A Systematic Review to Establish a Definition for Natural Disaster Preparedness

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Abstract

Disaster Preparedness (DP) needs to be best viewed from a broad perspective in order to have a sound understanding of its practices, its scope and its impact on the successful implementation of disaster management. However, the DP concept has become more complex as time has progressed because there is no consensus within the literature as to its definition. Therefore, with the aim of deriving a working definition for DP, which includes all the aspects of the concept, a systematic review was carried out. The systematic review covered publications from 2015 to 2020 in order to discover the different types of definitions for DP within the literature. The 34 identified definitions from the selected articles have been analysed focusing on five definitional attributes called: concept of DP, aim of DP, stakeholders related to DP, time frame with reference to the disaster, and key practices of DP. The final definition revealed that DP has a close relationship with disaster mitigation, response and recovery, which provides the base for the successful implementation of these phases. Therefore, the study suggests that the DP concept needs to be addressed thoroughly, in order to have successful outcomes in overall disaster management.

Keywords
Disaster Preparedness, Systematic Review, Disaster Management

1. Introduction

In recent decades, natural disasters have been on the rise (Pamidimukkala et al. 2020), and their impact has been significant, mainly due to the effects of unpredicted climate change which is fueled by the growing socio-economic activities in the modern world (Rosselló et al. 2020). In 2019, for example, natural disasters such as hurricanes, floods and earthquakes have severely impacted upon over 25 million people around the world causing US$17Bn worth of damages to the world's economy (Global Humanitarian Assistance [GHA] 2019). According to International Strategies for Disaster Risk (ISDR 2008), scientists believe that the trend of disaster occurrences will continue and weather-related hazards will become more volatile day by day. Given the increasing intensity, and the frequency of natural disasters that are anticipated due to climate change, Kim and Zakour (2018) suggest that it is important to pay close attention to natural disaster management, now more than ever. The International Federation of Red Cross and Red Crescent Societies (IFRC 2017) asserts disaster management as the administration of resources and responsibilities in order to deal with every type of humanitarian crises focusing on disaster preparedness, response and recovery. Disaster Preparedness (DP) absorbs an important role of disaster management in opposing a greater degree of human suffering (Beura 2016). As per the findings of Sena and Woldemichael (2010), although, currently, many researchers mainly focus on the response phase of disaster management, much of the hard work on disaster management is carried out before disasters occur, in the form of DP.

In order to define the scope of natural DP, a clear definition of the specific term must be established first. Unfortunately, there is no common universal definition for DP (Keim and Giannone 2006; Ritchie and MacDonald 2010; Indahningrum 2013). The terms relating to disaster management such as DP, disaster mitigation, disaster prevention, are ambiguous at present (Ritchie and MacDonald 2010) making it difficult to isolate DP from other components of disaster management (Dekens 2007). Sutton and Tierney (2006) reveal that this ambiguity of definitions has become an issue among scholars and practitioners of disaster management when setting out the

boundaries for phases such as DP while formulating policies and activities. Sutton and Tierney further highlight that in order to build up a proper discussion about DP, it is necessary for a literature study to clear-out this confusion and establish a key definition for DP. Therefore, this study aims to conduct a systematic literature review to disclose the different definitions for natural DP from past research and then to compare and contrast them for establishing a more precise working definition to clarify the overlapping borders of preparedness with other disaster management phases. This study is also aimed at exploring whether the articles within the literature highlight appropriate disaster preparedness practices and how the boundaries of preparedness can be better defined.

Literature reviews have obtained high importance among the scholars as there is a belief that "most research can only be understood in context – and a key part of that context consists of the results of other studies" (Petticrew and Roberts 2006, p. 3). Among different types of reviews, the systematic reviewing approach has become popular due to its specific features which cannot be seen in other traditional reviewing methods (Pahlevan-sharif et al. 2019). Biolchini et al. (2005) describe the systematic review as a process that follows a well-organized pre-defined sequence of methodological stages, so that others who refer to the review can replicate the same protocol and acquire a judgement on the reliability, validity and the adequacy of the chosen standards. Accordingly, a systematic review has been adopted for this study as it provides unbiased results from the literature with a high level of quality and efficiency (Liberati et al. 2009) which is paramount in analyzing a number of viewpoints from different researchers from different times and backgrounds regarding the term DP. The systematic review was conducted using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement (Liberati et al. 2009).

