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Early Warning Urgent Logistic Disaster in Rural Area based on Classification Algorithm: Indonesian Case

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***Abstract*— According to the ESCAP report, nearly half of the world's natural disasters occur in the Asia Pacific region, with Indonesia ranking first in terms of the number of victims. In terms of disasters, Indonesia lags in terms of early warning, response, and recovery. In terms of post-disaster management, the issue is the distribution of aid to disaster victims, including uneven logistics distribution, slow distribution, and poor coordination among related agencies. This paper proposes a solution in the form of a disaster logistics management system with data management features for disaster victims' needs, a donation collection system, and distribution management and monitoring of volunteers who will go to disaster sites. This system's decision-making model is based on a smart system that uses sorting data to determine the priority level of the type of assistance needed at the disaster site and the K-Nearest Neighbor (KNN) algorithm to determine the priority of the distribution of aid locations. As a result, command center officers will be able to better coordinate with field teams in making decisions about priority actions that must be taken. Furthermore, this system serves as a public accountability medium for distributing disaster logistics to the government and related officials.**

Keywords*— *logistics, disaster management, data sorting, KNN, smart system

I. Introduction

A disaster is defined as an event or series of events that endangers and disrupts people's lives and livelihoods due to natural or non-natural factors, as well as human factors, resulting in human casualties, environmental damage, property losses, and long-term psychological effects. [1].

When a disaster strikes, Indonesia is categorized as a country with a disproportionately high number of disaster victims compared to other countries. According to the most recent data, there has been an increase in disaster type, losses, and fatalities. According to statistical data on disaster recapitulation in Indonesia based on data successfully managed by the National Coordinating Agency for Disaster Management or Bakornas-PB in Indonesia, floods are the most common disasters, followed by landslides, cyclones, and droughts [2].

The disaster drew the attention of every Indonesian citizen and even a foreigner. They are concerned about the disaster, so they will contribute or donate a portion of their wealth in the form of aid. The challenges, however, are in the transparency, distribution, and management of these donations. Another issue is that there is no system in place to manage disaster relief logistics. As an example, consider the untargeted aid given to disaster victims. Often, logistical assistance with specific items is abundant, if not excessive, at one point in the disaster while it is scarce at another. The assistance provided is not a pressing need for the residents, and there are numerous other issues. The cause of this problem is the government's lack of precise logistics distribution management.

Another example is the number of residents who want to help victims directly by joining as volunteers (volunteers). Still, no forum can properly organize volunteers, so many do not work optimally at disaster locations because volunteer distribution is not properly and correctly regulated.

The major issues raised above regarding donor, logistics distribution, and volunteer management are all part of larger issues that must be addressed when a natural disaster strikes. These issues are very likely to be solved with an integrated smart system. With the developed system, it can collect and recap data in the form of the type and amount of incoming aid from donors and recap requests for the types of needs most needed by a specific post or area, ensuring that aid is delivered directly to the disaster site. The system can also accept user registrations from people who want to volunteer in a disaster area. The volunteer will be recorded and sent to the disaster site as part of a volunteer team to the needed location. Furthermore, the system can manage information on the rescue team at the media center, disaster posts, and on the ground.

This design is expected to result in an integrated information system with the Ministry of Social Affairs, PNBP, PMI, BASARNAS, BAKORNA-PB, Campus SAR Institute, and other related NGOs, allowing this system to be used partially/locally, nationally, and even internationally. The public should be able to access the system at any time.

II. Literature review

A. Disasters

Disasters are defined as events or series of events that endanger and disrupt people's lives and livelihoods due to natural and/or non-natural factors, as well as human factors, resulting in human casualties, environmental damage, property losses, and psychological effects **[1]**. Natural disasters, technological accidents, violent conflicts between groups, a lack of vital resources, and other major threats to life, health, property, welfare, and daily routines can all cause disasters **[3]**. Disasters, particularly those caused by human activity, can upset the balance of the environment. Human-caused disasters can occur as a result of carelessness or error **[4]**.

