazing lands					
7. A movement toward greater efficiency in resource use including recycling					
8. Protection and sustainable use of plant and animal genetic resources through appropriate laws and practices					
9. Development of integrated pest management and nutrient supply system					
10. Afforestration on common lands by the local communities through government schemes					
11. Improvement in genetic variability of indigenous population					
12. Incentives for environmentally clean technologies, recycling and conservation of natural resources					
13. Concerted efforts for development and propagation of non-conventional renewable energy generation systems					
14. Improvement of infra-structural facilities such as water supply, sewerage, solid waste disposal, energy recovery systems					
15. Encouraging efficient utilization of forest produces					

1	2	3	4	5	6
III Environmental protection					
1. Environmental change causes negative effect on people health and animals					
2. Organic farming can improve soil fertility and soil structure					
3. Willing to give up part of my profit for environmental conservation					
4. Create environmental consciousness through education and mass awareness programs					
5. Climate resilience reduces environmental degradation					
6. Environmental factors play an important role in climate change					
7. Crop cover may protect the soil climate					
8. Climate resilience efficient in mitigating climate change effects					
9. Less risk of pollution in climate resilience practices					
10. Raising of green belts with pollution tolerant species					
11. Increasing temperature and variation in rain fall are the main indicators of environmental change and modify the cropping pattern					
12. Inorganic fertilizers and pesticides cause long term harmful effects to the environment					
13. Pesticides and chemical fertilizers will reduce the number of soil micro organisms					
14. Practicing the afforestration activities helps in increasing environmental conditions					
15. Climate change reduces mineral output to the environment					
IV Ecological security management					
1. Conservation of natural and domesticated ecosystems, and of wild and domesticated species, to the fullest extent possible and the restoration and regeneration of degraded ecosystems					
2. Protection of domesticated species/varieties of plants and animals in order to conserve indigenous genetic diversity					
3. Bringing together the representatives of village institutions, civil society groups, academics and government functionaries on a common platform, so as to achieve better stewardship of the area					

1	2	3	4	5	6
4. Concentrating on Common Property Resources as these offer a single platform to collectively address issues of social justice, ecological restoration and poverty alleviation					
5. Development and promotion of methods of sustainable farming, especially organic and natural farming					
6. Development of methodologies to multiply, breed and conserve the threatened and endangered species through modern techniques of tissue culture and biotechnology					
7. Encouraging private individuals and institutions to regenerate and develop their wastelands					
8. Support for protecting traditional skills and knowledge for conservation of resources					
9. Conservation of micro-fauna and micro-flora which help in reclamation of wastelands and revival of biological potential of the land					
10. Protection and sustainable use of plant and animal genetic resources through appropriate laws and practices					
11. Restriction on introduction of exotic species of animals without adequate investigations					
12. Discouragement of monoculture and plantation of dominating and exotic species, in areas unsuited for them and without sufficient experimentation					
13. Taking measures to increase the production of fodder and grasses to bridge the wide gap between supply and demand					
14. Reorientation of the development process, ensuring that ecological and livelihood security become central concerns and that the conservation of biodiversity receives the highest priority					
15. Development and strengthening of formal education efforts for awareness of biodiversity promoting action for sustainable use and biodiversity conservation					

response collected on a five point continuum, namely, fully in vogue, in vogue, undecided, partially in vogue, and not in vogue with assigned score of 5, 4, 3, 2 and 1, respectively for positive statements and vice versa for negative statements. Thus, the minimum and maximum score one could get is 60 and 300, respectively. Higher the score indicates the high management level of farmers towards Climate Resilience Management level and lesser the score indicates low management level.

Results and Discussion

Dimension wise analysis climate resilience management level among farmers in Eastern Dry Zone

The results in Table III revealed that the irrigated situation, natural resource degradation management (62.00%) and Agriculture / non agricultural resource management (60.00%) were ranked I and II, respectively. Where in rainfed situation, environmental

TABLE III

Dimension wise analysis climate resilience management level among farmers in eastern dry zone

Dimensions	Scores	Per cent	Rank
Irrigated (n=30)			
Natural resource degradation management	93.43	62.00	I
Agriculture / non agricultural resource management	90	60.00	II
Environmental protection	88.25	58.84	III
Ecological security management	87.85	58.56	IV
Rainfed (n=30)			
Environmental protection	128	85.34	I
Ecological security management	84	56.00	II
Agriculture / non agricultural resource management	71.22	47.48	III
Natural resource degradation management	62.14	41.42	IV
Pooled (n=60)			
Environmental protection	216.25	72.00	I
Ecological security management	171	57.00	II
Agriculture / non agricultural resource management	161	53.67	III
Natural resource degradation management	155	51.66	IV

TABLE IV

Climate resilience management level of the farmers different situations in eastern dry zone

Management level	Irrigated		Rainfed	
	No.	%	No.	%
High	8	26.67	5	16.67
Medium	15	50.00	11	36.67
Low	7	23.33	14	46.66
Total	**30**	**100**	**30**	**100**

TABLE V

Distribution of farmers according to their climate resilience management level in eastern dry zone

Management level	No.	%	Mean	SD
High	13	18.33		
Medium	26	43.33	249.56	9.49
Low	21	38.34		
Total	**60**	**100**		

protection (85.34%) ecological security management (56.00%), were ranked I and II, respectively. In pooled situation, environmental protection (72.00 %) and ecological security management (57.00 %) were ranked I and II, respectively. The probable reason for above findings might be environmental protection is the prime factor which determine climate change. Ecological security management determine the life of all creatures on this earth and ecological resource supports the living beings. The findings are conformity with the findings with Mamathalakshmi *et al.* (2013).

Climate resilience management level among the farmers in Eastern Dry Zone

An examination of Table IV indicates the levels of climate resilience management of farmers in different situations. In irrigated situation, half of the respondents (50.00 %) belongs to medium climate resilience management subsequently 26.67 and 23.33 per cent under high and low climate resilience management, respectively. Due to irrigation facilities, the irrigated farmers harvests two to three crops in a year leading to increased opportunities. In the rainfed situation, 46.66 per cent respondents had low level of climate resilience management followed by 36.67 and 16.67 per cent of them fall under medium and low climate resilience management level, respectively. As it is rainfed situation only one crop can be harvested per year was the possible reason for this type of results. The findings are conformity with the findings of Vinay Kumar *et al.* (2010).

Distribution of farmers according to their climate resilience management level in Eastern Dry Zone

A critical look at the Table V shows that 43.33 per cent of farmers belonged to medium level of climate resilience management followed by 38.34 and 18.33 per cent of them belong to low and high climate resilience management level, respectively. It can be inferred that majority (62 %) of farmers had medium level to high level of climate resilience management level. Most of the respondents have availed the benefits of government initiated programmes and also majority of the respondents depends on-farm and off-farm activities for their livelihood security. The results are in close agreement with findings of Shankar (2010).

It can be concluded that the scale developed is useful to measure the climate resilience management level beyond the study area with suitable modifications. The reliability and validity of the developed scale indicated the precision and consistency of results. The study revealed that majority (62 %) of farmers had medium to high level climate resilience management practices.

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