2. Systematic Review

2.1 Aim, Objective and Research Question

Initially, there should be a sound research question supported by a precise aim and objectives in order to develop the search strategy, the eligibility criteria and the study selection (which are very important components of the PRISMA checklist (Eriksen and Frandsen 2018; Liberati et al. 2009)). Accordingly, the aim of the research was defined as "to establish a working definition for Disaster Preparedness (DP) within the context of natural disasters". The objectives for achieving this aim were set out as: (1) conducting a systematic literature review to disclose the different definitions for natural DP from past research, and (2) building up a working definition by analysing these different definitions.

In order to derive the search terms for the systematic review, the research question was formulated using a PICO template. PICO is typically used in formulating clinical questions in medical disciplines, but recently this approach has been applied in social science studies (Eriksen and Frandsen 2018). Miller (2001) states that there are two types of templates when applying the PICO method: "PICO" (P- Population, I- Intervention, C- Comparison, O- Outcome) and "PICo" (P- Population, I- Interest and Co- Context)" which have slight differences considering the features of the study. Since the research question in this study is generic and there is no "Comparison" component, the research question was constructed utilizing the "PICo" template. Accordingly, "How has the term 'Disaster Preparedness' been established as a definition by previous scholars within the context of natural disasters?" was formulated as the research question through PICo. Thereafter, a comprehensive logic grid was prepared inserting the alternative terms that can be used for each component of PICo.

Table 1. Logic grid for the PICo analysis

PICo Component	Key term in Question	Alternative 1	Alternative 2	Alternative 3
P-Population	Definition	Explanation	-	-
I- Interest	Disaster Preparedness	Emergency Preparedness	Hazard Preparedness	Disaster Readiness
Co- Context	Natural Disasters	-	-	-

Table 1 identifies the key terms of the research question and indicates the synonyms which have been used in past literature as the alternatives for each key term. Aromataris and Riitano (2014) have described that such a logic grid helps to build up the final search string for a study by combining each key term and synonyms.

2.2 Source Selection

Since the use of high-ranking and indexed scholarly articles is recommended by Simons et al. (2009), the search was conducted within two highly recognized citation databases: Scopus and Web of Science. Both the databases provide a literature search within a broad range of international scientific journals, as well as within high-ranking conference proceedings (Geekiyanage et al. 2020).

2.3 Search Strategy

An interactive search strategy was developed with the aid of the logic grid (Table 1) by combining and refining the search terms. The development of the strategy was conducted using the Scopus database due to its user-friendliness. The adopted technique used boolean operators, trancations, and filters. Jankowski (2008) defines truncation as the purposeful shortening of a search term, generally at its core, using wildcard characters (*,#,?,!) in order to sort out the variants occurring due to language or tense dissimilarities. The search string was developed using the terms of the logic grid (Table 1) by merging the key terms and their alternatives using "OR" along the raw and merging the terms in different raws using "AND". Moreover, truncation was used for the word "Natural" as "Natur*". The initial search was based upon title, abstract and keywords. However, many of the articles did not mention the terms "Definition" and "Explanation" within the title, abstract and keywords even though they are included within the text. Therefore, in order to avoid losing the relevant important articles while conducting the initial search, the terms "Definition" and "Explanation" were eliminated from the string. Accordingly, **"Disaster Preparedness" OR "Emergency Preparedness" OR "Hazard Preparedness" OR "Disaster Readiness" AND "Natur*** was the search string used. A similar protocol was followed for Web of Science.

2.4 Eligibility Criteria

It is necessary to have eligibility criteria for the selection which need to be appraised for the validity, applicability, and comprehensiveness of a review (Liberati et al. 2009). These eligibility criteria identify the inclusion and exclusion conditions for the study. Table 2 presents the eligibility criteria for this study.

Table 2. Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria	Rationale
Sources published in English language	Sources published other than in English	English is the international and the universal language.
Publication year from 2015 -2020	Publication year prior to 2015	Avoiding out of date results, plus the adequacy of 5 years' articles for the review
Published and unpublished sources	-	Unpublished articles also have the latest results
Research areas: Social Sciences, Environmental Science, Earth and Planetary, Engineering, Energy	Research areas: Computer Science, Medicine, Business Management and Accounting, Economics and Finance	Research areas related to natural disasters
Document type: Articles, Conference Papers, Book Chapters, Reviews, Books	-	-
Disaster preparedness only related to natural disasters	Disaster preparedness related to man-made disasters	Definition is only searched for natural disaster preparedness

The papers were not screened for considering the methodological quality as the aim of the systematic review was to gather information on the definition of Disaster Preparedness (DP).