According to Law No. 24 of 2007, natural disasters are disasters caused by events or a series of events caused by nature, such as earthquakes, tsunamis, volcanic eruptions, floods, droughts, hurricanes, and landslides. Various disaster events worldwide,

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particularly in Indonesia, appear to be increasing in number and impact. Disaster management processes are required to carry out disaster risk reduction, as is an understanding of disaster management cycles and approaches. Finally, disaster events and disaster management aspects are humanitarian operations, so critical determinants must be developed, trained, and applied. Communication, information, coordination, and cooperation are frequently problematic factors **[1]**.

Natural disasters have ramifications for humans and/or the environment. Disaster vulnerability can be caused by a lack of proper disaster management, environmental impacts, or by humans themselves. The resulting losses are determined by the community's ability to withstand disasters. The Asian region is at the top of the list of natural disaster victims. Asia is prone to disasters because it is home to nearly half of the world's disasters. The ESCAP report also includes countries in the Asia Pacific region that experienced natural disasters between 1980 and 2009 **[5]**.

B. Disaster Management

Disaster management is a series of efforts that include establishing disaster-prone development policies, disaster prevention activities, emergency response, and rehabilitation [1]. Essentially, the implementation is divided into three stages:

a) Pre-disaster, which includes: No disaster situation and Situations in which there is a risk of disaster
b) In the course of emergency response in a disaster situation
c) Post-disaster, which is carried out after the disaster has occurred [6].

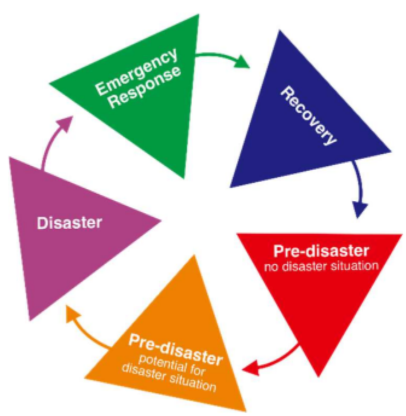

Figure 1. Disaster Stages

Figure 1 depicts the disaster stages. The disaster management stages outlined above should not be interpreted as rigid stages in which activities at one stage ends when the next stage begins. Activities of various stages will be carried out in accordance with their time allotments. For example, the primary activity is recovery during the recovery phase, but prevention and mitigation activities will begin concurrently to prepare for future disasters [7].

C. Disaster Logistics Management System

In the context of disaster management, logistics are goods to meet basic needs such as food, clothing, housing, and their derivatives. Meanwhile, equipment refers to all tools that can be used to conduct, search, rescue, and evacuate disaster-affected communities, thereby assisting in fulfilling basic needs for the immediate recovery of vital infrastructure. At the same time, the Logistics Management System and Disaster Management Equipment manage logistics and equipment such as planning, procurement, warehousing, distribution, and elimination to achieve goals and objectives effectively and efficiently [8].

The logistics management system and disaster management equipment are a system that satisfies the following criteria:

a) Logistics support and equipment must be available at the right time, place, quantity, quality, need, and target, based on a priority scale and service standards.
b) The transportation system necessitates field improvisation and creativity, whether by land, sea, river, lake, or air.
c) Logistics and equipment distribution necessitates the use of specialized delivery methods.
d) A unique management system is required to inventory needs, procurement, storage, and delivery of logistics and equipment to those affected by the disaster.
e) Paying attention to the dynamics of disaster victims' movement.
f) Coordination and prioritization of the use of limited transportation resources.
g) Assistance from the military, police, business entities, non-governmental organizations, and other relevant agencies both inside and outside the country, at the authorities' command.
h) Prioritize an effective and efficient supply chain.

To be fair, a logistics management system is required. A good logistics management system may include distributing logistics based on the needs of the community or victims of natural disasters [9]. Efforts to improve logistics management must continue to be made to create dependable, effective, and efficient management in support of each search and rescue operation [10].

III. METHODOLOGY

A. System Architecture

This system is divided into two major components: the internal and external systems (see Figure 2). The internal system includes:

a) A database.
b) A server computer.
c) Supporting applications.
d) Local network admin users and operators.
e) A security system.

