

A Scale to Measure Farmers' Perception Towards Climate Vulnerability

ABSTRACT

Perception is influenced by various factors such as attitude, knowledge, information, socio-cultural factors and previous experience. To understand human behaviour, it is necessary to understand the process of perception. The farming community may not have knowledge about the reasons for climate vulnerability but they can understand and realize the consequence of it. Agriculture is susceptible to climate vulnerability through increased temperature and changes in rainfall patterns. These factors affect germination, plant growth, grain development and maturity in turn productivity. Increased temperature creates heat stress on crops and this adversely affects the production of crops. While the uneven distribution of rainfall creates drier or waterlogged conditions for crops that hamper the growth of crops. In this direction, the research was designed with the objective of developing a scale to measure farmers' perception towards climate vulnerability. A list of 62 statements indicating the positive or negative perception was considered for scale construction. The statements were edited in the light of the informal criteria suggested by Edwards. The total individual score of judges was calculated by summing up the weights given by judges to the individual statement. On the basis of total individual scores, 25 per cent of judges with the highest total individual scores and 25 per cent of judges with lowest total individual scores were taken assuming that these groups provided criterion groups in terms of high and low evaluated by the individual statement. Item analysis is done by 't' value for

each statement using formula and procedure given by Edwards. Finally 52 statements which had 't' value 1.75 and above were qualified for inclusion in the scale.

KEY WORDS: Climate change, Vulnerability, Perception, Scale, Reliability, Validity

INTRODUCTION

Climate change is already hard reality at global level. Its impact on agricultural activities in developing countries has increased dramatically. According to Intergovernmental Panel on Climate Change (IPCC) report, the United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global and/or regional atmosphere and which is in addition to natural climate variability observed over comparable time periods (IPCC, 2007). The Intergovernmental Panel on Climate Change (IPCC, 2007) has projected that by 2100 atmospheric concentrations of carbon dioxide could have reached between 540 ppm and 970 ppm and that; as a result, global surface temperature could rise by between 1.4°C and 5.8°C. In India agriculture matters first and foremost, not least because the farmer holds a special place in Indian hearts and mind. Developing countries like India are most vulnerable to climate change and variability (Chakravarty *et al.* 2012). From economic point of view Indian agriculture accounts 16 per cent in GDP (Economic Survey of India, 2017- 18), thus agriculture plays important role in social and economic life of people in India. The Increasing climatic vulnerability with global warming has seasonal/annual fluctuations in food production. Droughts, floods, tropical cyclones, heavy precipitation events, hot extremes, and heat waves have negative impact on agricultural production and farmer's livelihood. An increase in CO₂ to 550 ppm increases yield of rice, wheat, pulses and oilseeds by 10-20%. A 1°C increase in temperature may reduce yield of wheat, soybean and mustard by 3-7% (Aggrawal *et al.*, 2009). Losses will be

more with increase in temperature. The productivity of most crops decreases only marginally by 2020 but by 2100 it will be 10-40 per cent due to increase in temperature and rainfall as well as decrease in irrigation water (Mahato, 2014).

Concentrated efforts needs to fulfil the need of growing population and stabilize output and income, agriculture system must become more resilient i.e., more capable of performing well in the face of disruptive events. Effective adaptation and mitigation is required to cope with the climate change (Agrawal, 2007) can be effective when farmers perceive climate vulnerability in a better way. Any coping strategies or adaptation measures towards climate change will be formulated on the basis of the farmers' interest at grass root level.

Perception provides better insights and information relevant to environment and based on experience. Perception is the way in which people was perceives things that defines character and attitude. It represents our understanding of a present situation on the basis of our past experiences. Perception of the farmers gives information about the climate vulnerability and driven by multiple forces.

Understanding of farmers' perception about climate vulnerability can contribute to inform scientific and policy discussions on climate change. Hence, the present study was designed to develop and standardized a scale for measuring farmers' perception towards climate vulnerability which would bring about understanding of farmers experience towards climate vulnerability.