2.5 Study Selection and Data Extraction

The title, abstract, keywords, authors' names and affiliations, journal name, and year of publication, access type, and source name of the identified records were exported to a MS Excel spreadsheet. All the identified articles were subjected to title and abstract screening initially and categorised as: relevant, irrelevant and unsure by a single reviewer. In this stage (1) articles not relating to natural disasters, (2) articles not contributing to the definition of Disaster Preparedness (DP), and (3) articles that were completely irrelevant to the research area were excluded. The appropriateness of whether to include the unsure articles in the second screening process was discussed among two reviewers and, thus, the final set of articles was concluded for the second screening. In the second screening process, the full texts of all the relevant articles were reviewed and the necessary data was extracted. According to Masnoon et al. (2017), a pre-defined extraction sheet should be prepared to ensure consistent data extraction in this exercise. As per this study, the extracted items used were the definitions of DP and its associated terms (such as disaster

mitigation, disaster recovery and disaster response) in order to elaborate how the distinction of the definition of DP was made and defined. The selection of the articles is depicted in the following flow diagram (Figure 1).

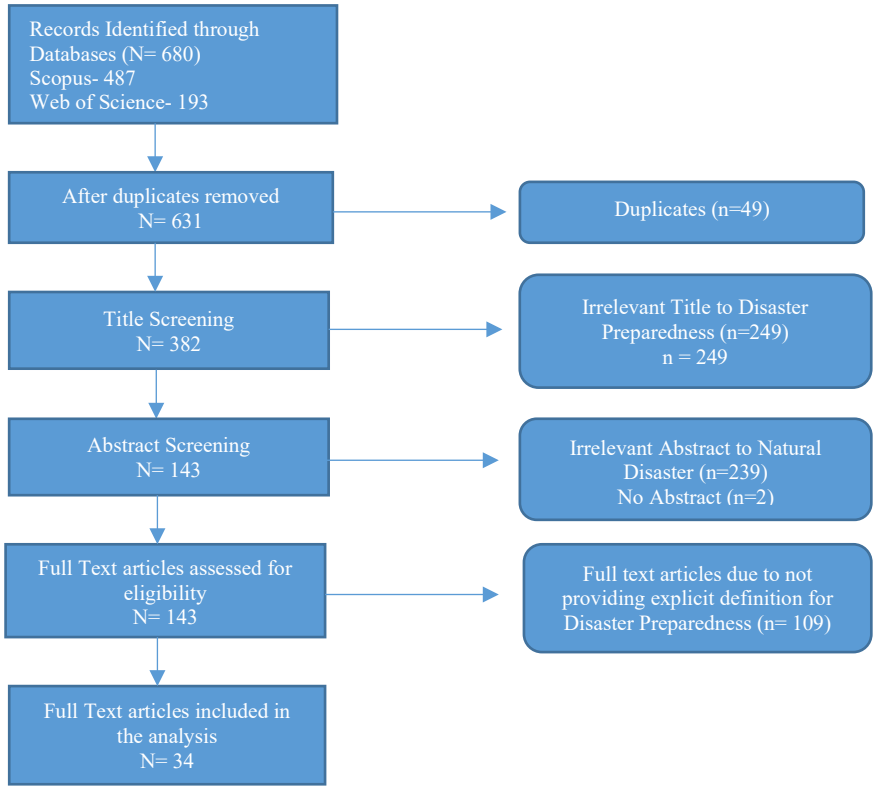

Figure 1. Study selection flow diagram

As per the flow diagram, the complete search found 680 records from Scopus and Web of Science. Among them, 49 duplicates were excluded. At the title screening, 249 records were excluded due to the irrelevancy of their title to the study. 239 abstracts were disregarded (as they were out of the natural disaster context) and 2 records had to be ignored as they had no abstract in the abstract screening phase. 143 articles were selected for the full-text screening. Finally, 34 articles were obtained for the in-depth analysis (after removing 109 records that did not provide an explicit definition for DP).

A summary of the final selected articles for the in-depth analysis is presented by a graph showing their classification per document type (see Figure 2).

