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Determining the Dimensions Affecting Resilience Status of Livestock Farmer against Extreme Weather Events by Developing One Resilience Scale

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A B S T R A C T

Understanding the 'Resilience status' of farmer especially livestock farmers is very important as it can indicate the individual farmer's coping ability against extreme weather events. One resilience scale was developed to measure the resilience of farmers. A total of 29 statements/ items were sent to different judges and their opinion and rating was recorded by using 'Google form'. On the basis of calculation of 't-values' 14 items were retained for final 'Resilience Scale' construction. Then from 102 respondents, responses were recorded to identify the dimensions of 'resilience' against extreme weather event. 'Factor Analysis' was used for identifying the dimensions. A total of five components were explaining 72.814 percent of total variability. The five component were named as 'Extreme weather preparedness dimension', 'Peer Support and recognition dimension', 'Pessimistic attitudinal dimension', 'Optimistic attitudinal dimension' and 'Priority setting dimension'. The developed 'Resilience scale' can be handy tool to measure resilience status of farmers and support policy makers in decision making and field extension worker for prioritizing activities.

Introduction

The contribution of agricultural GDP to total GDP has decreased enormously in the last two decades. Many farmers who were actively engaged in agriculture have left the occupation and became marginal laborer due to uncertainties involved in agriculture. Though, still Agriculture is the principal source of livelihood for more than 58% of the population of this country (Anand, 2017). The one of the major sources of uncertainty in Indian agriculture is due to uncertain weather conditions. It has been seen form practical experiences that the farmers who are raising livestock along with their regular crop farming have been succeeded in evading the economic losses arising due to weather vagaries. Thus, study of resilience status of livestock farmers against extreme weather events is becoming more and more important, especially in changing global climatic condition.

Timmerman (1981) has defined resilience as a system's capacity to absorb and recover from the occurrence of a hazardous event; reflective of a society's ability to cope and to continue to cope in the future. Livestock farmer's capacity and their agility to adjust with changing weather conditions can effectively indicate their surviving potentiality in the changing climatic conditions. The impacts of extreme weather events will depend on interactions between the physical impacts and socio-economic factors (Linnenluecke *et al.,* 2008). Thus, identifying the underlying factors which signifies the resilience status of farmers is very much critical. A sustainable network of physical systems and human communities, capable of managing extreme events; during disaster, both must be able to survive and function under extreme stress (Godschalk, 2003). In the rapidly developing area of research on ecosystem services and the people who depend on them, the term "resilience" is often used to describe the characteristic features of a system that are related to sustainability (Carpenter *et al.,* 2001). A sustainable farming system which is resilient to extreme weather events must be flexible to absorb the stress generated by extreme weather events. By taking account of all these aspects, one study has been conducted to identify and analyze the determining factors which describe the resilience status of livestock farmers by developing one 'Resilience Scale'.

Material and Methods

Construction of 'Resilience Scale'

For construction of 'resilience scale' 89 items were constructed after consultation with experts and from available literatures. After through consideration and fixing the criteria given by Edwards (1969) 29 items were retained and responses from judges were collected by using 'Google Form'. The responses were collected from different judges who were professionals belonged to ICAR Deemed Universities, Central Agricultural University, State Agricultural Universities, State Veterinary and Animal Husbandry University, *Krishi Vigyan Kendras*, Rama Krishna Mission Vivekananda University etc. Response from 36 judges was retained for final item analysis and 14 statements have been retained. The statements were retained on the basis of t-value (more than 1.75). After that the items were coded with code names. The selected items and their respective code names along with their t-values are given in the Table 1.

Reliability of the 'Resilience scale' was checked by Cronbach's alpha. The value of Cronbach's alpha was 851 with 14 items which was suggesting that items were having relatively high internal consistency. For validity of the scale 'Face Validity' was used.

Data collection

Responses from 102 respondents from different parts of West Bengal were collected to run Factor Analysis by using Principal Component Analysis (PCA) to group different items in different underlying dimensions. First of all, Kaiser-Meyer-Olkin Measure of Sampling Adequacy was checked and the value was found to be .713. In case of Bartlett's Test of Sphericity, Approx. Chi-Square value was 611.729 which was significant at 1 percent level of significance. This suggested that, the PCA can be run on the data. SPSS 20 was used for analysis.

Results and Discussion

Total variation explained by different components

Factor Analysis by using Principal Component Analysis (PCA) was done to identify different

underlying factors of resilience towards extreme weather events. As in total 14 items were there in 'Resilience Scale' 14 components were generated. From Table 2 it can be seen that, 72.814 percent of total variance was explained by these 5 components. The first component has explained the highest amount of variability and contributed 25.364 percent of total variability, on the other hand second, third, fourth and fifth components contributed 13.057, 12.006, 11.334 and 11.054 percent of total variability respectively. Rest 9 component have contributed less than 28 percent of the total variability.

