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## A review of literature on types, stages of recovery and humanitarian logistics operations in the tsunami and earthquake disaster in Indonesia

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# A review of literature on types, stages of recovery and humanitarian logistics operations in the tsunami and earthquake disaster in Indonesia

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**Abstract.** Recovery after a disaster determines the survival of the population in the affected area. However, there is still little lecturer to discuss recovery compared to other processes. This literature review aims to develop findings from previous literature reviews with a focus on the area of Indonesia and the earthquake and tsunami disaster. The conclusions that can be drawn are the majority of journals discussing earthquakes and researching on physical recovery. Economy recovery being the least discussed them, and the most widely researched recovery phase is a long term recovery. In 2016-2017 there is now a majority of themed journals of recovery management, and 2010-2012 the most widely publicized long term reconstruction journal. This article also presents 5 gaps in the recovery themed literature.

## 1. Introduction

Indonesia is located on of the most vulnerable island nation. This is due to the position of Indonesia which is above the collision line between two continental plates or often called the ring of the fire. Disasters such as the 2004 tsunami that hit Aceh province were also caused by an earthquake resulting from collisions between the two continental plates. The effects of disasters are very wide. Two areas in Aceh province that suffered the most damage is the city of Banda Aceh and Maoulaboh. Hundreds of thousands of people have been killed by tsunami waves, almost all infrastructure destroyed, economic crippling, farmland destruction, and massive psychology impact on Acehnese survivors. Various humanitarian organizations and the Indonesia government continue providing continuous assistance and recovery to the affected Acehnese.

Given the recurrent cycles of earthquakes and tsunami occurring in Indonesia, government and communities must be prepared to reduce post-disaster impacts by having a good type and recovery phase. From a disaster like a tsunami that hit several countries in 2004, it can be concluded that some types of recovery are needed as well as the relief operations. Recovery types include psycho-social recovery, recovery economics, physical recovery, and environmental recovery [1], while recovery starts from disaster assessment, short term recovery, long term reconstruction, and recovery management [2]. In the category of each recovery, it is always related to the strategy how to distribute all the things required for the survivors and the recovery/reconstruction itself.

In addition to the many variations and volatile demand, humanitarian logistics also have to deal with different types of disasters. Natural disasters, wars, and epidemics are the most disastrous types of disasters [3]. However, with such complex problems, humanitarian logistics must remain concerned with performance (effectiveness and responsiveness), acting as a link between various phases and



processes in disaster management, as a source of data primarily for post-disaster analysis, and determining the success of a disaster management operation [4].

The 2004 tsunami disaster was referred to as a turning point in humanitarian logistics because of the many judgments that came over the weaknesses of humanitarian logistics at the time [5]. But the various disasters that are still happening lately, then the humanitarian logistics must have changed in that time period.

Banomyong, Varadejsatitwong, and Oloruntoba [6] mentioned in his journal that the number of recovery studies during the years 2005-2016 only amounted to 8 studies. The least number of recovery studies are also confirmed by Altay and Green [7] and Kovács and Spens [8]. This paper aims to update the data and clarify the details of the previous literature review by specializing in the tsunami earthquakes in Indonesia. This paper reviews humanitarian logistics and the types and stages of recovery in research journals with the theme of recovery in the tsunami and earthquakes in Indonesia. The time period used for the limitation of the literature collection is 2005-2017.

## 2. Methodology

By filtering the literature in accordance with the subject area, it can be concluded state of the art of field [9]. The statement from Baker [10] and Hart [11] is also the same direction, adding another purpose of the review literature is to identify gaps and development of existing literature. Here are the steps are taken in writing this review literature :

- The first step in this review literature is to determine the criteria used to filter the literature, it's the subject field and time range.
- The second step is the screening stage of literature published by a particular publisher.
- The third step is to arrange and sort the literature that has been collected so that the gap and detail of each literature can be found
- The fourth step is to make a review and classification of the subject area of the literature that has been collected
- Finally, the fifth step is to find the gaps inferred from the review in step four.

Such measures have been used by Jabbour et al. [12] in the literature review on humanitarian logistics and previously tested on research from Jabbour et al. [12] and Mariana, Sobreiro, & Do Nascimento Rebelatto [13] [14]. As a restriction, reviews are conducted on published literature such as theses, proceedings, and literature from search engines such as Google Scholar, Science Direct, Emerald Insight, and others. Keywords used in the literature search are “recovery phase”, “Indonesia’s earthquake”, “Indonesia’s disaster” and “Indonesia’s disaster and logistics operations”.