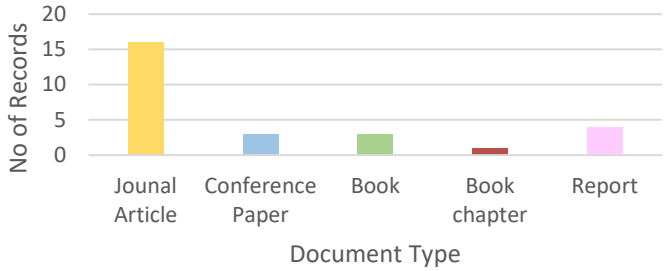

Figure 2. Document type contributing to the final analysis

3. Results

Following the analysis of 34 articles, 34 definitions were found. These definitions were derived into several definitional attributes of disaster preparedness. According to Sympson (2020), the format of a good definition should

consist of two parts: (1) the category of concept, and (2) differentiating characteristics. The category of concept refers to the category or class that the concept fits into. Differentiating characteristics are the specific characteristics that set your term apart from other terms within that category. Accordingly, the definitional attributes that should be included in the Disaster Preparedness (DP) definition have been identified and categorised under the above two parts as follows in Figure 3.

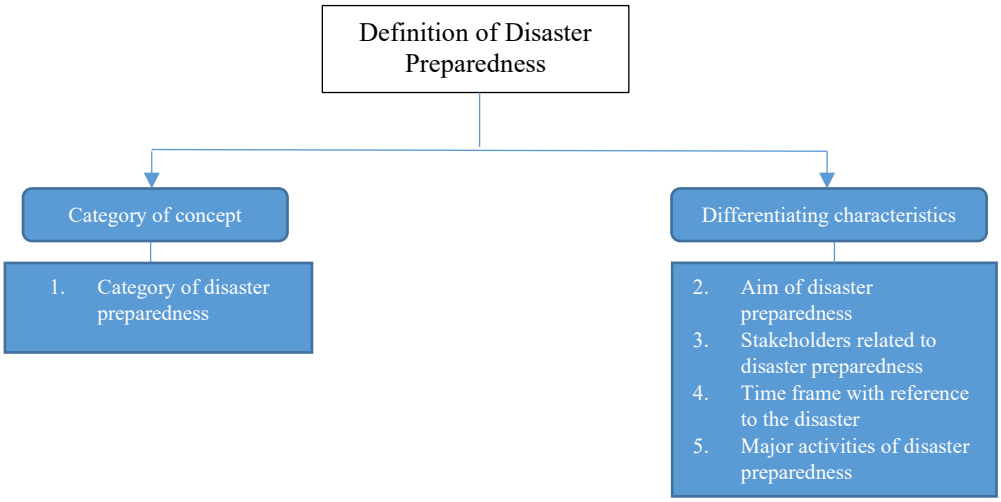

Figure 3. Definitional attributes of disaster preparedness

As per Figure 3, the DP definitions were analysed under 5 identified attributes to build up a working definition.

3.1 Category of Disaster Preparedness

The category which Disaster Preparedness (DP) fits into is disclosed in different definitions as follows.

Table 3. Contribution for category of concept

Category of Concept	**Number of Definitions/ Percentages**
Set of activities	14 (41%)
Capacities	7 (20%)
Measures	5 (14%)
State of readiness	3 (8%)
Systems and capabilities	1 (2%)
Specific efforts	1 (2%)

According to Table 3, the majority of articles (14) identified DP as a “set of activities. Moreover, 7 and 5 articles have defined it as “capacities” and “measures” respectively. Other terms like “state of readiness” and “specific efforts” were found in only a few definitions.

DP activities can be considered as the set of actions that build up the capacities of communities to cope with, and minimize, the effect of a disaster. Examples of preparedness activities are given in Section 3.5. DP capacities are the qualities and resources that an individual or a community can use and develop to anticipate, cope with, resist and recover from the impact of a hazard (American Association of Physics Teachers 2000). According to Anderson (1994), these capacities consist of material capacities such as food, animals, cash and tools; social capacities such as leadership, experience and networks, and attitudinal capacities such as beliefs, motivations, work values and creativity.

