

# ASSESSMENT OF COMMUNITY DISASTER RESILIENCE IN SRI LANKA: METHODOLOGICAL APPROACH IN DEVELOPING AN INDEX

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## ABSTRACT

*Disasters threaten communities, causing immense damage to life, property, and overall well-being. In recent years, the frequency and impact of disasters have increased, highlighting the urgent need for enhancing Community Disaster Resilience (CDR). CDR refers to a community's ability to effectively anticipate, respond to, and recover from disasters. This research presents the proposed methodology to develop an index to measure community resilience to disasters in Sri Lanka. Based on the previous studies on resilience, a Systematic Literature Review (SLR) was conducted to identify all possible proxy indicators of CDR across economic, social, institutional, physical, environmental, and human health dimensions. The primary data collection and analysis will be conducted using a systematic approach called Q-methodology. As the SLR results generated too many items in the first instance, a pilot study will be undertaken to reduce the number and to identify the most relevant indicators (Q-set) for measuring CDR in Sri Lanka. This Q-set data will be ranked based on how much each expert in the field of disaster management, who will be selected through the snowball technique, would agree with each identified indicator (Q-sort). Then, Q-sort data is subjected to factor analysis to determine the inter-correlation between the results of Q-sorting. The qualitative data gathered during Q-sorting is expected to be analysed using thematic analysis. Finally, the index will be constructed by deriving the weightage of each indicator based on the Q-sorting results. This paper provides an extensive illustration of the above methodology.*

**Keywords:** Community Disaster Resilience (CDR); Index; Indicators; Methodology.

## 1. INTRODUCTION

With the increase in occurrences of high-impact disasters, the concept of resilience is widely recognised (Tanvir et al., 2022). In the disaster context, the word resilience can simply be explained as the ability of people to recover within the shortest possible time with minimal or no assistance (Malalgodha et al., 2013). Disaster resilience is further

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defined as the capacity to adapt existing resources and skills to new situations and operating conditions (Lee, 2020; Tanvir et al., 2022). However, natural hazard events do not always turn into natural disasters, particularly in resilient communities (Parsons et al., 2016). According to Cox and Hamlen (2015), Graveline and Germain (2022) and Tariq et al. (2022), resilience-building actions and interventions are primarily carried out at the community level because the ability of a community to survive and thrive is crucial in the face of uncertainty. Tariq et al. (2021a) define the term community as a group of people with diverse characteristics linked by social ties, sharing common perspectives, and engaging in joint action in geographical locations or settings. As Cutter et al. (2008) highlighted, key assessment factors for disaster resilience are social, economic, institutional, infrastructure, community competence (health, understanding risk, quality of life, etc.), and environmental. Further, Tariq et al. (2021a) define community resilience as a multidimensional concept that includes physical, human/health, economic, social, environmental, and governance. Those dimensions of resilience need to be transformed through a common characteristic of the community (e.g. geographic location, livelihood, etc.) to form community resilience (Norris et al., 2008; Tariq et al., 2021a)

As the Community Disaster Resilience (CDR) concept continues to evolve, researchers are increasingly focusing on developing frameworks and tools that can measure and classify community resilience (Tariq et al., 2021a). The assessment of resiliency is crucial not only for planning and decision-making yet for identifying the vulnerable population in the society that is usually most affected when a disaster strikes (Deria et al., 2020). Two main ways of measuring disaster resilience are qualitative and quantitative (Aksha & Emrich, 2020). In-depth interviews, focus group discussions, life stories, and observations are commonly used in qualitative approaches to explore community resilience in small-scale studies (Scherzer et al., 2019). Cutter (2016) stated that quantitative measures often result in indices, scorecards, models and toolkits. However, Rodriguez et al. (2022) argue that its operationalisation remains unclear despite many attempts to quantify resilience. Further, Koliou et al. (2020) emphasise that, despite the growing importance of measuring CDR, no straightforward procedure to define and measure CDR has emerged. Moreover, most existing studies focused on measuring resilience in a particular region and at a particular scale without deriving inferential rules or equations for further use (Lam et al., 2016).