Overall, this internal system collaborates to keep operations running. While the external system is a public access point that anyone can use, there are no restrictions.

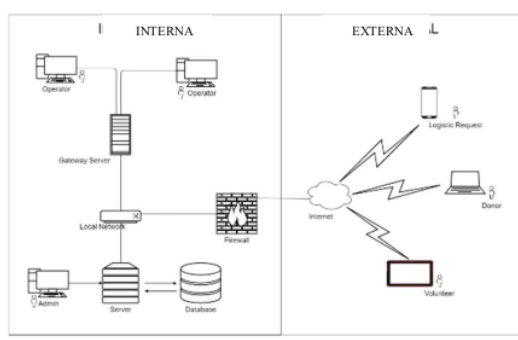

Figure 2. System Architecture

B. System's Processes

This system's UML describes the structure and processes that take place in the system from the input stage to the output stage. Donors, Recipients (victims), Volunteers (Volunteers), and Admin are the four levels of users with different roles or features. The admin is in charge of managing all of the system's features and inputs. Figure 3 depicts a UML system in an Activity Diagram of the system's four user levels.

Figure 3 depicts user activity diagrams at the levels of donors, beneficiaries (victims), and volunteers. Donors can use the system to send and enter donations. Admin is in charge of receiving and approving sent donations. Help recipients can use the system to send and input requests for assistance. The administrator is in charge of evaluating incoming help requests and then approving and sending the requested assistance if the request is valid and of high priority. Volunteers or volunteers can register using a system that will be accepted and managed by the administrator.

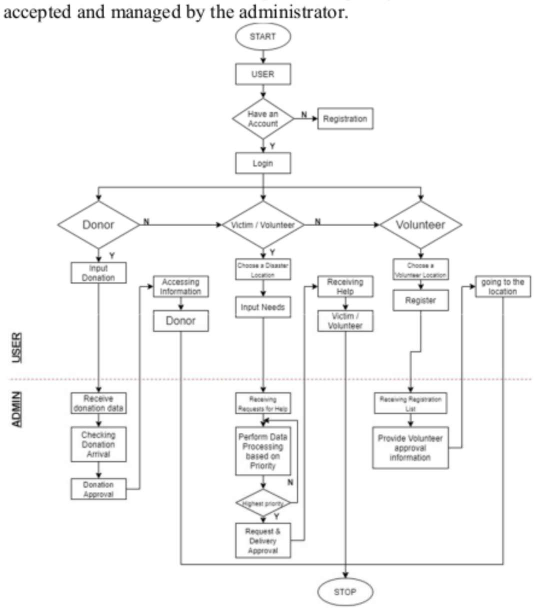

Figure 3. System's Activity Diagram

C. *Smart System*

The data sorting system and the KNN algorithms are the two decision-making mechanisms or smart systems used in this study. The data sorting system determines the priority of logistical assistance, while the KNN algorithm determines the priority location for logistical assistance distribution. By projecting learning data onto a multidimensional space, the KNN algorithm can perform classification. This area has been divided into sections that correspond to the learning data criteria [11].

The data sorting system works in determining the priority of logistical assistance by classifying/grouping the logistical request and donation data entered by the user based on the type (such as food, clothing, etc.). The data that has been grouped is calculated to determine the frequency or amount demand for logistics per location and type, as well as the total availability of logistics per type. The highest number of logistics requests per location and type is considered priority logistics to be distributed to that location. The following Figure 4 shows a schematic description of the data sorting system in question.