As mentioned above, these capacities are built up through DP activities. DP measures are designed for an evaluation of the relative level of DP (Simpson 2008). These measures provide an indication for the decision-makers of how prepared a particular community is for handling a certain type of disaster. The level of experience, the level of knowledge, socio-economic factors and demographic characteristics can be considered as measures of DP (Granberg 2013).
As per the definitions presented by the majority, the heaviest burden of the DP concept is carried out under the category of "activities". However, this term cannot be completely included under the category of "activities" as it has some relations with "measures" and "capacities" too. Moreover, there is an interconnection between these three categories with reference to DP. DP activities help to build up DP capacities while DP measures evaluate those capacities and decide the state of preparedness. Given the interconnection between these three categories and their relationship to DP, it can be concluded that DP is considered as a "set of activities, measures and capacities" because DP can be discussed under all three categories.

3.2 Aim of Disaster Preparedness

The aim of Disaster Preparedness (DP) has been described in definitions as follows:

Table 4. Contribution to the aim

Aim of Disaster Preparedness	Number of Definitions/ Percentage
Effective response and recovery	23(67%)
Mitigate the impact of hazard	17(50%)
Minimize possible negative impacts of disasters	2(5%)
Reducing loss of life, injuries and property damage	1(2%)
Improve chances of successfully dealing with an emergency	1(2%)

As given in Table 4, the most commonly used aim (in 67% of the studies) for DP is 'to ensure the effective response and recovery'. Effective response and recovery not only reduce injury, loss of life, and damage to the property of vulnerable communities, but also contribute to the resilience that leads to sustainable development in long run (United Nations for Disaster Risk Reduction [UNDRR] 2019). Therefore, it is very important to address effective response and recovery when forming preparedness efforts. The second most common aim is 'to mitigate the impact of the hazard' (presented in 50% of the studies). Even though natural disasters cannot be prevented, there are ways to avoid the worst-case scenarios and diminish the magnitude of a disaster so that some of the adverse consequences will be mitigated (Brower and Schwab 2000). Brower and Schwab further assert that tools and techniques, which allow this mitigation, should come in the guise of DP. Hence, DP should undertake an important role in focusing on the mitigation of disaster impact too. The significant fact is that 10 studies have highlighted both the aforementioned aims within their definition indicating that achieving both of them is equally important within the preparedness concept. Therefore, considering the opinions expressed in the majority of the examined studies and the importance of both the aims, "to mitigate the impact of hazard and to ensure effective response and recovery" is established as the aim of DP for the working definition.

3.3 Stakeholders related to Disaster Preparedness

This section discusses the target group with regard to Disaster Preparedness ('To whom') and the population engaged in Disaster Preparedness ('By whom'). An analysis of the definitions is presented in Table 5.

Table 5. Contribution to the stakeholders

Population Type	Population	Number of Definitions
To whom	Vulnerable populations	3
	Individuals, communities and organisations	1

By whom	Government agencies, Non-Governmental Organisations (NGOs), communities or individuals	14

As shown in Table 5, many of the definitions have not paid much attention to the target group. However, from the reported definitions, the majority have emphasized the target group as the "vulnerable population" for the disaster. Governments, NGOs, communities and individuals have been identified, within 14 of the articles, as the stakeholders engaged in the Disaster Preparedness (DP) process while the rest of the definitions remain silent about stakeholder engagement.

A government is considered as a key stakeholder that will ensure that the DP strategies are aligned with national priorities and guides to allow for more coordinated national approaches (Johns Hopkins University, 2016). Pelling and Holloway (2006) state that governments establish new local agencies and empower them with responsibilities as well as creating policy frameworks and budget lines considering the funding possibilities. As an example, the Sri Lankan government established the Disaster Management Ministry by newly creating a Disaster Management Centre and merging it with meteorological platforms focusing on DP activities. According to Ishiwatari (2014), the DP of any country is strengthened by the involvement of NGOs such as the American Red Cross (ARC), the Business Executives for National Security (BENS) and the National Fire Protection Agency (NFPA). These organisations effectively engage in disaster administration and community preparedness activities because they have earned the trust of the community due to their reputation and the wealth of their resources and infrastructure on the ground to support preparedness activities (Johns Hopkins University 2016). Moreover, DP is not the sole responsibility of experts within governments and NGOs. The success of DP depends on the involvement of vulnerable communities and individuals. Communities and individuals should try to develop and implement locally appropriate DP approaches as they are the first to respond to a disaster. They should usually be involved in rescue planning as well as educational programmes for basic rescue techniques, first aid and emergency treatments (American Association of Physics Teachers 2000).