MATERIALS AND METHODS

Perception is the process of receiving information or stimuli from our environment and transforms it into psychological awareness (Van Den Ban and Hawkins, 1996). According to Ray (1991) perception is selective and perceives what one wants to perceive, this happens

because before one perceives a stimuli, he needs to give attention to the stimuli. Perception in this study was operationalized as the degree to which information or idea is perceived by the farmers about climate vulnerability. A psychometric scale was developed to measure the perception of the farmers towards climate vulnerability. The method of summated rating suggested by Likert (1932) was followed in the development of scale and was tested for the reliability and validity. The following steps were considered for measuring perception of farmers towards climate vulnerability :

Collection of statements

The first step in the construction of perception scale is to collect statements related to the perception towards climate vulnerability. A tentative list of 75 statements was collected in relevance to subject through consultation with Extension experts, Agricultural scientists and from available literature.

Editing of statements

These statements were edited as per the “informal criteria of Edwards and Kilpatrick, 1948” (Edwards, 1969). Statements that were overlapping in meaning or content, irrelevant to the local condition were rejected. Out of 75 statements, 62 statements were retained after editing. Further, these statements were evaluated by the concerned experts/scientists for the suitability of the items.

Response to selected statements

The proforma containing raw statements were mailed electronically and also handed over personally to total 150 judges. These judges were experts in the field of Extension Education from various Agricultural Universities and Institutes. The responses of judges were obtained on a three point continuum i.e. most relevant, relevant and not relevant. The judges were requested to

make necessary modifications and additions or deletions, if desire so. Out of 150 judges only 62 judges had returned the statements after duly recording their judgments in a stipulated span of 3 months and were considered for the item analysis.

Item analysis

Item analysis is an important step while constructing valid and reliable scale. The total individual judges score was calculated by summing up the score of each statements given by individual judge.

Calculation of ‘t’ values

The ‘t’ value equal to 1.75 or more than is thumb rule for selecting statements. Basically ‘t’ test find the differences in the mean score for each statements between high and low group selected for the scale (Padaria *et. al*, 2020). Based upon the total individual scores, the judges were arranged in descending order. The top 25 per cent of judges with their total individual score were considered as high group and bottom 25 per cent as the low group so that these two groups provided criterion groups in terms of evaluating the individual statements. With the help of these criterion groups, ‘t’ values were calculated for each statements of the proforma by using the under mentioned formula (Likert, 1932). Thus, out of 62 judges to whom the statements were administered for the item analysis, 16 judges with highest and 16 judges with lowest scores were used as criterion groups to evaluate individual statements.

$$t = \frac{\bar{X}_H - \bar{X}_L}{\frac{\sqrt{\sum(X_H - \bar{X}_H)^2 + \sum(X_L - \bar{X}_L)^2}}{n(n-1)}}$$

Where

t = the extent to which a given statement differentiates between the high and low groups,

\bar{X}_H = the mean score on a given statement for the high group,

\bar{X}_L = the mean score on a given statement for the low group,

$\sum(X_H - \bar{X}_H)^2$ = The variance of the distribution of responses of the high group to the statements,

$\sum(X_L - \bar{X}_L)^2$ = The variance of the distribution of responses of the low group to the statements, and

n = number of subjects in low or high group

Final selection of the statements

The 't' value is a measure of the extent to which a given statement differentiates between the high score and low score groups. The 't' value equal to or greater than 1.75 were selected, finally for inclusion in the perception scale.

Table 1. Standardized scale to measure perception of the farmers' towards climate vulnerability

S.No.	Statements	t value
(A)	Perception towards climate events	
1.	There is increase in environmental temperature	4.648*
2.	There is decrease in environmental temperature	1.704
3.	There is no change in environmental temperature	1.016
4.	I experienced scorching sunshine	5.208*
5.	Sunshine is not scorching	0.698
6.	I observed that the number of rainy days (>2.5mm) are more	1.698
7.	I observed that the number of rainy days (>2.5mm) are less	1.968*
8.	There is no change in the number of rainy days	0.739
9.	I observed that the amount of rainfall is less	1.754*
10.	Uneven distribution of rainfall during cropping season	2.460*
11.	Late onset of monsoon in my region	2.257*
12.	Early withdrawal of monsoon during cropping season	1.623
13.	There is long dry spell during cropping season	2.380*
14.	Unpredictability of rainfall in my region	3.384*

