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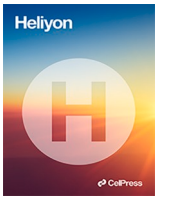

Social resilience and disaster resilience: A strategy in disaster management efforts based on big data analysis in Indonesian's twitter users

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ABSTRACT

Disasters have various causes, disaster management efforts, and actors involved. A systematic big data analysis is needed to identify social resilience to determine the quality of the country's resilience on disasters. This study aims to (1) determine perceptions about the causes of disasters and (2) understand perceptions of disaster management efforts. (3) identify actors involved in disasters. (4) analyze the relationship between social resilience and disaster resilience using large data sources. (5) formulate a disaster management. The research was conducted by describing in detail from the opinions of the twitter user community about disasters using the text mining method. The data retrieval and analysis process was carried out using Computer-Assisted Qualitative Data Analysis Software (CAQDAS) with MAXQDA series 2020, Gephi version 0.10.0 and SWOT analysis. The results of the study show: (1) Most of the perceptions of the causes of disasters are associated with religion; (2) Most of the perceptions about disaster management efforts are based on the application of disaster management at the recovery stage; and (3) The actors who are most involved in disaster management efforts are the security forces countries. (4) There is a strong relationship between social resilience and disaster resilience, as shown by each actor having a role in disaster management efforts. (5) There are nine formulations of development strategies in disaster management efforts. The limitation of this research is that it only uses big data from Twitter and social media sources. The implications of this research can be used as a reference for governments, organizations, communities, or others involved in disaster management efforts, especially in countries that have diversity and are prone to disasters.

1. Introduction

A disaster is an event or series that can threaten and disrupt life. The causes of disasters are natural factors and non-natural factors or human factors that cause casualties, environmental damage, property losses, and, and other serious psychological impacts on education, social conditions, behavior, and emotional development over a relatively long time [1,2]. Since the beginning of 2017,

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there have been 149 cases of disaster that occurred in 73 countries that are considered to have increased in the term of frequency and trend [3]. The frequency of disaster events internationally highlights the importance of preparedness in dealing with disasters [3]. Disasters have a serious impact on education, social conditions, behavior to emotional development in long time period [2].

Indonesia is a country that potentially often occurs disasters, both natural disasters and social disasters. Geologically, Indonesia is crossed by three active plates of the world and an archipelagic country whose 70% of its territory consists of waters. Viewed from the geographical location, Indonesia is located between two continents, namely the continents of Asia and Australia, that have an impact on its socio-cultural diversity. In the World maters report, Indonesia's population in 2020 was 274.9 million and occupied the number 4 position for the largest population in the world [4]. From its population, is divided into ethnic groups that have various beliefs and different cultures. The number of islands in Indonesia is 16,771 islands, 1340 ethnic groups, and six official beliefs [5,6].

Indonesia's natural and cultural diversity influence the condition of its social resilience. Social resilience is the ability of social entities to overcome, survive and/or recover threats, challenges, obstacles, disturbances that come from inside and outside. Some researchers said that social resilience is a manifestation of the ability of people, social units and social systems to overcome, survive and recover from disasters [6]. Another opinion stated that resilience discusses the social environment, economic conditions, institutions, infrastructure, institutions and nature as well as in it there is a place for community gathering, social support, knowledge about risks and a sense of community [7]. Social resilience is also a willingness in natural resource management that is carried out based on assumptions and concrete evidence in the environment [8].

Social resilience and disaster resilience are two concepts that are interrelated and affect each other. Disaster resilience can be defined as the ability to quickly return from pre-disaster to post-disaster conditions optimally [9]. The concept of disaster resilience is commonly recognized as an important tool to describe an organization's ability to recover from the impact of disasters and unforeseen events [10]. Of course, disaster resilience is a logical and significant concept and is useful for individuals, organizations, industries and governments [11]. The level of social resilience of a community can affect the community's ability to face and recover from the impact of disasters. On the other hand, disasters can affect the level of social resilience of the community. Therefore, effective strategies are needed in increasing social resilience and optimizing disaster resilience. One strategy that can be used is to utilize internet services through social media data.