Furthermore, Aksha and Emrich (2020) suggest that resilience measures have primarily been a developed world phenomenon because various methods and measures have been used to examine and estimate community disaster resilience in developed countries, while very few have been applied towards understanding disaster resilience in developing nations. Mavhura and Manyena (2018) complement that in developing countries, vulnerable populations are regularly exposed to the severity of natural hazards and disasters. Still, more focus has been paid to immediate response and coping capacities rather than resilience enhancement. When referring to the Sri Lankan context, survivors of the 2004 Boxing-day tsunami relied on coping resources within their communities, such as extended supportive networks, religious faith, and cultural traditions, to manage emotional distress (Ekanayake et al., 2013). Moreover, Mendis et al. (2022) emphasised that marginalised communities in Sri Lanka are disproportionately affected by disasters highlighting the importance of their engagement in a post-disaster context. Further, Sri Lankan communities face challenges in building disaster resilience, including inadequate financial and human resource capabilities, a lack of knowledge of disaster risks and

vulnerabilities, and a lack of focus on pre-disaster planning (Malalgoda et al., 2013). Therefore, assessing community resilience in Sri Lanka is vital for understanding community-specific vulnerabilities, decision-making and strengthening community resilience to disasters.

Among the different assessment methods available, only the index values make it possible to assign an overall performance rating to community resilience since they are often standardised for comparison purposes (Almutairi et al., 2020). Parsons et al. (2016) argue that many existing disaster resilience indexes lack comprehensive criteria, making it difficult to generalise the assessment process. A few indexes are empirically validated using observed disaster impacts, making it unclear which index should be preferred for decision-making (Feldmeyer et al., 2020). Singh-Peterson et al. (2014) highlighted that indicator selection for developing an index requires careful consideration, ensuring a reliable reflection of the study area characteristics. Even though different indexes to assess resilience towards disaster have been developed and relatively use the same criteria, different countries may require adjustments in sub-criteria and resilience indicators (Dyah et al., 2014). Furthermore, Beccari (2020) and Cai et al. (2018) emphasise that resilience assessments must be adjusted based on the context, as community resilience is highly context-specific. While researchers and practitioners in the hazard and disaster management field have increasingly focused on community resilience to disasters, there have been little to no empirical studies in Sri Lanka. Several disaster resilience indicators that have been developed by researchers (Cutter et al., 2008; Qasim et al., 2016; Odiase et al., 2020) can be utilised to develop a comprehensive comparative index for community disaster resilience in Sri Lanka. Even though there are several disaster resilience indexes developed by worldwide researchers there is no overarching research that provides a comprehensive and comparable index of community disaster resilience across the country in Sri Lanka. This suggests the need to conduct an extensive study on developing a community disaster resilience index for Sri Lanka. Thus, this research expects to develop a composite index to assess Community Disaster Resilience (CDR) in Sri Lanka by combining factors in different resilience domains.

Furthermore, an appropriate research methodology is critical to attaining the research objectives while providing the most out of the research. Therefore, this paper aims to design and justify the research methodology to develop a comparative community resilience index to measure the level of resilience of the community in Sri Lanka from natural disasters.

## **2. DEVELOPMENT OF RESEARCH METHODOLOGY**

Research methodology is a general research strategy defining how research should be carried out (Mendis et al., 2023). It includes a system of beliefs and philosophical assumptions that shape the understanding of research questions and underpin the choice of research methods (Melnikovas, 2018). Figure 1 shows six layers of Research Onion i.e. (i) philosophy, (ii) approach to theory development, (iii) methodological choice, (iv) strategies, (v) time horizon, and (vi) techniques and procedures. Subsequent sections discuss each layer of the research onion and the methodology adopted on each layer.

### **2.1 DECIDING ON THE SUITABLE METHODOLOGY**

The research design is the selection of the appropriate research philosophy, research approach, research strategy, research choice, time horizon, and techniques. The two most

prominent research design models are the nested model developed by Kagioglou et al. (2000) and the research onion model developed by Saunders et al. (2019). With both systems embracing a systematic process towards researching while providing a basis to make informed decisions, research onion with further layers than the nested method is much more comprehensive (Mostafavi & Ganapati, 2021). Social science researchers widely use the research onion model to develop the theoretical framework (Mendis et al., 2023). As a result, the Saunders research onion model is followed to design this research methodology.