15.	Occurrence of drought was frequent	3.411*
16.	Floods are occurring frequently in my region	1.589
17.	There is increasing incidence of strong wind	3.417*
18.	Hailstorm is common in rabi season	3.904*
19.	Winter has become colder and rainier	4.201*
20.	Summer season is widened	4.362*
21.	Rabi season is shortened	4.261*
(B)	Perception towards the causes of climate change	
22.	Climate change is the punishment of god for ill treatment of nature by human beings	0.823
23.	Ancestral spirits are responsible for climate change	1.358
24.	Deforestation is the prime cause for climate change	2.244*
25.	Continuous cropping make changes in climate events	4.441*
26.	Over grazing is a reason for climate change	7.376*
27.	Excess use of agrochemicals in farms may emit green house gases responsible for global warming	5.650*
28.	Urbanization is responsible for climate change	3.742*
29.	Climate change is a natural phenomena	2.147*
30.	There is no role of human activity in climate vulnerability (-)	4.580*
(C)	Perception towards the impact of climate vulnerability in agriculture	
31.	Weather variation makes farm operations more difficult	2.668*
32.	There is more incidence of insects and pests	4.491*
33.	There is more incidence of plant diseases	4.897*
34.	Climate change affects weed infestation in the field	4.716*
35.	Climate change affects the crop maturity	4.301*
36.	Climate change reduces crop yield	4.293*
37.	Climate change reduces the grain quality of the crops	2.100*
38.	Climate change affects the post harvest management of the crops.	4.261*
39.	There is a fall in the ground water level	5.184*
40.	Sometimes complete failure of crops in my farm due to climate vulnerability	4.032*
41.	There are more incidences of animal diseases.	4.620*

(D)	Climate risk perception	
42.	Extreme weather events will happen more frequently in the future.	7.550*
43.	New insect pest may arise due to climate change	8.518*
44.	New weed species may occur in farm due to climate change	8.081*
45.	New plant diseases may arrive in farm due to climate change	5.644*
46.	Adaptation measures to climate change may increase cost of cultivation	3.019*
47.	Climate change may affect the crop yield in my farm	5.848*
48.	Climate change may reduce the grain quality	4.401*
49.	Climate change may have potential impacts on agriculture	3.177*
50.	Climate change may have potential impact on human system	2.441*
(E)	Overall perception of the farmers towards climate vulnerability	
51.	Climate effects are extreme and notable	2.705*
52.	There is no change in climate in my region (-)	1.678
53.	There is variation in summer temperature	6.253*
54.	There is variation in winter temperature	5.681*
55.	Erratic distribution of rainfall during crop growth period	3.109*
56.	Cropping season are changing in my village due to climate vulnerability	3.886*
57.	Degradation and unsuitability of land for cultivation	2.737*
58.	Climate vulnerability is affecting my farming	7.080*
59.	Climate change increases food insecurity	3.733*
60.	Critical crop growth stage is highly vulnerable to weather variability	1.973*
61.	Climate vulnerability forces the migration of village people to urban area	3.886*
62.	My standard of living will improve due to climate vulnerability (-)	3.255*

*statements selected for scale

Reliability of scale

A scale is reliable when it gives consistently the same results when applied to the same sample. The final set of the 52 statements which represents the perception of the farmers towards climate vulnerability, was administered on five continuum basis to a fresh group of 20 farmers, which were not included in the actual sample. The designed perception scale for the study was

pre- tested for its reliability by using the split half technique. Reliability was calculated by using the under mentioned Formula (Spearman, 1910, Brown 1910).

$$r_{SB} = \frac{2r_{hh}}{1 + r_{hh}}$$

Where,

r_{hh} = Pearson correlation between odd and even

The coefficient of correlation between odd and even scores was 0.82 found to be significant at 1 per cent level of significance. It showed that scale is reliable.

Validity of scale

Validity of scale is the property that ensure the obtained test score as valid, if and only if it measure what it is supposed to measure. A scale is said to be valid if it stands for one's reasoning.