In previous research it was stated that disaster-affected communities must be recognized as a community that requires improvement in an adaptive system on social resilience [12]. In addition, previous research also stated that increasing resilience is a mechanism in disaster management that is crucial [11]. Social resilience can help communities deal with disasters and minimize their impact, while disaster resilience can increase social resilience. One way to understand the relationship between these two concepts is to analyze data from social media. The use of social media data is interesting, effective, efficient, and innovative because it can obtain large amounts of data, reach a wide range of data, almost everyone can use technology to access social media, presents new data according to the times, does not take a long time, and does not require a large amount of money.

Based on data from the Indonesian Internet Service Providers Association (APJII) collected in 2021, there are 210,026,769 people connected to the internet from a total population of 272,682,600 people. Thus, a total of 77.02 Indonesians use the internet. As many as 98.02% of respondents said that they use the internet to access social media (twitter, Facebook, WhatsApp, telegram, Instagram, YouTube, and others). There are 7.2 million of active Twitter users (APJII, 2022). Social media is closely related to information seeking behavior related to a phenomenon that occurs. The role of social media as a solution to find out the information. Social media can also be used to analyze a situation.

One of the social media that can be used for data analysis is Twitter. Twitter data is an example of a real-world real-time data source that can present community narratives such as narratives about disasters. Thus, the research on examining social media users can be maximized however there are a few research on that. Twitter data is an example of a real-world, real-time data source that can present societal narratives, such as disaster narratives. Twitter accounts can effect social change and reach a wide audience because of their agency in content creation [13]. Thus, research by studying social media users should be maximized, but until now, not much research has been conducted.

This research has a novelty, namely using big data from social media in the form of Twitter to examine a condition of resilience. The use of big data sources in research in heterogeneous and dynamic societies can be extrapolated by other researchers, so that this kind of research will continue to develop according to real conditions. Overall, big data analysis can broaden our understanding of the state of affairs and, by answering key questions, can help researchers harness the power of big data while ensuring quality and integrity [14]. Diverse amounts of big data from many sources must be put to good use to improve the entire life cycle construction process [15].

In addition, the novelty of this study is that it also analyzes the relationship between factors in social resilience and disaster resilience in creating strategies. The purpose of this research is to find out perceptions about the causes of disasters, disaster management efforts, and actors involved in disasters. Furthermore, this study also aims to find the relationship between these factors to describe the state of social and disaster resilience. The next objective is to formulate a strategy for disaster management. This is very important to do because Indonesia is a disaster-prone country and requires a formulation of disaster management problems for the country's development.

2. Method

The process of data collection and data analysis are carried out using Computer-Assisted Qualitative Data Analysis Software (CAQDAS) which is able to process qualitative research data. The software used is MAXQDA 2020 series and Gephi version 0.9. MAXQDA is a software used to analyze unstructured data content such as interview documents, articles, media, surveys, and so on. Meanwhile, Gephi is a data analysis software that presents interactive graphs and network analysis and visualization that allows users

to learn the properties of graphs and networks in detail, without having to write any code [16]].

The results of qualitative data from MAXQDA were then analyzed further statistically and entered into the GEPHI 0.9 application. Grabbing, data processing and visualization are carried out to show the data relationship of each aspect. The data relationship will show the relationship of various aspects that influence each other. Furthermore, to formulate a disaster management strategy, a SWOT analysis was carried out. The SWOT analysis limits the creation of top-down strategy solely for the sake of alignment and strategy implementation and introduces strategy as part of a participatory long-term planning process. The results of the SWOT analysis are able to increase the effectiveness of organizational strategy, communication, and learning [17].

The research was conducted by describing in detail the opinions of the twitter user community who talk about disasters using text mining methods. The systematic built by the author is to parse Indonesian twitter documents containing the keywords "disaster" or "Indonesia" here in after referred to as corpus. The Twitter data retrieval period began from October to December 2022 and obtained a total of 22,112 data. This was because at that time there had been earthquakes and volcanic eruptions in several parts of Indonesia, which caused a lot of damage and killed people. Data filtering was carried out very carefully through two stages to eliminate biases twitter data, such as double users or discussions that were not included in the particular aspect being analyzed. This really needs to be done because the data being analyzed is big data.