## 3. Classification and Granting Code

Classification and coding are used to facilitate a review of the literature that has been selected. The methods used take references from Junior and Godinho Filho [15], Jabbour [16], and Jabbour et al. [17]. The classification contains 4 categories numbered from 1-4. Each section in the category is numbered with the A-5 alphabet. One article can have more than one code so it will look a gap in all the articles collected. The categories and codes used are as follows:

- Classification 1- disaster type: there are two types of disasters taken in this research, namely earthquake and tsunami.
- Classification 2- type of recovery: type of recovery has four kinds of psycho-social recovery, Economy recovery, physical recovery, Environment recovery
- Classification 3- recovery phase: there are 4 different types of recovery steps: disaster assessment, short-term recovery, long-term reconstruction, and recovery management
- Sub-category long term reconstruction: there is a discussion of disaster risk reduction and no discussion of disaster risk reduction.
- Classification 4- year of journal issuance: the year of journal publishing begins in 2004-2017, coded A-E for a period of 2 years.

**Table 1** classifying and coding of central structures disaster recovery phase literature

Classification		Code	
1 Kind of disaster	1A	Earthquake	
		1A1- There is humanitarian logistics discussion on earthquake disaster 1A2 - No humanitarian logistics discussion on earthquake disaster	
	1B	Tsunami	
		1B1- There is humanitarian logistics discussion on earthquake disaster 1B2 - No humanitarian logistics discussion on earthquake disaster	
		2A	Psycho-social Recovery
		2B	Economy Recovery
2 Kind of Recovery	2C	Physical Recovery	
	2D	Environment Recovery	
	3 Step of Recovery	3A	Disaster Assessment
		3B	short term Recovery
		3C	long term reconstruction 3C1 – there is review/discussion on disaster risk reduction 3C2 – no review/discussion on disaster risk reduction
			3D
4 Years of journal publication		4A	2004-2006
		4B	2007-2009
	4C	2010-2012	
	4D	2013-2015	
	4E	2016-2017	

#### 4. Basic Concept of Humanitarian Logistics, Type and Stage Recovery

Any potentially affected area should have an adequate humanitarian logistic system. This is intended to minimize damage and casualties when disaster strikes. The definition of humanitarian logistics according to Thomas and Mizushima [18] is: “*The process of planning, implementing, controlling, and storing efficient and low-cost good flows is accompanied by relevant information. Starting from the point of origin to the point of consumption in accordance with the needs of the recipient*”.

In the event of a disaster, at every stage of emergency relief such as mitigation, preparedness, response, and recovery depends largely on the smoothness of humanitarian logistics [19]. At the pre-disaster stage (mitigation and preparedness), disaster victim will receive more assistance if disaster management equipment is served first [20]; [21]; [22]; [23]; [24]. Evacuation of the population will also be more coordinated if previously there has been planning a shelter position [25]. Humanitarian logistics in the post-disaster phase (response) include mass evacuation, aid delivery, victim evacuation, debris collection, road cleaning and local development [26]. Furthermore, in the recovery phase, humanitarian logistics includes activities such as temporary shelter construction, lifelines recovery and recovery of infrastructure, and provision of medicines for the prevention of common diseases (long-term recovery).

According to Baker et al., the recovery phase is divided into 4, namely disaster assessment, short term recovery, long-term reconstruction, and recovery management [27]. The disaster assessment phase runs in the direction of the assessment of the emergency response so that the physical impact of the disaster can be accurately assessed. After a disaster assessment is completed, short-term recovery is done with the main objective of securing affected areas, housing victims and creating conditions conducive to initiating the recovery process. Reconstruction of disaster-affected areas marks a long-term reconstruction phase. Reconstructed aspects can be such as psychological, economic,

demographic and political. The last stage of recovery management is to coordinate and ensure all stages of recovery run smoothly [27].

