

An index to metricise the disaster resilience of Thane cyclone affected cashew growers

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ABSTRACT

The disaster resilience index (DRI) brings together a group of indicators related to the disaster resilience performance of the farmers in the affected regions. These reflect the organizational, developmental, capacity and institutional action taken to reduce damages and losses to prepare for crisis and efficiently recover. The present study describes the development of a DRI of Thane cyclone affected cashew growers in Cuddalore district. Relevancy weightage score was used to develop the index which comprised 28 indicators identified based on judges' opinion considering the relevancy score obtained by each of the indicator. Fourteen indicators having the score of more than 0.69 were selected. The potential value of the DRI was also examined by exploring the impact of Thane storm on local population.

Keywords: Disaster; resilience; index; indicator; cashew growers

INTRODUCTION

Disaster risk is not only associated with the occurrence of intense physical phenomenon but also with the vulnerability conditions that favour or facilitate disaster when such phenomenon occurs. Vulnerability is intimately related to social processes in disaster prone areas and is usually related to the fragility, susceptibility or lack of resilience of the population when faced with different hazards. In other words

disasters are socio-environmental by nature and their materialization is the result of the social construction of risk. The resilience tool provides a framework for understanding the most effective combination of short and long term strategies for lifting families out of cycles of poverty and hunger. A commonly used definition of resilience is the ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change

(Adger 2000). In food security context resilience is defined as the ability of a household to keep with a certain level of well-being (ie being food secure) by withstanding shocks and stresses. This depends on available livelihood options and on how well households are able to handle risks. This definition implicitly considers both (ex-ante) actions that reduce the risk of households becoming food insecure and (ex-post) actions that help households cope after a crisis occurs.

Why measure resilience?

The insight of why and how people become food insecure suggests ways of preventing this from happening. If interventions are designed in ways that increase resilience by enhancing people's ability to manage risk over time the need for humanitarian interventions when hazards occur will diminish. Resilience index should not be seen as an alternative to vulnerability index but as a complement. Vulnerability index tends to measure only the susceptibility of people to damage when exposed to particular hazards or shocks. Moreover the lack of long-term reliable panel data means that vulnerability index as applied at present is appropriate only for cross-sectional surveys. This approach risks oversimplifying a more systemic view of household strategies by reducing the relevance of long term components (Azam and Imai 2009). Resilience index on the other hand uses a systemic approach which incorporates both short and long term factors.

Disaster resilience index (DRI)

It is the ability to prevent disasters and crises as well as to anticipate, absorb, accommodate or recover from them in a timely, efficient and sustainable manner. This includes protecting, restoring and improving food and agricultural systems under threats that impact food and nutrition security, agriculture and food safety/public health (Anon 2012). In this study disaster resilience has been operationalised as extent to which the existence of selected indicators are perceived by the respondents at given point of time. The indicators were identified by reviewing the literature and as quoted by various authors.

Identification and scrutiny of indicators

Identification of indicators influencing the disaster resilience was carried out through detailed analysis of literature. Further scrutiny was done by discussion with experts from the relevant field viz Department of Agricultural Extension and Rural Sociology, Environmental Scientists, Economists and Directorate of Agri-Business Development in TNAU, Coimbatore as well as Joint Director of Horticulture and Assistant Agricultural Officers working in Thane affected area. Based on the preliminary discussion twenty eight indicators were selected considering the situation existed in the study area.

Relevancy rating of the indicators

The list of indicators was sent to 55 judges who comprised extension specialists

of State Agricultural Universities of Tamil Nadu, Kerala, Andhra Pradesh, Karnataka and Gandhigram Rural University. Of the 55 judges 30 responded by sending their judgement. The experts were requested to specify whether each of the identified indicators was relevant and suitable for inclusion to measure disaster resilience of the Thane affected cashew growers or not. Their

responses were obtained on a three point continuum viz 'most relevant', 'relevant' and 'least relevant' frequencies and scored as 3, 2 and 1 respectively.