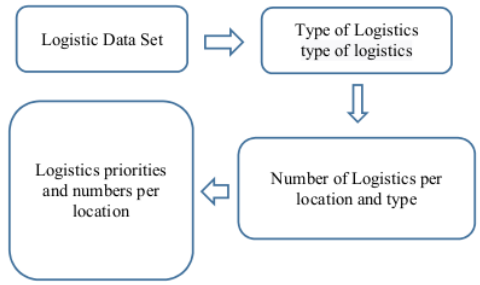

Figure 4. Sorting Data System Scheme

The K-Nearest Neighbor (KNN) algorithm is a classification algorithm that uses the k training data that are closest to the object to classify it. The value of k cannot be greater than the number of training data, and it must be odd and greater than one [12]. The Euclidean Distance is the distance used. In numerical data, the most commonly used distance is the Euclidean distance [13]. The Euclidean distance is defined as follows.

$$d(x_i, x_j) = \sqrt{\sum_{r=1}^{n}(a_r(x_i) - a_r(x_j))^2} \quad (1)$$

Remarks:

$d(x_i, x_j)$: Eucledian Distance
x_i : ith record
x_j : jth record
a_r : rth data
i, j : 1,2,3…,n

The KNN algorithm determines the priority location for logistical assistance distribution by testing disaster data (test data of whether it is a priority or not) against training data (data on the priority of logistical assistance distribution obtained from the disaster that occurred), where both data have the same attributes. The attribute describes a parameter used as a criterion in the calculation of the euclidean distance. The number of injured victims, the number of victims who died, the distance from the disaster center, the number of families who cannot carry out their normal activities, and the number of families who have lost their homes are used as criteria.

In the KNN algorithm, the process of calculating the euclidean distance between test and training data is depicted in Figure 5.

Training Data

Identity Attribute	Attribute 1	Attribute 2	Attribute 3	…	Attribute *n*	Category
	x_j	…	…	…	…	C1
	…					…
	…					…
	…					…
	x_i					?

Testing Data

$$d(x_i, x_j) = \sqrt{\sum_{r=1}^{n} a_{r(x_i)} - a_r(x_j))^2}$$

Figure 5. Euclidean Distance Calculation Process

As shown in Figure 5, the training and test data are presented in a table, with all of the attributes shared by both displayed. There is a category column in the training data table that contains the category or data status (in this case, priority or non-priority) for each row in the table. The contents of the category column in the test data table are not yet known. This is what will be investigated, regardless of whether the test data is a priority.

The Euclidean distance is calculated using Equation 1 by entering the values of each attribute of the training and test data into the formula.

After obtaining the Euclidean distance value, the smallest value among the Euclidean distance values that exist at a given K value is investigated to determine the given test data category (whether including priority or not).

This process is repeated for each existing test data until the location that will be the priority for distribution of logistical assistance is obtained (assessed from the higher priority level based on the number of priority categories obtained). The following Figure shows a schematic description of the KNN algorithm.

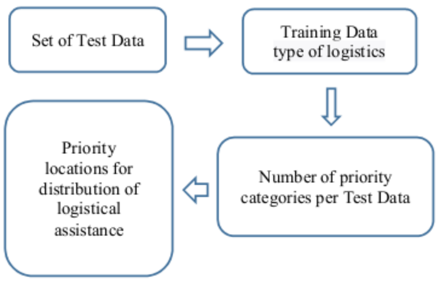

Figure 6. KKN Algorithm Scheme

IV. RESULT AND DISCUSSION

The UNM disaster care information system is an information system that helps UNM deal with the many disasters that occur. This information system contains several important features. These features will make it easier to distribute aid to disaster victims. This application will allow you to receive and distribute assistance. The idea is for the community to help the community. Its application is no longer limited to the smallest scope of South Sulawesi and Indonesia but to the entire world that has access to it. The accountability system will be managed and informed transparently for both donations received and donations disbursed.

The mechanism for determining which area is the priority will be determined by the system using the KNN algorithm based on conditions in the disaster area. The system will also use a data sorting system to determine the most urgently needed assistance needed by the disaster area, making disaster logistics management easier for officers.

A. Interface System

In general, there are two types of user levels in disaster care information systems: administrator and user. Administrators are users who manage the information system and interact with it internally. While the user is a user who will interact with the system externally, it also includes donors, users who seek assistance, and volunteers (volunteers). At login, each user who has registered with the system will select the type of user shown in Figure 7.