Hence, as per the findings from the definitions' analysis, "Vulnerable Communities" as the target group and "Governments, NGOs, communities and individuals" as the population engaged in disaster preparedness have been finalized as appropriate for the working definition.

3.4 Time Frame with Reference to a Disaster

The time frame with reference to a disaster is very important when distinguishing Disaster Preparedness (DP) from other disaster management activities. 20 records out of the 34 studies (representing the majority (58%)) assert that the 'DP concept is conducted prior to the disaster' while the other definitions did not mention the time frame. Even though 'preparedness' itself indicates implementation prior to a disaster, authors argue that it is better to mention the time frame to derive a comprehensive definition.

3.5 Major Practices of Disaster Preparedness

The key practices of Disaster Preparedness (DP) have been disclosed through reviewing the selected records. These practices will be useful in constructing the disaster preparedness definition. In fact, it is necessary to mention these practices, so that the reader can have a clear understanding (with examples) of DP. Table 6 depicts the key practices acknowledged within the records.

Table 6. Major practices of disaster preparedness

Key Practices	Number of Definitions
Development of early warning systems and evacuation systems	8
Formulation of emergency preparedness plans	13
Education and training programmes	8
Prepositioning of resources	7

Developing early warning and evacuation systems as a DP practice was mentioned by 8 records. The development of early warning and evacuation systems has been globally approved as one of the major non-structural practices for DP due to its multiple benefits (such as extreme effectiveness and cost-effectiveness) compared to the negative impact of natural disasters (Sukhwani et al. 2019). Contingency planning is also required in preparedness planning as well as planning for post-impact response and recovery, as stated in 13 articles. Conducting education and training

programmes is helpful for the development of awareness of potential next disasters among the vulnerable communities. These programmes should contain: safe facilities for learning, school disaster preparedness, disaster risk reduction and resilience trainings and drills (Muñoz et al. 2020). Prepositioning of resources has been identified as another key practice by 7 records stating different ways of implementation. Among them (presented in many articles) are storing basic supplies such as food, water, clothing, medicines and fuel, preparing emergency kit and strengthening housing structures. Apart from the aforementioned key practices, formulating disaster preparedness policies and legislation, conducting risk analyses, improving self-efficacy, establishing proper information and communication systems were also mentioned as DP activities in some articles.

4. Discussion

There is a heterogeneity in the definitions of Disaster Preparedness (DP) which have been identified and clarified through 5 definitional attributes to form a precise working definition. The papers included in the final selection for the review contributed in different ways for identifying and defining the outcomes of this study. As per the final analysis, the working definition for DP has been defined as follows:

> Disaster Preparedness refers to a set of activities, measures and capacities that are developed by governments, NGOs, communities and individuals prior to a disaster with the aim of helping vulnerable populations to **mitigate** the impact of hazards and to support their effective **response** and **recovery** including developing early warning and evacuation systems, formulating emergency preparedness plans, conducting education and training programmes and prepositioning resources.

The working definition derived through the systematic literature review includes all the other three components of disaster management which proves the interconnection between these concepts. Therefore, it is needed to clearly define the boundaries of those terms: mitigation, response and recovery.

Mitigation is the permanent reduction of disaster risk (Sena and Woldemichael 2010; Dekens 2007). Laaser and Beluli (2016) state that mitigation can be considered as the main element of the pre-disaster period and preparedness is a very important component in the overall mitigation process. Moreover, Sena and Worlemichael (2010) state that DP is known as secondary mitigation while primary mitigation is introduced as the reduction of the resistance of a hazard. As the key element of mitigation, preparedness aims to mitigate the impact of a hazard.

Disaster response denotes a set of activities implemented immediately after a disaster in order to meet the most urgent necessities of the affected population until more permanent solutions are developed (Reyes et al. 2020; Mpekiaris et al. 2020; Dekens 2007). Activities of DP such as the development of early warning and evacuation systems, the development of preparedness plans and training programmes are mainly focused on providing immediate assistance for an effective response.

Disaster recovery refers to the activities in the post-disaster phase which facilitate relief, rehabilitation and reconstruction to enable disaster-affected communities to return to their normal living context (Lewis et al. 2014; Mpekiaris et al. 2020). DP provides the foundation for a smooth recovery after an effective response through the development of preparedness plans and training programmes.