The responses received from the judges were analysed and the relevancy weightage (RW) of i^{th} indicator (RW_i) was worked out by using the following formula:

$$\text{Relevancy weightage (RW)} = \frac{(\text{Most relevant} * 3) + (\text{Relevant} * 2) + (\text{Not relevant} * 1)}{\text{Maximum possible score}}$$

The indicators sent for judges' opinion with their relevancy weightage are presented in Table 1.

Considering the average of relevancy weightage scores (0.69) the components were screened for their relevancy. Accordingly components having relevancy weightage of more than 0.69 were considered. Using this process fourteen indicators having more than 0.69 relevancy weightage were selected for the study and are furnished in Table 2.

Followed by identification of major indicators of disaster resilience, statements were identified for each major indicator.

Selection of statements

Under each major indicator the statements were framed based on perusal of literature and discussion with experts. The statements were edited based on 14 criteria

suggested by Edwards (1969). These statements were then subjected to scrutiny by an expert panel of judges to determine the relevancy. For this purpose the statements were given to a panel of 30 judges who were requested to indicate the appropriateness (relevancy) of each statement for inclusion in the scale. The responses were obtained on three point continuum viz 'most relevant', 'relevant' and 'not relevant' with scores of 3, 2 and 1 respectively. Based on judges' responses the relevancy weightage was worked out for each statement by using the formula stated above. The statements having relevancy weightage of 0.69 and above were selected.

Procedure for development of disaster resilience index (DRI)

The finalised schedule with fourteen major indicators and their respective statements was administered to the

Table 1. Identified disaster resilience indicators with their relevancy weightage

Indicator	Relevancy weightage
Agricultural assets/non-agricultural assets	1.01
Risk taking ability	0.67
Decision making behaviour	0.60
Self-confidence	0.62
Coping with Stressors	0.81
Time of resilience	0.82
Knowledge on disaster management	0.80
Social safety net	0.90
Planning ability	0.83
Conflict management	0.57
Coordinating ability	0.50
Crisis preparedness	0.85
Leadership capability	0.36
Trainability	0.36
Social participation	0.36
Dependency	0.36
Literacy level	0.36
Resource management	0.36
Adopting new technology and practices	0.93
Not easily discouraged by failure	0.54
Hardship	0.49
Climate change	0.96
Shocks due to natural disaster	0.36
Access to basic services	1.02
Income and food access	1.06
Sensitivity	0.87
Adaptive capacity	0.89
Enabling institutional environment	0.98
Average	0.69

Table 2. List of finalized disaster resilience indicators with their relevancy weightage

S/N	Indicator	Relevancy weightage
1.	Agricultural assets/non-agricultural assets	1.01
2.	Coping with stressors	0.81
3.	Time of resilience	0.82
4.	Knowledge on disaster management	0.80
5.	Social safety net	0.90
6.	Planning ability	0.83
7.	Crisis preparedness	0.85
8.	Adopting new technology and practices	0.93
9.	Climate change	0.96
10.	Access to basic services	1.02
11.	Income and food access	1.06
12.	Sensitivity	0.87
13.	Adaptive capacity	0.89
14.	Enabling institutional environment	0.98

respondents. In case of the quantitative indicators the respondents were asked to put forth their choices. The scores were given based on measurement and the scoring procedure developed by Thilagam (2012). In case of the qualitative indicators the respondents were asked to give their responses based on a three point continuum scale viz agree (A), undecided (UD) and disagree (D) for which the scores given were 3, 2 and 1 respectively.

Quantification of indicators

Each indicator was measured by means of scoring procedure developed for the study. To evolve a composite DRI and to derive meaningful conclusions separate index was developed for each indicator. The

procedure followed by Thilagam (2012) was adopted with necessary modification as suited for the study. The details of quantification of each indicator are furnished below:

1. Agricultural assets/non-agricultural assets index (AA/NAAI)

These are the key elements of a livelihood. In both rural and urban contexts assets give a household the opportunity to have something tradable, something to build an activity upon and assets to employ. Examples of indicators include land, livestock and durables. The agricultural assets/non-agricultural assets index was worked out by using the following formula:

$$AA/NAAI = SAA/NAA_{xi} / TAA/NAA_{yi}$$

where

AA/NAA= Agricultural assets/
non-agricultural assets index

SAA/NAA xi= Score secured by
a Thane affected cashew grower on
agricultural assets/non-agricultural assets

TAA/NAAYi= Total possible score
for a Thane affected cashew grower on
agricultural assets/non-agricultural assets

Thus calculated AA/NAA score
was used for further analysis.