The content validity of the scale was tested. The content validity is the representative or sampling adequacy of the content, the substance, the matter and the topics of a measuring instrument. This method was used in the present scale to determine the content validity of the scale. As the content of the perception was thoroughly covered the entire universe of the climate vulnerability through literature and expert opinion, it was assumed that present scale satisfied the content validity. As the scale value difference for almost all the statements included had a very high discriminating value, it seemed reasonable to accept the scale as valid measure of the desired dimension.

RESULTS AND DISCUSSION

The final scale consisting of 52 statements can be administered to the farmers on a five point continuum viz., Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (D) and Strongly Disagree (SD) with a weightage of 5,4,3,2 and 1 for positive statements and reverse scoring

system for negative statements. The overall possible maximum and minimum score ranges between 260 to 52 (Table 2).

Table 2: The final perception scale comprising 52 statements

S.No.	Statements	Responses				
		SA	A	UD	D	SD
(A)	Perception towards climate events					
1.	There is increase in environmental temperature					
2.	I experienced scorching sunshine					
3.	I observed that the number of rainy days (>2.5mm) are less					
4.	I observed that the amount of rainfall is less					
5.	Uneven distribution of rainfall during cropping season					
6.	Late onset of monsoon in my region					
7.	There is long dry spell during cropping season					
8.	Unpredictability of rainfall in my region					
9.	Occurrence of drought was frequent					
10.	There is increasing incidence of strong wind					
11.	Hailstorm is common in rabi season					
12.	Winter has become colder and rainier					
13.	Summer season is widened					
14.	Rabi season is shortened					
(B)	Perception towards the causes of climate change					
15.	Deforestation is the prime cause for climate change					
16.	Continuous cropping make changes in climate events					
17.	Over grazing is a reason for climate change					
18.	Excess use of agrochemicals in farms may emit green house gases responsible for global warming					
19.	Urbanization is responsible for climate change					
20.	Climate change is a natural phenomena					
21.	There is no role of human activity in climate					

	vulnerability (-)					
(C)	Perception towards the impact of climate vulnerability in agriculture					
22.	Weather variation makes farm operations more difficult					
23.	There is more incidence of insects and pests					
24.	There is more incidence of plant diseases					
25.	Climate change affects weed infestation in the field					
26.	Climate change affects the crop maturity					
27.	Climate change reduces crop yield					
28.	Climate change reduces the grain quality of the crops					
29.	Climate change affects the post harvest management of the crops.					
30.	There is a fall in the ground water level					
31.	Sometimes complete failure of crops in my farm due to climate vulnerability					
32.	There are more incidences of animal diseases.					
(D)	Climate risk perception					
33.	Extreme weather events will happen more frequently in the future.					
34.	New insect pest may arise due to climate change					
35.	New weed species may occur in farm due to climate change					
36.	New plant diseases may arrive in farm due to climate change					
37.	Adaptation measures to climate change may increase cost of cultivation					
38.	Climate change may affect the crop yield in my farm					
39.	Climate change may reduce the grain quality					
40.	Climate change may have potential impacts on agriculture					
41.	Climate change may have potential impact on human system					
(E)	Overall perception of the farmers towards climate vulnerability					

42.	Climate effects are extreme and notable					
43.	There is variation in summer temperature					
44.	There is variation in winter temperature					
45.	Erratic distribution of rainfall during crop growth period					
46.	Cropping season are changing in my village due to climate vulnerability					
48.	Degradation and unsuitability of land for cultivation					
49.	Climate vulnerability is affecting my farming					
50.	Climate change increases food insecurity					
51.	Critical crop growth stage is highly vulnerable to weather variability					
52.	Climate vulnerability forces the migration of village people to urban area					
62.	My standard of living will improve due to climate vulnerability (-)					

CONCLUSION

Effective adaptation towards to climate vulnerability is mainly depends upon when farmers were able to understand climate change and vulnerability which inturn is reflected by their perception towards it. Hence, a scale to measure the perception of farmers towards climate vulnerability has been presented in this paper. This scale can be used with suitable modification by future researchers to measure the perception of farmers towards climate vulnerability.

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