**Table 2** coding of the studies considered

No	Authors		Category			
1	Wimbardana & Sagala (2012) [28]	1A, 1A1	2A	3C	3c2	4C
2	Amijaya & Kloft (2013) [29]	1A, 1A1	2C	3C	3c1	4D
3	MacRae & Hodgkin (2011)	1A, 1A2	2C	3B		4C
4	Kusumasari & Alam (2012) [30]	1A, 1A2	2C	3C	3c1	4C
5	Boen (2006)	1A, 1B, 1A2	2C	3C	3c2	4A
6	Resosudarmo et al. (2008)	1A, 1A1, 1A2	2B	3C	3c2	4B
7	Grundy (2010)	1A, 1A2	2C	3C	3c1	4C
8	Maly, Kondo, & Shiozaki (2012)	1A, 1A2	2C	3C	3c1	4C
9	Bayudono (2009)	1A, 1A2	2A, 2C, 2B, 2D	3D		4B
10	Steinberg (2007)	1A, 1B, 1A2	2A, 2B, 2C	3C	3c1	4B
11	Ophiyandri et al. (2013)	1A, 1A2	2C	3C	3c1	4D
12	Andriansyah (2015)	1A, 1A2	2D	3D		4E
13	Joakim (2016)	1A, 1A2	2A, 2C, 2B, 2D	3D		4E
14	Wijayanto (2016)	1A, 1B, 1A2	2C	3D		4E
15	Brown et al. (2015)	1A, 1B, 1A2	2D	3D		4E
16	Joakim & Doberstein (2014)	1A, 1A2	2C	3C	3c1	4D
17	Scawthorn et al. (2006)	1A, 1A2	2C	3A		4A
18	Sofyan (2012)	1B, 1A1	2A, 2C, 2B, 2D	3D		4C
19	Dahuri (2006)	1B, 1A2	2A, 2C, 2D	3A		4A
20	Sugiyasu & Murao (2013)	1B, 1A2	2C	3D		4D
21	Tinning (2011)	1B, 1A2	2B, 2D	3C	3c2	4C
22	Brintnell et al. (2009)	1B, 1A2	2A	3A		4B
23	Meilianda et al. (2017)	1B, 1A2	2A, 2B, 2C, 2D	3D		4E
24	Thorburn (2009)	1B, 1A2	2A, 2B, 2C, 2D	3D		4B
25	Wong (2009)	1B, 1A2	2D	3A		4B

The types of recovery discussed in this study are psycho-social recovery, economic recovery, physical recovery, and environmental recovery. The effects of disaster on each aspect are explained as follow:

#### 4.1. Psycho-social recovery

The real impact of psychosocial for the victims of the disaster has been investigated since 25 years ago and found in some literature such as [31]; [32]; [33]; [27]; [34]. Psycho-social impacts of the disaster are not only affecting mental aspect but also physically affected to disaster victims such as fatigue and gastrointestinal illness and musculoskeletal disorder. Moreover, Emotional signs of anxiety, depression, sadness, changing hours of sleep and appetite, and abuse of certain drugs are also

common [2]. However, the impact of psycho social perceived by each person is different depending on the place where the victim suffered a disaster [35].

#### *4.2. Economy Recovery*

Economy recovery has an impact on the redistribution of economic value on a large scale. Proper financing arrangements will affect the number of successful economic players recovering or failing, but still depending on the source and terms of the fund [36]. All elements who are responsible for post-disaster planning should focus on key economic factors in order for economic recovery to proceed smoothly [37]. However, the thing to remember is that the economic conditions before the disaster can not be repeated on the economic conditions after recovery [38].

#### *4.3. Physical Recovery*

Physical damage is the worst damage after a disaster. The impact of disasters will change the urban physical environment even though development tends to be the same as it was before the disaster [36]. Proper physical recovery actually opens the opportunity to redevelop the damaged building with a better and stronger structure [39]. If the physical recovery management is not properly regulated, there will be a failure of poor quality of the building, lack of adequate housing stock, and loss of opportunity to reduce the risk of disaster protection in the building to be re-created [40].

#### *4.4. Environment Recovery*

Natural events such as storms and hurricanes cause floods, heavy rain, and high sea waves that have the potential for each hazard. But the potential for severe damage is also due to the vulnerability of people who are on the path of natural events [41]. The environmental damage experienced must depend on the characteristics of the area. For example, the damage caused by the tsunami resulted in a lot of solid waste and disaster debris [41]. Reports from United Nation Environment Program (UNEP) show severe damage to the infrastructure, building, and industrial premises, including water and systems [42].