## 2.2 RESEARCH DESIGN

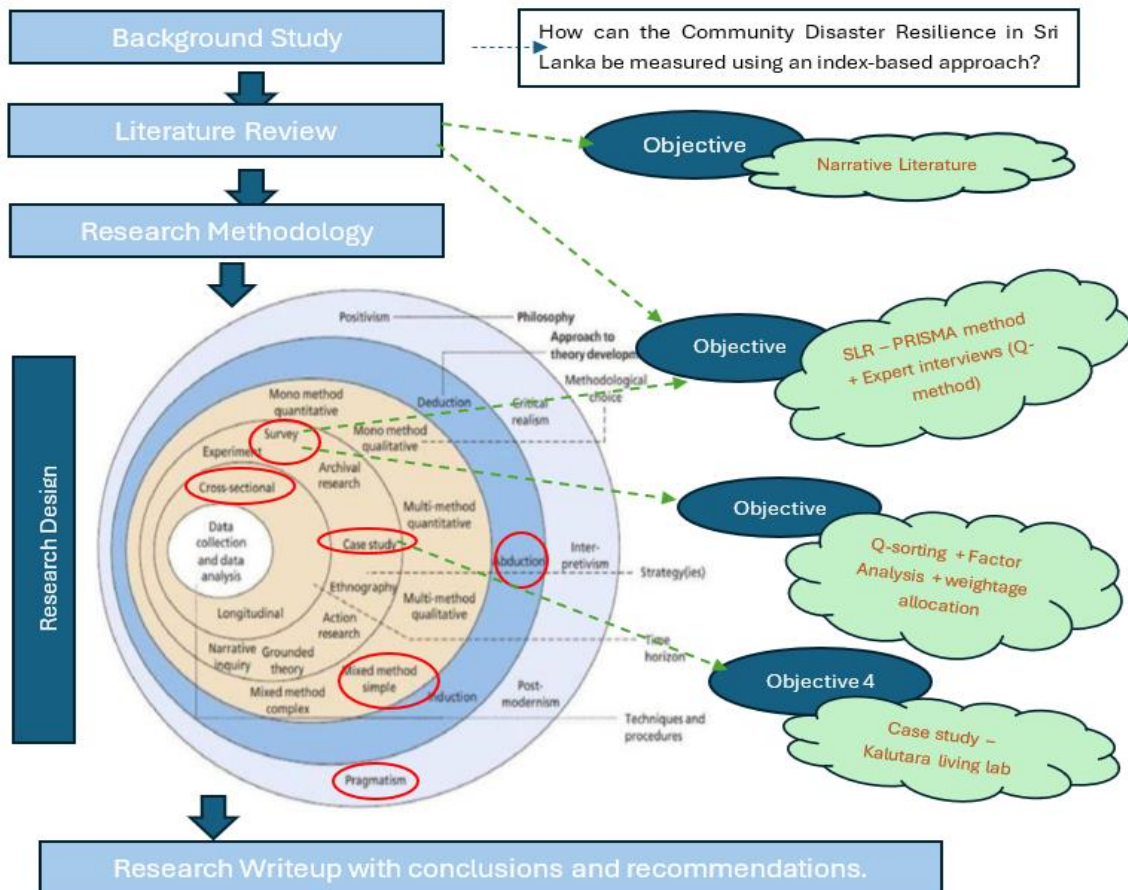


Figure 1: Research design

### 2.2.1 Research Philosophy

Research philosophy refers to the set of beliefs, assumptions, and principles that direct and shape a researcher's method of conducting research (Mendis et al., 2023). The Saunders research onion unpacks three perceptions (ontology, epistemology, and axiology) that underlie various research philosophies (positivism, critical realism, interpretivism, postmodernism, and pragmatism), shaping a researcher's approach to the entire research process (Saunders et al., 2019).

The **ontological** question is, "What is the form and nature of the reality?". The two leading ends of ontology can be identified as realism and idealism. As stated by Amaratunga et al. (2015), in realism, the researcher deals with the existing reality, independent of their observations. Idealism means that reality begins with ideas or thoughts based on different

perspectives of people (Amaratunga et al., 2015). The **epistemological** question refers to assumptions about knowledge, what constitutes acceptable, valid and legitimate knowledge and how knowledge can be communicated to others (Burrell & Morgan, 2017). There are two extremes in the epistemology assumption. One extreme suggests that if the researcher is independent of the subject studied, the study has characteristics of positivism. The other extreme relies on knowledge based on people and their opinions, where subjectivity is encouraged (Saunders et al., 2019). The **axiological** question is directly linked to the study's value concern. A study may be either value-free or value-laden (Lewthwaite & Nind, 2016). In a value-free study, the choice of what and how to study is determined by objective criteria, while in value-laden research, the choice is based on human values and experiences (Easterby-Smith et al., 2018).