However, after filtering the data, the amount of data in accordance with the research objectives amounted to 17,955 data. Furthermore, the corpus obtained is classified into code system (Causes of Disasters, Disaster Management Efforts, Actor). Code (Causes of Disaster) explains the causes of disasters. Code (Disaster Management Efforts) describes opinions about the way do in responding to disasters. Code (actor) discusses the perpetrators involved in disaster relief efforts. All of these codes have subcodes according to the results of text analysis. The content in the code is very important because all these aspects are the substance of issues, strategies and disaster control voiced by the community through twitter users in Indonesia. The following Fig. 1 shows the data processing process.

The use of methodology in this study was carried out in detail and systematically. The flow of the data processing process, as shown in the figure one starts from the initial data collection to obtaining research findings. Thus, the use of text mining with MAXQDA software tools, data visualization with Gephi software, and SWOT analysis to determine strategies based on strengths, weaknesses, opportunities, and threats can be replicated by other researchers.

3. Results

Every disaster has a cause. Filtering the data, it was found 1926 texts narrating the causes of the disaster. Analysis of public perceptions related to the causes of disasters need to be carried out in order to formulate disaster management strategies. Data processing in finding the cause of the disaster is done by making system code and system sub-code from various narratives about the cause of the disaster. Here is a full breakdown of the causes of the disaster according to twitter users.

The data in Table 1 above shows that people have many perceptions about the causes of disasters. The causes of disasters based on thousands of narratives that can be classified into 5 code systems. The 1162 narratives state that the cause of the disaster is related to the religious views of the community. However, when it viewed without system code, the most likely disaster is caused by extreme weather (26.27%), the existence of a khilafah system (22.69%) and human behavior that deviate from religion (10.28%). In addition to analysis of the perception of the causes of disasters, narrative analysis of disaster management efforts also needs to be carried out to determine the extent of community opinions and actions in disaster management. A total of 5079 respondents stated their narratives related to disaster management efforts and divided into four sub-codes as the following details.

In Table 2, here are 31 opinions grouped into four categories in disaster management. The three biggest opinions regarding disaster management efforts that were most often mentioned were trauma healing (19%), worship (14.35%), and handling physical health (7.64%). Further analysis is needed to determine the role of society, institutions, organizations, government, and others. Therefore, human existence plays a fundamental role in the social resilience and disaster resilience. The next analysis is used to determine the role of actors involved in disaster management efforts according to twitter users in Indonesia. In the concept of social resilience, the role of actor in responding to threats is needed to be considered the size of disaster resilience (see Table 3).

Twitter presents an unlimited narrative, so after coding data the further analysis is still needed to figure out the relationship between them. Mostly, one respondent has a statement that covers more than one aspect of the subcode system. To facilitate the process

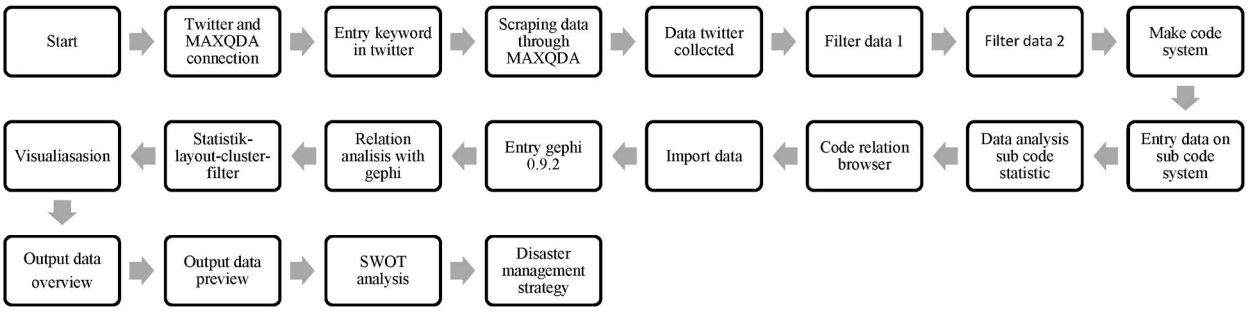

Fig. 1. Data processing process flow.

Table 1
Causes of disasters according to twitter user community.