## **5. Result and Discussion**

In search of articles randomly using related keywords, 25 articles were taken that fit the topic of discussion. The code obtained will be displayed as a percentage diagram. Here is a discussion of gaps for each category.

### *5.1. Type of Disaster*

Based on the percentage in Figure 1, 54% of journals chose the theme of recovery in earthquake disaster. 35% discussed recovery for both, most discussed the earthquake disaster followed by tsunami (Aceh), but some are not in one area. 11% of journals discuss tsunami disaster recovery. The most widely discussed earthquake disaster was the Yogyakarta earthquake of 2006. Whereas during the period of 2004-2017, in various areas of Indonesia there were frequent earthquakes, but the most attention highlighted was the Yogyakarta earthquake. Gaps that can be drawn from it are: G1: What can be applied from the Yogyakarta earthquake to manage earthquake recovery in areas that are difficult to reach and potentially repeat earthquakes?

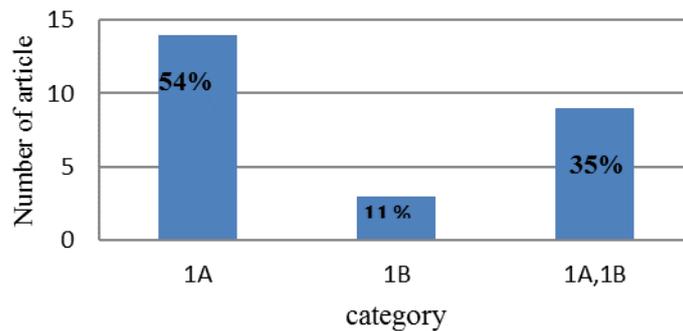


Figure 1. kind of disaster

5.2. Recovery Type

The second category maps the journal for recovery types (Figure 2 and Figure 3). 42% of journals chose physical recovery types. 19% of journals discuss all types of recovery that focus on 1 particular area. Environment recovery is the third most discussed theme with a 12% percentage, while psycho-social recovery gets 11% percentage. Journals with the theme of physical recovery are very much discussing housing recovery both from technical aspects and management, even differentiated by area and the value of local wisdom. The percentage the smallest is the type of recovery economy is only 4% of the total journal. Economy recovery is an important factor in long-term reconstruction to support the lives of local people, but not so much the subject of discussion. Considering this, the gap that appears is: G2: How is the sustainability of the current housing recovery in the affected area?; and G3: Does the number of housing-themed studies affect sustainability?

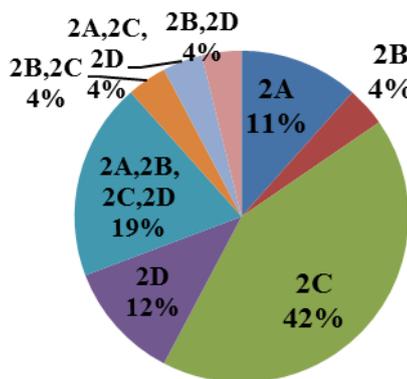


Figure 2 kind of recovery

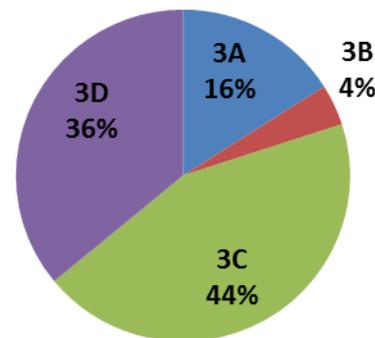
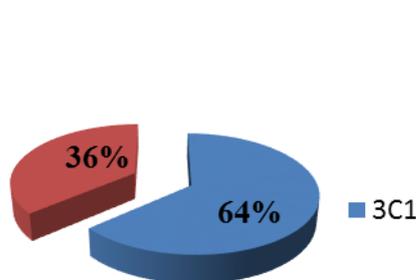