In this study, measuring community resilience to disasters using an index involves multiple indicators that should be selected as appropriate and prioritised based on the context in which they apply. Further, the background study highlighted that the inhabitants in the considered geographical location idealise indicators selected under community resilience dimensions. Conversely, idealism may not be suitable for comparing CDR in Sri Lanka across several geographical locations and taking measures to improve resilience. Therefore, this study's ontological positioning remains between realism and idealism. Moreover, the Stakeholders might have different perceptions considering the subjective nature of the research question. The subjective nature of community resilience draws the research towards interpretivism. Yet, there is a need to maintain the value-free nature of the study as much as possible since a community resilience index needs to be applicable and justifiable to the studied context regardless of the researcher's perceptions. Therefore, the knowledge for developing the resilience index is not solely constructed through the interpretation of the respondents involved in the research but rather from the context itself because the respondents were merely a sample from the context. Considering the value concern of the study, the inhabitants of a particular region clearly understand the community's level of resilience in the selected area. Therefore, the views on community resilience are laden. Nonetheless, when developing a context-specific CDR index, the researcher's values are insignificant, and the resilience index needs to be objective to the maximum degree. Hence, the research philosophy of the study is not positioned in positivism or interpretivism extremes yet in pragmatism, where it will be placed in a balanced position.

## **2.2.2 Approaches to Theory Development**

This refers to the theory development being inductive, deductive or abductive. The inductive approach, or "bottom-up," begins with data collection to explore a phenomenon and allow a theory to emerge (Soiferman, 2010). On the other hand, the deductive approach, or "top-down," begins with a theory and then develops an empirical observation to test the theory (Saunders et al., 2019). Under the abductive approach, it generates a new theory or modifies an existing one, further validated through additional data collection (Saunders et al., 2019). This research started with existing knowledge and theories related to disaster management, community resilience, different dimensions of community resilience, indicators of measuring CDR, assessment approaches of CDR, existing resilience indices and common properties of index development. However, further investigation is required through primary data collection to gain expert opinions to contextualise and prioritise the indicators selected via a systematic literature review. Moreover, the developed index will be validated by applying it to the chosen living lab

in Kalutara district, Sri Lanka. Hence, the abductive approach is the most suitable approach for this research.

### 2.2.3 Methodological Choice

According to Yin (2009), there are two fundamental research methods i.e. (i) quantitative, and (ii) qualitative. Further, Creswell (2016) illustrates three types of research methods i.e. (i) quantitative, (ii) qualitative, and (iii) mixed. Further, the methodological choice is the third layer of the research onion, which describes the use of qualitative, quantitative, and mixed methods (Melnikovas, 2018).

#### Qualitative research method

Qualitative research denotes an interpretative way of collecting and analysing data to investigate and explain a phenomenon (Cao, 2007). Qualitative research is essential to understand what is happening by looking at the whole problematic incident (Creswell, 2003). Further, qualitative research allows for a more open-ended and versatile approach to evaluation (Randall et al., 2011).

#### Quantitative research method

Quantitative research aims to investigate the relationship between variables, such as the dependent and independent variables (Creswell, 2016). Bryman (2004) states that quantitative work typically focuses on quantifying data collection and analysis. The core differences between these two approaches can be identified in Table 1.

Table 1: Key features of qualitative and quantitative data  
Source: (Creswell, 2016)

	Qualitative	Quantitative
<b>Purpose</b>	To investigate the meaning of people's experiences, people's culture and how people feel about a particular issue or case	To examine the relationship between variables and to quantify the data.
<b>Research question</b>	Open-ended questions	Closed-ended questions
<b>Data collection method</b>	Unstructured (e.g., interviews, documents, observations, audio-visual materials)	Structured (e.g., performance data, attitude data, observational data and census data)
<b>Analysis technique</b>	Non-statistical (e.g., text or image analysis)	Statistical
<b>Nature</b>	The researcher defines the truth	Reality is definite by the contributors

#### Mixed research method

There is another new approach called mixed method choice. According to Johnson and Onwuegbuzie (2004), a mixed research method combines quantitative and qualitative elements. If a researcher wishes to consider both statistical trends (quantitative data) and personal experiences (qualitative data), this method would be ideal (Creswell, 2016).