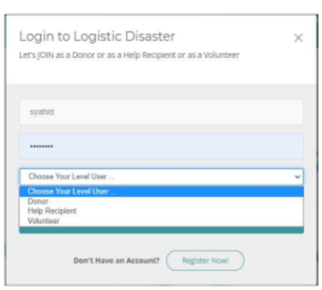

Figure 7. User Level at Login Stage

These users have various characteristics. The features in question are in line with what existing users want. These features will be displayed based on the type of user logged in, such as a Donor, Beneficiary, Volunteer, or Administrator. The system is comprised of three major components: 1) donations, 2) requests for assistance, and 3) volunteers. The user will choose this feature based on the donor's preference for assistance, the location of the request for assistance, and the location desired by the volunteer.

Donors are users who want to donate money through the system. Figure 8 depicts the type of aid donations made possible by this disaster care information system.

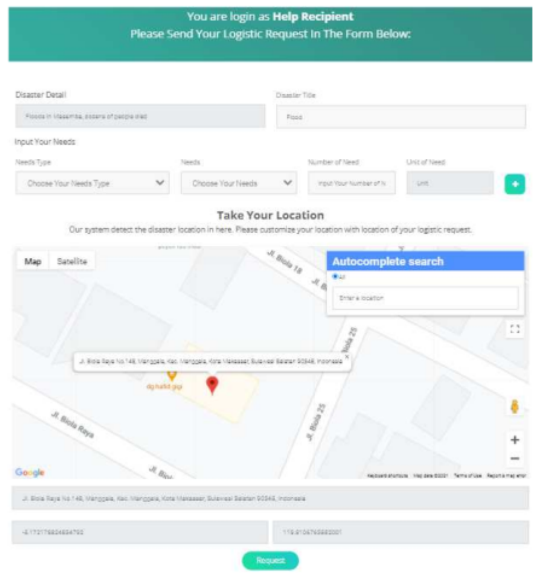

Figure 8. Request for Help

The second user is the one who requested assistance. These users can make requests for assistance based on the needs they have the most. A volunteer is a user who is willing to help with the disaster of his choice. Select the desired disaster location and then click the volunteer button to register as a volunteer.

B. Data Mining

The information is gathered via the website carebencana.unm.ac.id. The information gathered came from logistics donation data, logistics request data, and volunteer registration data. The received data will be compiled, and data mining will be performed to determine the priority of logistics requests to be sent. The number of requests for the same type at a disaster site is used to determine the process.

Application Features

This disaster care information system includes the following features:

a) Make a donation

The donation feature accepts logistical donations that are still eligible for donation. This system will categorize the logistics based on the type of assistance received and keep track of the donations. In addition, the system will perform a recapitulation, which will result in a report for administrators and operators.

b) Request for Help and support

The request for help feature is a request for an assistance mechanism that the logistics system has accommodated. The system will keep track of all request data that is entered. This assistance request will also be categorized based on the disaster area and the type of request. Meanwhile, the operator administrator will review the requested assistance for the type of personal assistance that individuals may require immediately. If there is still enough stock, it is possible to distribute it.

c) Volunteer

The Volunteer feature is intended for locations that have been impacted by disasters and require volunteer assistance. This logistics system includes a feature that can mediate for anyone registered as a volunteer in a disaster-affected area. This feature can be enabled or disabled flexibly for each disaster. Natural disasters, which may result in damaged public facilities and residents' homes, are usually the disaster locations that require the most volunteers.

d) Intelligent Logistics System

The intelligence system is used to calculate the amount of aid stock received, the priority of aid to be sent, and the disaster locations for aid recipients. A data sorting system is used to determine the amount of aid stock received and the priority of aid to be sent based on the type of aid that has been donated. The existing smart system (using the KNN algorithm) will list priorities for users who make requests for assistance based on data obtained from each user's input to determine the beneficiary's priority location. The priority of logistical assistance is depicted in Figure 9 below.