From the scree plot (Fig. 1) we can see 5 components were having Eigen value more than 1. By default, in most statistical software packages is to retain all factors with eigenvalues greater than 1.0 (Costello and Osborne,2005). Rest nine component were having eigenvalues less than 1 and thus was not considered for further analysis. More over it can also be seen from the graph that the eigenvalues were consistently lower from 6th component to 14th component.

Rotated component matrix to identify different dimensions

Varimax rotation was used with Kaiser Normalization and we got the Table 3 and the items were grouped according to the rotated component matrix. The items with loadings equal to or greater than 0.3 were considered meaningful and extracted for factor analysis, as typically, researchers take a loading of an absolute value of more than 0.3 to be important (Field, 2009).According to the results of rotated component matrix we got five components and different items under each dimension were identified. Under the first component 6 items fell (item no 3, 7, 8, 10, 2,14). In the second component 3 items fell (item no. 11,9,12). Similarly, under component no 3, 4 and 5 a total of 2, 2 and 1 items fell respectively. The details of the same are given in the Table 3.

Identification and naming different dimensions associated with resilience

From the Table 4 different items of the developed resilience scale were grouped in to different dimensions according to the analysis of PCA. For the first component which is explaining 25.364 percent of total variability is consisting of 6 statement namely: 'When I face extreme weather events I can easily find out the way out of it', 'Outcome of extreme weather events make me nervous', 'I am always prepared to face extreme weather events', 'I have less self confidence to face the challenge of extreme weather events alone', 'I always save money to adjust losses due to natural disaster' and 'I always take interest on weather forecast'. Out of these six statements four statements were positive and two statements were negative. The component was named as 'Extreme weather preparedness dimension'. All the statements under these dimension was indicating the psychological preparedness of one individual to face the challenges of extreme weather events. The second component was explaining 13.057 percent of total variability and named as 'Peer Support and recognition dimension'. The items falling under the dimension were 'In extreme weather events other farmer takes my assistance', 'My friends will stand by my side in difficult times', 'During hard times my family is my biggest strength'. All the items under this dimension is indicating support from friend and family which can give psychological advantage in facing extreme weather events situations. This is one of the important dimensions as social support can enhance individual's mental strength to face challenges due to extreme weather events.

Table.1 Selected 'Resilience Scale' Items along with their t-values and code name of the items

Item no.	Item	t-value	Code Name of the items
1	When I face natural disaster I cannot take prompt action	4.35	FNDPA
2	I always save money to adjust losses due to natural disaster.	4.98	SMLND
3	When I face extreme weather events I can easily find out the way out of it	4.86	EWEFW
4	I am a very disciplined person	4.00	VDP
5	Keeping busy myself in farming is the most important thing for me	4.22	KBFMI
6	I feel frustrated when I face losses in farm business	6.15	FFLFB
7	Outcome of extreme weather events make me nervous.	3.43	OEWMN
8	I am always prepared to face extreme weather events	4.57	PFEWE
9	My friends will stand by my side in difficult times.	4.69	FSDT
10	I have less self confidence to face the challenge of extreme weather events alone.	3.62	LSCCE
11	In extreme weather events other farmer takes my assistance	4.10	OFTMA
12	During hard times my family is my biggest strength.	3.53	HTFBS
13	I always find-out brighter side of any incidence.	5.06	FBSAI
14	I always take interest on weather forecast	5.08	TIWF