Hence, there is a good interconnection between these terms and DP should be given the best priority among them as it is directly linked with all the other stages of disaster management. It is evident that successful DP is the key to accomplishing the success of the mitigation, response and recovery processes and, thereby, achieving the success of overall disaster management.

The interconnection of the above terms and the attributes of disaster preparedness are presented in the following Figure 4.

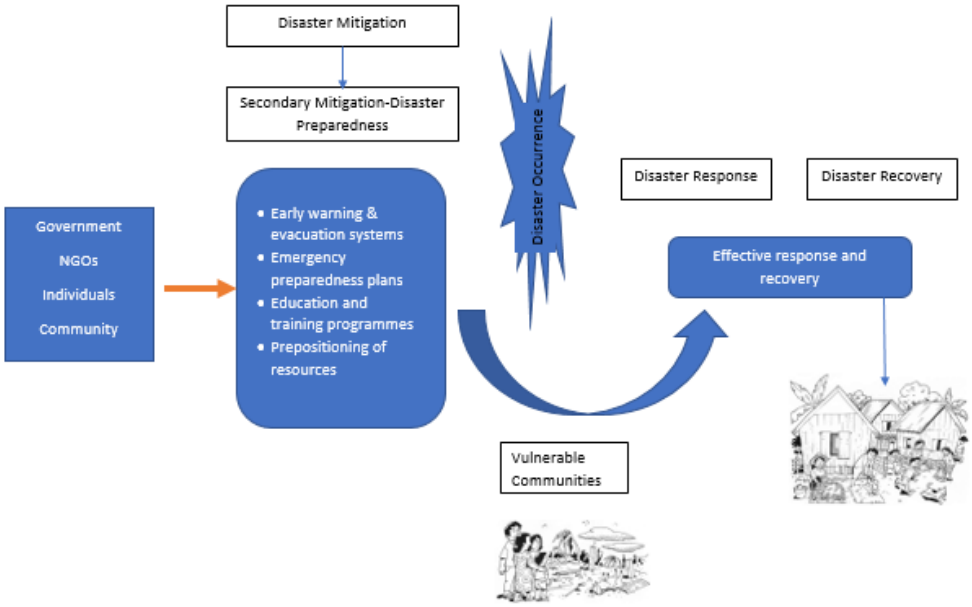

Figure 4. Interconnection between terms

5. Conclusion

This study intended to conduct a comprehensive systematic literature review in order to establish a clear understanding of the term 'disaster preparedness'. The identified definitions for disaster preparedness from the review were analysed utilizing 5 definitional attributes to build-up the working definition. Disaster preparedness consists of a set of activities that help to build up several disaster preparedness capacities (material capacities, attitudinal capacities and social capacities) among vulnerable communities. The level of disaster preparedness of a particular community can be measured via their education level, their level of experience and other social and demographic factors. The main aim of disaster preparedness is to mitigate the impact of a hazard and to ensure effective response and recovery. The stakeholders engaged with the disaster preparedness process have been identified as governments, NGOs, individuals and the community. Disaster preparedness programmes are conducted targeting vulnerable populations with respect to a particular disaster. Unique disaster preparedness processes should be formulated focusing on the form of a particular disaster and on the characteristics of the vulnerable population (which is very challenging). Developing early warning and evacuation systems, forming disaster preparedness plans, conducting training programmes and prepositioning of resources were revealed as the key practices of disaster preparedness. The final definition suggests that disaster preparedness is directly linked with disaster mitigation, disaster response and disaster recovery providing the base for the effective functioning of those phases. Therefore, it is necessary to pay high attention to disaster preparedness in order to have successful outcomes in the overall disaster management process. The final outcome of this study was the precise definition for disaster preparedness resolving the confusions of researchers and practitioners regarding the boundaries of the term. Further, studies are recommended to uncover the different types of disaster preparedness processes and their contribution to other disaster management phases.

Acknowledgements

The authors would like to acknowledge the financial assistance provided by the University of Moratuwa, Sri Lanka, for the publication of this paper at the conference.

Further, acknowledgement also goes to Global Challenges Research Fund (GCRF) and the Engineering and Physical Sciences Research Council (EPSRC) under the International Grant, EP/PO28543/1, entitled "A Collaborative Multi Agency Platform for Building Resilient Communities".

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