#### Selection of suitable research method

Based on the definitions and comparison of the above research methodologies, it was decided that the mixed research method should be chosen for this study. Mixed methods

research is becoming increasingly popular given the benefit of combining quantitative and qualitative data to explore phenomena (Duncan Millar et al., 2022; Minc et al., 2022). This research aims to assess the community resilience to disasters in Sri Lanka by developing an index. Therefore, this requires an in-depth inquiry to gather information related to indicators within the context of Sri Lanka. The indicators needed to be prioritised based on the quantitative data collected during the expert interview rounds. Qualitative methods provide a closer look and richer understanding, while quantitative methods add breadth and a "big picture" approach, leading to greater breadth and depth of understanding (Boumezrag, 2023). Therefore, the mixed research method will be facilitated here to provide a deeper understanding and broader perspective regarding the research question.

#### **2.2.4 Research Strategy**

The research strategy is the fourth layer of the research onion, explaining the formal procedure for conducting the research and the method of achieving the aim and objectives (Saunders et al., 2019). According to Yin (2009), there are five different research strategies i.e. (i) survey, (ii) case study, (iii) experiment, (iv) archival analysis, and (v) history. As mentioned by Saunders et al. (2019), experiments, surveys, case studies, and archival analysis are the most commonly used research strategies in social science research.

From the perspective of having an in-depth investigation (Tellis, 1997) and examining contemporary issues in real life (Merrigan & Huston, 2004), the case study will be the perfect strategy. Further, Simmons (2017) encourages researchers to implement case studies if the phenomena related to the qualitative research question are best answered by the case study method. Moreover, qualitative case studies allow researchers to describe a phenomenon using various data sources (Baxter & Jack, 2015). The survey research strategy is the collection of information from a sample of individuals through their responses to questions (Check & Schutt, 2012). The survey research strategy mainly uses questionnaires and interviews as the data collection methods (Ponto, 2015). An experimental research strategy facilitates the researcher in reliably establishing a cause-effect relationship, and these types of studies are suitable for carried out in closed environments such as laboratories (Saunders et al., 2019). The archival analysis involves a procedure of reviewing documents and textual materials (Ventresca & Mohr, 2002).

Among these research strategies, survey and case study research strategies will be used. The study is under consideration to gain expert opinions on identifying the most appropriate indicators for measuring community disaster resilience in Sri Lanka and prioritising them to take the weighted average in developing the index. Hence, the survey strategy will be used during the preliminary phase of the study. As highlighted by Yin (2009), a case study design will be used to answer "how" and "why" questions in the research problem and when in-depth investigation is required to find answers. The study consists of a "how" nature question (How is the resilience status of the community in Sri Lanka?) Therefore, the case study strategy will be used in the final stage of the study by drawing into the living lab in Kalutara district to check the applicability of the developed index.

#### **2.2.5 Time Horizon**

A study could be designed in a longitudinal or cross-sectional time horizon (Saunders et al., 2019). A longitudinal study analyses a phenomenon over time to compare data

(Caruana et al., 2015). A cross-sectional study is a 'snapshot' study in which the phenomenon is investigated at a specific time (Setia, 2016). This study intends to measure the level of community resilience in Sri Lanka across several geographical locations at a particular time. Hence, regarding time horizons, this research is a cross-sectional study.

### **2.2.6 Research Techniques**

Research techniques are the final peel of the research onion, which shows the different techniques available for data collection and analysis (Melnikovas, 2018). These techniques support the research in answering the research question. Research techniques consist of two strands i.e. (i) data collection, and (ii) data analysis.

#### **Data collection techniques**

As the initial step of this research, a background study was conducted to identify the research gap and formulate the research problem, aim, and objectives. Apart from the narrative literature review, a systematic literature synthesis was performed by adopting Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), mainly to explore all possible statements of the question. The primary data collection will be based on Q-methodology to gather qualitative and quantitative data to develop the index. In the final stage, the index will be validated based on the data collected through living-lab Kalutara and other census data collected from relevant authorities. Interviews will be executed in a semi-structured format. All the interviews will be recorded to enhance accuracy and minimise the risk of losing data, with the permission of the respective interviewee.