2. Coping with stressors index (CSI)

This is the technique of controlling
the levels of stress by a disaster affected
farmer for the purpose of improving his
resilience for the disaster. Stressors index
was worked out by using the following
formula:

$$CSI = SCSIXi / TCSI yi$$

where

CSI= Coping with stressors index

SCSI xi= Score secured by a
Thane affected cashew grower on coping
with stressors

TCSIyi= Total possible score for a
Thane affected cashew grower on coping
with stressors

Thus calculated CSI score was
used for further analysis.

3. Time of resilience index (TRI)

This is act or process of planning
and exercising conscious control over the
amount of time spent on specific activities
especially to increase effectiveness and
efficiency in managing the disaster. The time
of resilience index was worked out by using
the following formula:

$$TRI = STRIXi / TTRI yi$$

where

TRI= Time of resilience index

STRI xi= Score secured by a
Thane affected cashew grower on time of
resilience

TTRIyi= Total possible score for a
Thane affected cashew grower on time of
resilience

Thus calculated TRI score was
used for further analysis.

4. Knowledge on disaster management index (KDMI)

It refers to the level of knowledge
possessed by the disaster affected farmer
about the disaster and its management
techniques. The knowledge on disaster
management index was worked out by using
the following formula:

$$KDMI = SKDMI_{xi} / TKDMI_{yi}$$

where

KDMI= Knowledge on disaster management index

SKDMI_{xi}= Score secured by a Thane affected cashew grower on knowledge about disaster management

TKDMI_{yi}= Total possible score for a Thane affected cashew grower on knowledge about disaster management

Thus calculated KDMI score was used for further analysis.

5. Social safety net index (SSNI)

Social safety nets are a crucial aspect of mitigating crisis. They include assistance from international agencies, charities and non-governmental organizations as well as help received from friends and relatives. The social safety net index was worked out by using the following formula:

$$SSNI = SSSNI_{xi} / TSSNI_{yi}$$

where

SSNI= Social safety net index

SSSNI_{xi}= Score secured by a Thane affected cashew grower on social safety net index

TSSNI_{yi}= Total possible score for a Thane affected cashew grower on social safety net index

Thus calculated SSNI score was used for further analysis.

6. Planning ability index (PAI)

The degree to which a disaster affected farmer is capable of starting the activities that he or she intends to do by certain ways in his own plan and will, comes under it. The planning ability index was worked out by using the following formula:

$$PAI = SPAI_{xi} / TPAI_{yi}$$

where

PAI= Planning ability index

SPAI_{xi}= Score secured by a Thane affected cashew grower on planning ability index

TPAI_{yi}= Total possible score for a Thane affected cashew grower on planning ability index

Thus calculated PAI score was used for further analysis.

7. Crisis preparedness index (CPI)

It includes the capability of a farmer to anticipate and prepare for crisis situation by proactively following up with the disaster alerts in minimizing the impact. The crisis

preparedness index was worked out by using the following formula:

$$CPI = SCPI_{xi} / TCPI_{yi}$$

where

CPI= Crisis preparedness index

SCPI $_{xi}$ = Score secured by a Thane affected cashew grower on crisis preparedness index

TCPI $_{yi}$ = Total possible score for a Thane affected cashew grower on crisis preparedness index

Thus calculated CPI score was used for further analysis.

8. Adopting new technology and practices index (ATPI)

This dimension captures the level of adoption of different technologies and practices in farming activities. Examples of indicators include fertilizers, artificial insemination and pesticides among other technological inputs adopted in agriculture. Adopting new technology and practices index was worked out by using the following formula:

$$ATPI = SATPI_{xi} / TATPI_{yi}$$

where

ATPI= Adopting new technology and practices index

SATPI $_{xi}$ = Score secured by a Thane affected cashew grower on adopting new technology and practices index

TATPI $_{yi}$ = Total possible score for a Thane affected cashew grower on adopting new technology and practices index

Thus calculated ATPI score was used for further analysis.

