



EXPLORATORY FACTOR ANALYSIS IN PERCEPTUAL UNDERSTANDING OF LIVESTOCK REARERS TOWARDS CLIMATE VARIABILITY IN KARNATAKA

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Abstract- Climate variability has been considered as one of the most serious long-term challenges faced by the dairy farmers this study examines how dairy farmers Karnataka state perceive climate variability. This was done with 120 samples which were purposively selected from the study area, for analysis, perception scale was used with modification, Reliability and validity was checked before conducting the study, finally the scale is of fourteen statements, (nine positive and five negative) and the response for each statements was rated over a five point continuum and weighted mean rank was assigned, among fourteen statements there are changes in environmental temperature ranks first with a weighted mean score 93.83; There is change in timing of precipitation (80.17) ranks second and as follows. Exploratory Factor Analysis (EFA) was employed to identify the latent constructs in the perception of farmers towards climate variability. After completing the exploratory factor analysis to estimate the factorial validity, the reliability was assessed through Cronbach alpha.

Keywords- Perception, Climate variability, Adaptation, Northern dry zone of Karnataka

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Introduction

The climate variability is increasingly becoming an important consideration of our lives. Climate variability refers to the way climate fluctuates yearly above or below a long-term average value. The warming trend in India over the past century was estimated to be 0.60 °C. The IPCC (2007) predicted that by the year 2100 increase in global average surface temperature may be between 1.8 and 4.0 °C, with global average temperature increases by 1.5-2.5°C. Approximately 20-30 percent of plant and animal species are expected to be at risk of extinction. Livestock sector plays a prominent role in the economic progress of the country, as it provides employment to people in principle or subsidiary status. It has the potential to act as an instrument to bring about socio-economic transformation. Small and marginal farmers and landless labours derive substantial part of their livelihood from sale of milk and own about 70 per cent of cattle in rural areas. But in recent days, Climate variability affects the livestock farming and it became the serious consideration. In recent times, climate variability has been considered as one of the most serious long-term challenge faced by the livestock rearers.

Adaptation to climate change and variability is now considered as an important response option worthy of research and assessment, not simply to guide the selection of the best mitigation policies, but rather to reduce the vulnerability of groups of people to the impacts of climate change, and hence minimize the costs associated with the inevitable. This has in part stemmed from a realization that, a certain amount of climate change will occur and that society can take concrete steps to minimize the net losses (including taking advantage of opportunities for gains). It is often heard about different adaptation strategies especially micro-environment modification like shelter modifications; water cooling or sprinkler system; strategic nutrient supplementation etc while forgetting the ground reality that out of 529.7 million livestock, 440 million livestock are reared by 100 million household with/without any housing system and by crop residues. Livestock

rearers adapt some strategies when they perceive that climate change is occurring. Here perception of farmers towards climate variability is very much important. Keeping in view of all these, a comprehensive study was conceptualized with an objective to assess the perception of dairy farmers towards climate variability in northern dry zone of Karnataka.

Materials and Methods

Perceptions refer to the process of receiving information or stimuli from our environment and transform it into physiological awareness. Individual's perception about climate variability was measured by using the modified scale of Kant *et al.* (2013). The validity and reliability test was done in study area with non sample respondents in order to avoid testing effect. Nevertheless these respondents were representative of the community in which the final study was conducted. The scale is of fourteen items, (nine positive and five negative) and the response for each items was rated over a five point continuum which ranged from strongly agree to strongly disagree. Weighted mean was calculated and based on weighted mean Rank was given after that factorial analysis method was applied.

The study was conducted in Northern dry zone area which was purposively selected because of this zone is most frequently exposed to climate variability. Nearly 70 percent of its area falls under dry land farming. Raichur and Bellary Districts are coming under this dry zone were selected purposively for the study, as these districts holds largest livestock population in northern dry zone of Karnataka. From each districts two taluks have been selected randomly eventually from each taluks two villages selected randomly. From each selected village, 15 livestock rearers were selected randomly. Thus in total 120 livestock rearers spread over in eight villages of Manvi, Raichur, Huvinahadagi and Bellary taluks constituted the sample for the study.