- **"Q-methodology"**

Q-methodology or Q-method approach is a participatory tool that allows for analysing individual perspectives (Tariq et al., 2022). Q-methodology combines qualitative and quantitative techniques to study the subjectivity of the research question ( Millar et al., 2022). According to Duncan Miller et al. (2022), the Q methodology enables us to recognise and characterise the shared perspectives on a subject while revealing areas of consensus and disagreement across these views. Mukherjee et al. (2018) recommend the use of the Q-method in situations where conflict is high. Further, a strength of the Q-methodology is that it combines the richness of qualitative data with the rigour of statistical analysis (Dziopa & Ahern, 2009). Using Q-methods, the resilience assessment process gets a participatory approach built into its implementation, whereby key stakeholders are an inherent part of the resilience assessment process (Huggins et al., 2015). One of the benefits of using the method is that it does not require forming a prior hypothesis on perspectives in advance; the results show the patterns of opinions as they exist in the individuals in a group (Huggins et al., 2015). Tariq et al. (2021b) utilised Q-methods to understand the preferences of different stakeholder groups regarding resilience and the issues they face. Although the method works well with small, selected samples of individuals, it is not intended to be generalised to a larger population, hence its appropriateness for ranking among different stakeholder groups (Raadgever et al., 2008; Zabala & Pascual, 2016).

The Q-method approach utilises a series of statements in the domain of communicability, or the sum of topics, measures, and indicators within a particular context (Zabala, 2014). Participants sort these statements, each providing a viewpoint on what they think are the most critical statements from their perspective (Huggins et al., 2015). Moreover,



according to Millar et al.(2022), there are two vital elements to any Q-study. First, participants rank a set of statements of opinion on a grid. This is followed by a factor analysis to identify clusters of shared viewpoints that can then be interpreted. Tariq et al. (2022) define a five-step approach of utilising Q-methods in their study, and those steps will be followed during this study.

*Table 2: Five-step approach of the Q-method*

Steps	Methods to be adopted
Collection of all possible statements about the issue at hand (the concourse)	Systematic review
Selection of the most relevant statements (the Q-set)	Internal Workshop
Selection of the respondents (the P-set)	Snowball technique
Ranking of statements by respondents according to how much they agree with each statement (Q-sorting)	In-depth interviews and focus group discussions
Analysis and interpretation	Thematic analysis, Descriptive statistics & Factor Analysis (FA)

Complex concepts such as community resilience are often defined and understood differently by the different stakeholder groups at the local levels in the community (Tariq et al., 2022). This study focuses on CDR and develops a library of indicators to measure CDR based on an SLR. The review results were used as the "Concourse" in this study, creating an initial library of 20 leading indicators and 88 sub-indicators measuring CDR. The research team then looks at these indicators in detail through an internal workshop for further refinement to form the final set of indicators (final statements). In the subsequent stages, these refined indicator sets will be used as statements in the "Q set". In Q-methodology, the participant sample is known as the P set. The p-set sample will be purposive based on the snowball technique. Data collection involves participants rank ordering the Q set statements onto spaces on a grid (Q-sorting). Once participants have completed the Q sort, they are asked, in a short interview, to explain the positioning of their statements. Once the Q sort is complete, by-person factor analysis is undertaken to identify clusters of participants who have completed their Q sorts similarly to reveal a set of shared viewpoints. As the final step, weights will be calculated using a mathematical formula to develop the index, and this index will be tested by applying it to the Living Lab at Kalutara, Sri Lanka.

**Data analysis techniques**

Data analysis depends on the researcher's empirical thinking and interpretation (Sridarran et al., 2018). Qualitative data collected through semi-structured interviews will be analysed using the content analysis method. Content analysis is a data analysis technique that helps organise qualitative data and achieve the research objectives (Langkos, 2014). Content analysis can be carried out either manually or using computer-aided software. This research will use manual and computer-based software for the data analysis. Further, quantitative data gathered during Q-sorting will be analysed using the factor analysis method. Factor analysis typically produces several statistically possible factor solutions to identify the inter-correlation among the Q-sort results (Millar et al., 2022). Q factor

analysis is generally undertaken using specialist, free Q analysis software such as KenQ and PQ-Method.

### 3. CONCLUSIONS

In this paper, the authors have tried to demonstrate and justify the methodology devised to develop a comparative index to measure community disaster resilience across geographical locations in Sri Lanka. The adopted methodology helps to derive a more accurate index based on the indicators identified through the systematic literature review and expert opinions. Furthermore, this paper presents a rigorous procedure to explore the research problem with the perception of providing valuable insights to improve CDR in Sri Lanka. This research is progressing with the collection of primary data under this methodology.

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