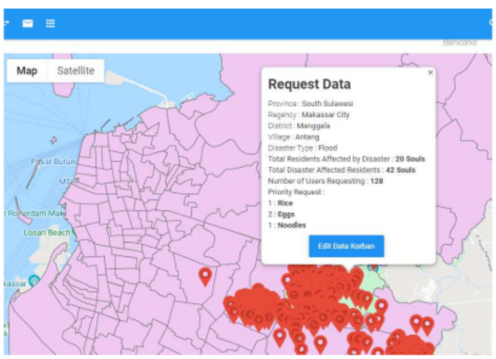

Figure 9. Assistance Request Detail

Figure 9 depicts detailed information on the distribution of requests for assistance. The location of the user's request is indicated by the red marker. The address of the disaster location, as well as the total number of users who requested assistance, appears in the widget that appears. The widget also displays the most common types of user requests, which the system categorizes into three priority help requests.

Then, to determine the priority of the location, synthetic data was used as a test in this study, both for training and for test data. The following are the training data that were used.

In Table 1. above, Atr1, Atr2, to atr5 state the attributes of the given training data, with the following details:

1. Atr1 = Number of Death Victims
2. Atr2 = Number of Injured
3. Atr3 = Number of heads of family losing their homes
4. Atr4 = Number of Head of Family Cannot Do Normal Activity
5. Atr5 = Distance from Disaster Center

Then, the test data used are as follows.

Table 1. Training Data

N	Atr 1	Atr 2	Atr 3	Atr 4	Atr 5	Category
1	20	150	60	400	1	Priority
2	100	160	95	200	2	Priority
3	80	150	50	100	3	Priority
4	30	200	100	130	4	Priority
5	100	20	70	50	8	Not Priority
6	10	30	10	20	10	Not Priority
7	50	50	100	20	12	Not Priority

Table 2. Test Data

Village	Atr 1	Atr 2	Atr3	Atr4	Atr 5
A	20	100	40	200	5
B	15	125	16	145	6
C	31	235	68	270	2
D	10	95	10	130	7
E	27	155	90	289	3

Atr1, Atr2, and Atr5 have the same meaning in Table 2 as they do in Table 1. Figure 11 depicts a graph of the test data.

After the system processes the training and test data with a value of K = 5, the priority location for logistical assistance distribution is village C, followed by village E, village A, village B, and village D.

Figure ten. The graph below depicts the priority levels per village based on system listings.

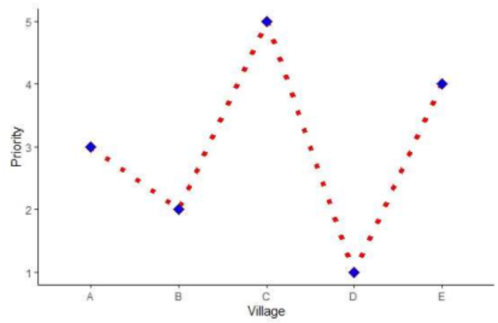

Figure 10. Priority Location

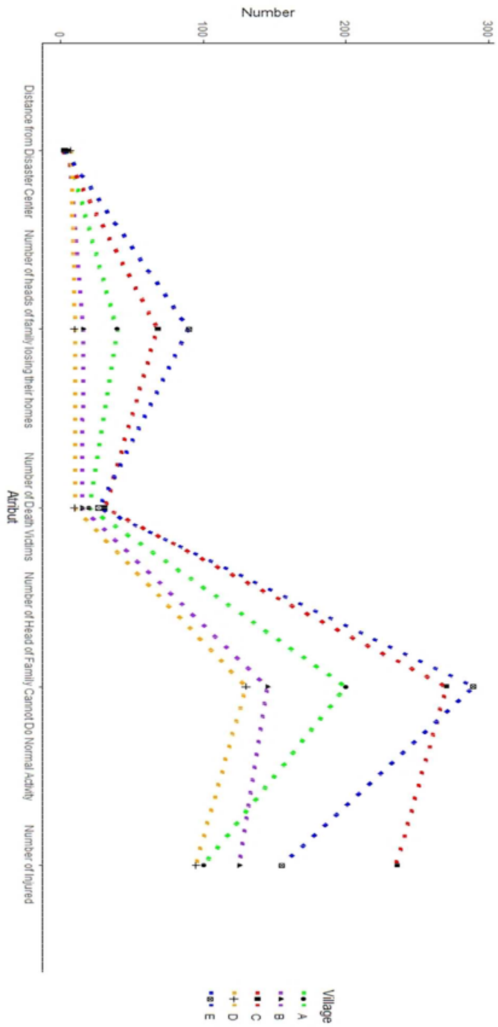

Figure 11. Test Data

V. CONCLUSION

The following are the conclusions that can be drawn from this research:

a) The disaster logistics information system can store and disseminate disaster logistics gathered from the community.
b) The system is simple to use as a donor or a recipient (requester) of donations.
c) The Open Volunteer feature is an additional feature that is thought to be important. This feature will be extremely useful in disaster-stricken areas that require many workforce and evacuation teams.
d) The smart system embedded in this application will make it easier to organize the type of donation, quantity, and location, as well as an accounting system for those who request donations, including registered volunteers.

FUTURE WORK

a) In the future, a mobile application will be required to make it easier to access and operate.
b) Investigate the origin of assistance requests' accuracy.
c) Allows integration into devices that can detect disaster symptoms in a specific location.

ACKNOWLEDGMENT

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REFERENCES

[1] Republik Indonesia, *Undang-Undang Republik Indonesia Nomor 24 Tahun 2007 Tentang Penanggulangan Bencana*. Indonesia, 2007.

[2] F. M. Ramadhan, "Data Bencana Alam 1998 - 2017, Makin Banyak yang Terdata," *Online*. Accessed: Dec. 19, 2019. [Online]. Available: https://grafis.tempo.co/read/1512/data-bencana-alam-1998-2017-makin-banyak-yang-terdata

[3] M. K. Lindell, "Disaster studies," *Curr. Sociol.*, vol. 61, no. 5–6, pp. 797–825, Sep. 2013, doi: 10.1177/0011392113484456.

[4] Bahagia, F. M. Mangunjaya, R. Wibowo, and Z. Rangkuti, "The Existence Condition Of Environment And Disaster Literacy At Elementary School Student Mother In Bogor West Java," vol. 3, 2021.

[5] L. Tondobala, "Pendekatan Untuk Menentukan Kawasan Rawan Bencana di Pulau Sulawesi," p. 13.

[6] BNPB, *Peraturan Kepala Badan Nasional Penanggulangan Bencana Nomor 4 Tahun 2008 Tentang Pedoman Penyusunan Rencana Penanggulangan Bencana*. 2008.

[7] BNPB and JICA, *Petunjuk Teknis Penyusunan Rencana Penanggulangan Bencana Daerah Tingkat Kabupaten/Kota*. 2015.

[8] BNPB, *Peraturan Badan Nasional Penanggulangan Bencana Republik Indonesia Nomor 04 Tahun 2018 Tentang Sistem Manajemen Logistik Dan Peralatan*. 2018.

[9] N. Doorn, "Resilience indicators: opportunities for including distributive justice concerns in disaster management," *J. Risk Res.*, vol. 20, no. 6, pp. 711–731, Jun. 2017, doi: 10.1080/13669877.2015.1100662.

[10] K. Krismiyati, "Manajemen Logistik Dalam Menunjang Kegiatan Operasi Pencarian dan Pertolongan Pada Kantor Search And Rescue (SAR) Kelas A Biak," *J. Ilm. Ilmu Adm. Publik*, vol. 7, no. 1, p. 46, Aug. 2017, doi: 10.26858/jiap.v7i1.3439.

[11] A. Solichin, "Comparison of Decision Tree, Naïve Bayes and K-Nearest Neighbors for Predicting Thesis Graduation," in *2019 6th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI)*, Sep. 2019, pp. 217–222. doi: 10.23919/EECSI48112.2019.8977081.

[12] J. Han, M. Kamber, and J. Pei, "Data Mining Concepts and Techniques. Waltham: Elsevier," *Walth. Elsevier*, 2012.

[13] J. Han and M. Kamber, "Data Mining:Concept and Techniques," *New YorkMorgan Kaufmann Publ.*, 2006.

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