9. Climate change index (CCI)

In rural areas climate change can highly affect the capacity of a household to make a living (eg drought in the Horn of Africa). Examples of indicators include soil type, soil erosion and soil degradation. The climate change index was worked out by using the following formula:

$$CCI = SCCI_{xi} / TCCI_{yi}$$

where

CPI = Climate change index

SCCI $_{xi}$ = Score secured by a Thane affected cashew grower on climate change index

TCCI $_{yi}$ = Total possible score for a Thane affected cashew grower on climate change index

Thus calculated CCI score was used for further analysis.

10. Access to basic services index (ABSI)

This shows the capacity of a household to rely on a valid infrastructural setting. Examples of indicators include access to school, markets, health facilities and other minimum requirements (eg toilets, water and electricity). The access to basic services index was worked out by using the following formula:

$$ABSI = SABSIX_i / TABSI_i$$

where

ABSI= Access to basic services index

SABSIX_i= Score secured by a Thane affected cashew grower on access to basic services index

TABSI_i= Total possible score for a Thane affected cashew grower on access to basic services index

Thus calculated ABSI score was used for further analysis.

11. Income and food access index (IFAI)

These are aspects of a livelihood showing a household's capacity to earn a living. Examples of indicators include income, caloric intake and food expenditure. The income and food access index was worked out by using the following formula:

$$IFAI = SIFAI_{xi} / TIFAI_{yi}$$

where

IFAI= Income and food access index

SIFAI_{xi}= Score secured by a Thane affected cashew grower on income and food access index

TIFAI_{yi}= Total possible score for a Thane affected cashew grower on income and food access index

Thus calculated IFAI score was used for further analysis.

12. Sensitivity index (SI)

Sensitivity has two complementary meanings (i) the degree to which the household is actually affected by the shock (ie a household deriving a large part of its total income from shock affected activities has higher sensitivity than others) and (ii) the degree to which the household has been affected by the shock in the recent past (ie whether a household has been struck by a shock for the first time in five years or struck every year has important consequences with the household's sensitivity increasing and its capacity to react to the shock. The sensitivity index was worked out by using the following formula:

$$SI = SSI_{xi} / TSI_{yi}$$

where

SSI= Sensitivity index

SSI xi= Score secured by a Thane affected cashew grower on sensitivity index

TSIyi= Total possible score for a Thane affected cashew grower on sensitivity index

Thus calculated SI score was used for further analysis.

13. Adaptive capacity index (ACI)

This shows the capacity of a household to adapt to a new situation and develop new sources of livelihood (eg having more sources of income may decrease the negative effects a shock creates on a household). The adaptive capacity index was worked out by using the following formula:

$$ACI = SACI_{xi} / TACI_{yi}$$

where

ACI= Adaptive capacity index

SACI xi= Score secured by a Thane affected cashew grower on adaptive capacity index

TACIyi= Total possible score for a Thane affected cashew grower on adaptive capacity index

Thus calculated ACI score was used for further analysis.

14. Enabling institutional environment (EIEI)

The presence of strong support from local and central authorities plays a key role in the ability of households to cope with shocks. Examples of indicators include rural communities' perception of the presence and quality of services provided. The enabling institutional environment was worked out by using the following formula:

$$EIEI = SEIEI_{xi} / TEIEI_{yi}$$

where

EIEI= Enabling institutional environment

SEIEI xi= Score secured by a Thane affected cashew grower on enabling institutional environment

TEIEIyi= Total possible score for a Thane affected cashew grower on enabling institutional environment

Thus calculated EIEI score was used for further analysis.

CONCLUSION

“What gets measured, gets managed” by Peter Drucker is a very powerful quote and has immense meaning to it. On the same lines the study was conducted to metricise the disaster resilience levels of the Thane storm affected

farmers of Cuddalore district in Tamil Nadu. The resilience levels once indexed and measured shall be of great use in effectively managing natural disasters and enabling the victims to build higher levels of resilience with almost no extra effort in management.

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