Exploratory Factor Analysis

At the beginning, the data was checked for presence of outliers using box plot and normality by Normal Q-Q plot. Exploratory Factor Analysis (EFA) was employed to identify the latent constructs in the perception of farmers towards climate variability to ascertain factorial validity (Hair *et al.* 2009). Since the latent constructs in social science are often interrelated, the maximum likelihood (ML) factor extraction method was used with Promax rotation, which it permits inter-factor correlation. To reduce the number of factors to a manageable level, only the factors with an Eigen value exceeding one were selected for rotation. Since the sample size is 120, a factor loading of 0.50 was used as a lower cut-off value for selection of variables for each factor (Field, 2009).

Table-1 The scoring procedure was as follows.

Response	Positive item	Negative
Strongly agree	5	1
Agree	4	2
Undecided	3	3
Disagree	2	4
Strongly disagree	1	5

Reliability analysis

A test is said to be internally reliable if there is little variance that is specific to certain items. After completing the exploratory factor analysis to estimate the factorial validity, the reliability was assessed through Cronbach alpha, which is a measure of variance in the test. It represents internal consistency by averaging all possible combinations of split-half reliability i.e. splitting the test by every possible combination of items (Giles, 2002). The formula for calculating Cronbach alpha is given below:

Where N = No of items, M = Mean covariance between items, SUM (VAR/COV) – Sum of all the elements in the variance- covariance matrix. The generally agreed upon lower limit for Cronbach's alpha is of 0.7 (Nunnally, 1978), but this may decrease to 0.60 in exploratory research (Robinson *et al.*, 1991). The reliability was assessed using SPSS SCALE procedure.

Result and Discussion

Rural community could not realize the science of climate variability, but they rightly analyzed and felt its effects. Farmer perceptions are considered to be critical as a determinant of and necessary precondition for adaptation (Maddison, 2006). Perception is affected by factors such as culture, knowledge and access to information.

All (100%) of the respondents (69.17% SA and 30.83% A) perceived that "there are changes in environmental temperature" and they have assigned first rank to it with weighted mean score of 93.33. This might be due to the frequent variation in temperature results in decline of farm productivity. This finding similar to studies done by Nhemachen and Hassan (2007); they concluded that 84.40% of the respondents perceived significant changes in temperature.

Majority (60.00%) of the dairy farmers were agreed that "there is change in timing of precipitation", followed by strongly agreed (23.33%). However, 5.84 per cent of the dairy farmers were disagreed and 10.83 per cent were undecided. The weighted mean score was 80.17. In order of importance, it was assigned second rank by the respondents. Proper timing of precipitation plays prominent role in productivity of crops and animals. Because of this farmers have considered it very important. Variations of rainfall also create temperature aberration, which is aiding to ill effects of climate problems. This is consistent with findings from studies done by Gwimbi (2009); Mengistu (2011). They also reported the changes in rainfall patterns.

Table-2 Distribution of respondents based on their Perception towards climate variability

Note: SA: Strongly Agree, A: Agree, UD: Undecided, D: Disagree, SD: Strongly Disagree

No.	Statements	Responses					Weighted Mean	Rank
		SA%	A%	UD%	D%	SD%		
1	There are changes in environmental temperature	69.17	30.83	0	0	0	93.83	1
2	There is change in timing of precipitation	23.33	60.00	10.83	5.84	0	80.17	2
3	There are changes in ground water table	38.50	26.17	19.00	16.33	0	68.67	3
4	There is increase in number of droughts	6.67	41.67	20.33	18.33	13.00	58.17	12
5	There is increase in disease/insect pest infestation	15.00	45.83	18.33	7.50	13.34	61.67	8
6	There is change in feeding schedule for dairy animals	15.67	44.18	10.15	25.00	5.00	62.33	7
7	There is change in current farm management practices	23.33	25.00	29.17	15.83	6.67	64.00	6
8	Climate variability may affects the investment in dairy business	14.17	13.33	41.67	25.00	5.83	66.67	5
9	Climate variability is an important environmental issue	20.00	39.17	19.17	14.17	7.40	67.33	4
10	Climate variability is not a problem	12.50	10.89	18.67	24.27	33.67	60.78	10
11	There is no role of human in climate variability	10.79	16.57	19.17	32.50	21.03	60.50	11
12	Climate variability is more beneficial than harmful	11.67	15.83	13.33	33.83	25.43	54.50	13
13	Climate variability is beneficial for dairy farming	2.50	6.67	29.67	34.17	27.99	61.50	9
14	To combat climate variability urgent preparedness is not essential	13.33	21.00	34.17	15.83	15.67	52.13	14