Figure 3 stage of recovery

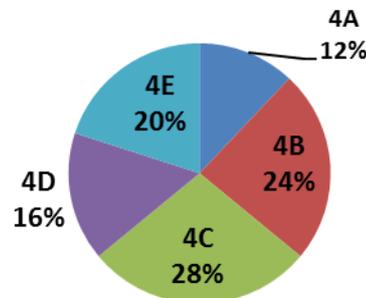
5.3. Recovery Phase

Journals with the Recovery Phase category have only 1 in each journal. So there are 4 codes, namely 3A, 3B, 3C, and 3D (Figure 3). Code 3C or long-term reconstruction has a percentage of 44%. Code 3D or recovery management of 36%, then the code 3A or disaster assessment by 16%. The short term recovery theme is at least in percentage with 4%. The number of journals with the longest reconstruction theme is at most and is directly proportional to the 2C category or physical recovery which mostly contains the theme of long-term housing/reconstruction, while most recovery management journals discuss all types of recovery (psycho-social recovery, economic recovery, physical recovery, environment recovery). Long term recovery should contain planning aimed at addressing future risk disaster. For example, retrofitting of steel structural construction buildings that cost 3 times more expensive but more powerful than ordinary buildings. However, these protection actions should not only be applied to physical recovery but should be equitably planned in every aspect, reducing the impact of future disasters. In this collected journal, 7 of 11 long term

reconstruction journals have discussed how preventive measures on long term recovery in areas with repeated catastrophic potential (Figure 4). Based on the value, then the gap that appears is: G4: Taking into account the vulnerability of repeatedly affected Indonesian areas in the short term, will long term recovery be able to reduce the risk of such damage? (Is there any research that has made a review about the effectiveness of disaster risk reduction on long term reconstruction?)



**Figure 4.** Long term recovery



**Figure 5.** years of article publication

#### 5.4. Years of Journal Publishing

In late December 2004, Indonesia gained much international attention for being the most severely affected region after the tsunami disaster. Followed after the earthquake in Yogyakarta in 2006. The percentage of journal issuance year started from 4C - 28%, then 4B - 24%, 4E - 20%, 4D - 16%, and last 4A - 12% (Figure 5). Code 4C is the year 2010-2012 to be the largest in number along with 3C code or long-term reconstruction. Judging from the year of the disaster (2004/2006), 2010-2012 is a time when many long-term reconstructions are being built in disaster areas. The percentage value does not vary much with the 4B code that is 2007-2009. While the 4E or 2016-2017 code all discuss recovery management. Judging from the gap that is drawn is: G5: In every evaluation and analysis of recovery management, what is the most essential for the stage and type of recovery when viewed from the time period per year?

#### 5.5. Humanitarian Logistics

Previous literature collected from the databases related to the natural disaster in Aceh and Yogyakarta shows that there are only a few numbers of articles concerns with humanitarian logistics (see Code 1A1 in Table 2). For instance, a study by Wimbardana & Sagala mentions that during the process of recovery to build back survivors' house and temporary shelters, demographics and unstable disaster locations become the major problems in implementing logistics and distribution activities in accordance with its function [28]. Moreover, Kusumasari & Alam uses Yogyakarta earthquake as the location of their study to understand what the government can do to relief the disaster operations [30]. It is stated that the policy made by the government to handle the disaster operations should do managing the command with other unit coordinators regarding the logistics distribution, especially within the three-days after the disaster. Finally, Amijaya & Kloft believe that the key concerns for planning of temporary housing in the period of post-disaster are location decisions and time of delivery which are a type of humanitarian logistics activities [29]. Humanitarian logistics in the previous natural disaster in Yogyakarta earthquake and Aceh's tsunami literature concerns with rebuilding the survivor's house for the earthquake in Yogyakarta so judging from the gap that can be drawn is: G6: How is the implementation of humanitarian logistics in other types and phases of disaster especially in Tsunami disasters?

## 6. Conclusion

The essence of this article is to develop the detail of the gap in the previous literature, which states that the recovery phase theme is the least discussed. Indonesia becomes the chosen area for the boundary of the article, as it is more familiar and includes disaster-prone areas that require a mature recovery plan. From the results and discussion it can be concluded that the majority of recovery journals discuss

earthquakes in Indonesia, while tsunami recovery is mostly discussed globally or in conjunction with other tsunami-affected countries. Physical recovery is the type of recovery most discussed in journals, while economic recovery is at least in number. Thus, long-term reconstruction is also the most discussed recovery phase, followed by recovery management. The year of issuance of journal recovery is the most that are 2010-2012. The review results also show the most discussed theme in the year 2017 that is recovery management. With these results, obtained 5 gaps associated with the 4 categories that have been reviewed. The gap is derived from reviewing the collected literature and compared with other literature discussing global disaster recovery.

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