Fig.1 Scree plot

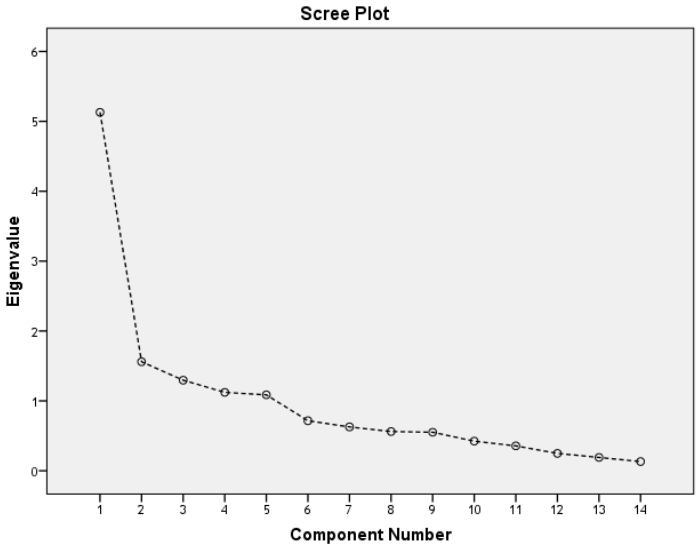

Table.2 Total variance explained

Total Variance Explained									
Component no	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1.	5.130	36.643	36.643	5.130	36.643	36.643	3.551	25.364	25.364
2.	1.560	11.142	47.784	1.560	11.142	47.784	1.828	13.057	38.421
3.	1.296	9.256	57.040	1.296	9.256	57.040	1.681	12.006	50.427
4.	1.122	8.013	65.053	1.122	8.013	65.053	1.587	11.334	61.760
5.	1.087	7.761	72.814	1.087	7.761	72.814	1.548	11.054	72.814
6.	.716	5.111	77.925						
7.	.627	4.481	82.407						
8.	.562	4.012	86.419						
9.	.551	3.935	90.353						
10.	.423	3.025	93.378						
11.	.356	2.544	95.923						
12.	.249	1.775	97.698						
13.	.191	1.361	99.059						
14.	.132	.941	100.000						

Table.3 Rotated component matrix

	Component				
	1	2	3	4	5
EWEFW ((Item 3)	.827				
OEWMN (Item 7)	.780				
PFEWE (Item 8)	.722				
LSCCE (Item 10)	.716				
SMLND (Item 2)	.618				
TIWF (Item 14)	.577				
OFTMA (Item 11)		.772			
FSDT (Item 9)		.689			
HTFBS (Item 12)		.561			
FNDPA (Item 1)			.763		
FFLFB (Item6)			.745		
VDP (Item4)				.854	
FBSAI (Item 13)				.766	
KBFMI (Item5)					.864

Table.4 Dimensions along with underlying items

Dimension 1: Extreme weather preparedness dimension(Percentage of Explained Variability = 25.364)
When I face extreme weather events I can easily find out the way out of it (+)
Outcome of extreme weather events make me nervous (-)
I am always prepared to face extreme weather events (+)
I have less self confidence to face the challenge of extreme weather events alone. (-)
I always save money to adjust losses due to natural disaster. (+)
I always take interest on weather forecast (+)
Dimension 2: Peer Support and recognition dimension (Percentage of Explained = Variability 13.057)
In extreme weather events other farmer takes my assistance (+)
My friends will stand by my side in difficult times. (+)
During hard times my family is my biggest strength. (+)
Dimension 3: Pessimistic attitudinal dimension (Percentage of Explained Variability = 12.006)
When I face natural disaster I cannot take prompt action (-)
I feel frustrated when I face losses in farm business (-)
Dimension 4: Optimistic attitudinal dimension (Percentage of Explained Variability = 11.334)
I am a very disciplined person (+)
I always find-out brighter side of any incidence. (+)
Dimension 5: Priority setting dimension (Percentage of Explained Variability= 11.054)
Keeping busy myself in farming is the most important thing for me (+)

('+' or '-' signs in the parenthesis indicates whether the statement is positive or negative, respectively)

McLaren and Challis (2009) also reported that, increasing social support and sense of belonging may benefit the mental health of farmers. Southwick *et al.,* (2016), also found that social support appears to be associated with resilience via a number of psychological and behavioral mechanisms. The third component which has contributed 12.006 percent in total variability was named as 'Pessimistic attitudinal dimension'. 'When I face natural disaster I cannot take prompt action' and 'When I face natural disaster I cannot take prompt action' were the items which fell under the dimension. Both of them were negative items and thus accordingly the dimension name was given as pessimistic dimension. The fourth dimension was 'Optimistic attitudinal dimension' and under this dimension also two items fell; namely, 'I am a very disciplined person' and 'I always find-out brighter side of any incidence'. Both the items were positive and thus the dimension name was assigned as optimistic dimension. The last dimension was named as 'Priority setting dimension' which was explaining 11.054 percent of total variability. Under the dimension one item was there namely 'Keeping busy myself in farming is the most important thing for me'. This item was also a positive item and indicating the prioritisation of activities thus the dimension name was given as priority setting dimension. Now these statements can be used measure 'Resilience status' of any respondents/ farmers by using a 5 point continuum scale as proposed by Likert (1932). These dimensions

actually explaining more than 70 per cent (Table 2) of variability which explain the resilience status of livestock farmers against extreme weather events.

It is concluded by understanding the resilience status of livestock farmer against extreme weather events is important as this status can categorise different groups of farming community according to their resilience capacity and in turn can help the policy maker and field extension worker to prioritise their intervention. Farmer varies in resilience status and accordingly the farmers with least resilience status can be attended by extension workers to make them fit to face the challenges of nature by developing their capacity, enhancing skill, improving knowledge and overall modification of behaviour. The developed 'Resilience Scale', thus, can not only serve to measure the individual farmer's resilience status but it can also become handy tool for field extension worker. On the other hand, the policy maker can identify areas dominated by farmers with low resilience status and can formulate contingency plans for those areas.

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