Most (64.17%) of the dairy farmers (38.50%SA and 26.17% A) experienced that "there are changes in ground water level", whereas 19.00 and 16.33 % of the dairy

farmers was undecided and disagreed; respectively. The weighted mean score of this statement was 68.67 with 3rd rank given by farmers. It seems that farmers

attached a considerable importance to change in ground water level as it is lifeline of people of the region because it is critical resource for securing livelihood security and it is also only source of water during drought. This might be due to the continued ground water utilization and less recharge owing to erratic and less rainfall.

Most (59.17%) of the dairy farmers (39.17% A and 20.00% SA) experienced that "climate variability is an important environmental issue". The weighted mean score was 67.33 with a rank of 4th. Now the farmers are most frequently undergoing thorough natural disasters they are considering it as an important issue. Moreover, information explosion is also making aware the farmers about the climate variability.

Large proportion (41.67%) of the dairy farmers were in undecided category, 14.17 percent and 13.33 percent of dairy farmers strongly agreed and agreed with 'climate variability may affects the investment in dairy business' and disagreed by 25.00 %. The weighted mean score was 66.67 with the 5th rank, uncertainties causing reduction in farm income resulting less availability of surplus capital to investment in dairy business.

Nearly half (48.33%) of the dairy farmers had perceived that (25.00% A and 23.33% SA) "there is change in current farm management practices". However, 29.17, 15.83 and 6.67% of dairy farmers were undecided, disagreed and strongly disagreed; respectively. The weighted mean score was 64.00 with 6th rank. Due to climate variability, farmers were forced to change management practices to maintain the productivity of crops and animals.

Majority (59.85%) of the dairy farmers (44.18% A and 15.67% A) perceived that "there is change in feeding schedule of dairy animals. While, 10.15, 25.00 and 5.00 percent of them were undecided, disagreed and strongly disagreed; respectively. The weighted mean score was 62.33. According to importance of this statement, armors have given 7th rank. Most (60.83%) of the dairy farmers (15.00% SA and 45.83% A) felt that "there is an increase in disease infection and insect pest infestation". However 18.33 and 7.50% of them had undecided and disagreed; respectively. It was ranked 8th with the weighted mean score of 61.67. Increase in disease infection and insect pest infestation may be due to the change in a well established rainfall pattern, temperature, sunshine hours, wind direction, humidity and wind velocity.

About 39.17% of the dairy farmers were disagreed that "climate variability is beneficial for dairy farming" and strongly disagreed by 32.16%, whereas 29.67% of the dairy farmers were undecided. The weighted mean score was 61.50 with the 9th rank. A close look of the result explains that large proportion of the farmers perceived that climate variability is not beneficial for dairy farming. Intensity of perception is quite strong as none of the farmers were strongly agreed and agreed with the statement. It may be concluded that farmers are aware that climate variability will negatively affect the dairy farming in the area.

About 33.67% of the dairy farmers were strongly disagreed that "climate variability is not a problem" and was disagreed by 24.27%. While, 18.67 % of the dairy farmers had undecided. The weighted mean score was 60.78 with the 10th rank. Farmers rightly felt that climate variability is a problem.

About 32.50% of the dairy farmers had disagreed that "there is no role of humans in climate variability". It reflects that there is the role of human being in climate variability and this is perceived by the majority of the farmers. This was followed by strongly disagreed (21.03%). However, 19.17, 16.57 and 10.79 % of the dairy farmers were undecided, agreed and strongly agreed; respectively. The weighted means score was 60.50 with the 11th rank.

About 41.67% of the dairy farmers were agreed that "there is increase in number of droughts" and strongly agreed (6.67%), while, 18.33, 20.33 and 13.34% of the dairy farmers had disagreed, undecided and strongly disagreed; respectively. The weighted mean score was 58.17 and farmers have assigned 12th rank to it. It seems that there is marked increment of number of drought in recent and past five years that is why farmers were able to perceive variation in the climate has been surpasses the critical level.

About 33.83% of the dairy farmers were disagreed that "climate variability is more beneficial than harmful" and strongly disagreed by 25.43 %. Though 13.33, 15.83 and 11.67 % of the dairy farmers were undecided, agreed and strongly disagreed; respectively. Farmers assigned thirteenth rank to it. The weighted men score was

54.50. The Farmers perceived that climate variability is more harmful than beneficial. About (34.17%) of the dairy farmers are undecided about "to combat climate variability urgent preparedness is not essential " and 51.67% and 41.66% of dairy farmers are in strongly disagreed and agreed; respectively. The weighted mean score was 52.13 with 14th rank. Decline in productivity of crops and livestock was experienced by the farmers there by, they perceived that urgent preparedness is needed to cope with ill effects of climatic problems.

Through frequency percentage method it can be concluded that most of the respondents perceived that there is a variation in climate factors which occurred over period of time. These factor adversely affecting the crops and livestock and socio-economic status of respondents.

Exploratory Factor analysis of perception of farmers of towards climate variability

Table-3 Pattern matrix of farmers' perception towards climate variability

Item	Factor loadings					
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
P2	-	.809	-	--	-	-
P3	.799	-	-	-	-	-
P4	-	.733	-	-	-	-
P5	.587	-	-	-	-	-
P7	-	-	-.641	-	-	-
P8	-	-	-.696	-	-	-
P9	-	-	.616	-	-	-
P10	-	-	.509	-	-	-
P11	-	.541	-	-	-	-
P12	-	-	-	-	.955	-
P13	-	-	-	-.991	-	-
P14	-	-	-	-	-	.901
Eigen value	2.244	1.954	1.668	1.757	1.113	1.012
Variance explained (%)	13.813	11.282	10.777	9.249	7.860	6.324

Note: P1, P2.....P14: Perception scale statements

Data on the farmer's perception towards climate variability was examined for the presence of errors and found serious outliers in item 14, which was excluded from analysis. The EFA has estimated the Kaiser-Meyer-Olkin (KMO) value of 0.521 was above the minimum level of 0.5, and a significant Bartlett's Chi-square ($\chi^2=761.301$, $p<0.01$) indicated the sampling adequacy. Six factors that exceeded the Eigen value of one were retained for rotation. These factors together explained 59.30% of the total variance in the data, which is close to the acceptable level of 60%.

Rotation Method: Promax with Kaiser Normalization.

a. Rotation converged in 12 iterations.

b. Extraction Method: Maximum Likelihood.

The pattern matrix displayed in [Table 4.3] indicates that items P1, and P6 didn't load in any factor. Among the factors, the factor 1 explained maximum variance (13.81%) and had highest Eigen value (2.224). Items P3 and P5 together positively loaded in factor 1. Factor 2 had the items P2, P4 and P11 with all of them showing a positive relationship. Other items P7, P8, P9 and P10 loaded in factor 3 and explained 8.78% variance. Among them, P7 and P8 showed negative relationship. Factors 4, 5 and 6 had only one item loading.

Among all the scales, the Factor 2 followed by factor 1. The factor 3 had negative alpha which indicate that correlations among variables are weak. This could be

due to two negative factor loadings (p7, p8). Since factors 4, 5 and 6 had only one item loaded, the reliabilities are not calculated and these factors are deleted from analysis.

Reliability of perception scale

The reliability of items identified for each factor in the perception scale are given in [Table 2].

Table-4 Reliabilities and associated statistics of perception scale

	Number of items	Internal consistency reliability (Cronbach alpha)	Scale mean	SD
Factor 1	2	0.49	6.05	1.54
Factor 2	3	0.59	10.17	2.07
Factor 3	4	-0.98	11.90	1.57

Conclusion

Climate change cannot be stopped but can be controlled, although farmers had perceive about projected impact of climate change but they did not know what it is and they seemed confused. Regarding individual perceptions majority of the respondents perceived increased environmental temperature, decreased precipitation, increased extreme weather events and an unusual pattern of rainfall. Therefore, Promote ICT and Climate Extension Network for effective dissemination of proven adaptable technologies in livestock rearing and a large scale climate change literacy programmes should be developed to prepare farmers, in which farmers can participate, learn and adapt effective coping strategies to increase farm yield as well as their livelihood.

Conflict of Interest: None declared

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