No	Causes of Disaster	Segments	Percentage
1	**Disasters due to lack of public knowledge (2)**		
	a. Lack of information about disasters	2	0,10
2	**Disasters due to natural factors (602)**		
	a. Indonesia 's position of ring of fire	68	3,53
	b. Earthquake-prone zones	18	0,93
	c. Global warming	6	0,31
	d. Extreme weather	506	26,27
	e. Extensive water conditions	4	0,21
3	**Disasters due to political and legal circumstances (40)**		
	a. Political problems of the country	4	0,21
	b. Bad behavior of political figures	18	0,93
	c. Bad behavior of government officials	17	0,88
	d. Legal injustice	1	0,05
4	**Disasters due to environmental damage by humans (120)**		
	a. Human behavior that damages nature and ecosystems	28	1,45
	b. Land use change	35	1,82
	c. Humans greedy for nature	12	0,62
	d. Poor waste management	45	2,34
5	**Disasters based on people's religious views (1162)**		
	a. Fitnah	58	3,01
	b. God's love	2	0,10
	c. Human behavior that deviates from religious teachings	198	10,28
	d. God's warning	6	0,31
	e. God's temptations	87	4,52
	f. Doom	127	6,59
	g. God's wrath	18	0,93
	h. The power of God	34	1,77
	i. Human sins	111	5,76
	j. Humans who are too fanatical of religion	11	0,57
	k. Blasphemy	38	1,97
	l. Bad behavior of religious figures	11	0,57
	m. Eliminating religion in education	24	1,25
	n. The existence of a khilafah system	437	22,69
	TOTAL	**1926**	**100,00**

Source: Primary data analysis with MAXQDA software

of reading a data, analysis is done by converting qualitative data into statistical code data and visualizing it. The advanced analysis step uses social network analysis. The implementation of social network analysis is able to describe the relationships between actors through visualization of social network maps. The map is a graph, a way of depicting relationships in social networks, that use codes and links to represent actors and relationships. This analysis produces modularity graphs whose power measures can explain how easily graphs can be broken down into communities, modules, or clusters [18]. The use of class modularity in social network analysis aims to produce communities or clusters that exist on the network [19]. The goal is to create a design so that the model can use the same component in facing a challenge [20]. Here are the results of network's social analysis shown in Fig. 2.

The results of graft data in Fig. 2 using modularity class show that there are six communities or clusters on the network. The most cluster is cluster number 4 marked purple (63.38%), followed by cluster number 3 with light green (14.08%), cluster number 2 colored blue (11.27%), cluster number 1 brown (5.63%), and the last are cluster numbers 0 and 5, dark green and pink (2.82%). While the quantity of disaster factors is indicated by the size of the circle. The bigger the circle, the more often it is mentioned by Twitter users. Twitter users mostly mention government leadership and the state security apparatus.

In this study, the graph above can be used to identify the strength of each subcode system. Social resilience emphasizes social entities (whether as individuals, organizations, or communities) and their ability to tolerate, absorb, overcome, and adapt to various types of environmental and social threats [21]. The threat has a high potential for disaster. Therefore, in the study, the existence of actors is the most influence. Thus, centrality of value is needed to identify influential actors in the network [22]. Furthermore, to determine the strength and relationship between the aspects studied, a preview data visualization was carried out. A preview of data analysis results can be seen in Fig. 3.

Twitter users often mention and link to several aspects related to disasters in one post. The graph above is also able to visualize the relationship between points. Relationships that influence each other are indicated by the direction of the line. The thicker the line, the stronger the mutual relationship. The coloring of the points and lines in the graph above is based on the clusters formed in the previous stage. This research shows that the strongest relationship is indicated by the thickest green line that connects government leaders (actors) with good state leaders (disaster management efforts). Furthermore, a strong relationship is also shown by the thick blue line between educators (actors) and disaster education (disaster management efforts). So, from the graft above, it can be seen that respondents often juxtapose these two things in their tweets. Detailed data retrieval can be done by placing the pointer at a point on the network graft. The results of relationships between actors in disaster management efforts are presented in Table 4 as follows:

After knowing the picture of the perception of the causes of disasters of the causes of disasters described in Table 1, the actors

Table 2
Disaster management efforts according to twitter users.

No	Disaster Management Efforts	Segments	Percentage
1	**Disaster Management Through Religious Activities (989)**		
	a. Worship/prayer	729	14,35
	b. Carry out da'wah	44	0,87
	c. Patient	179	3,52
	d. Involving religious teachings in protecting the environment	4	0,08
	e. Prayer beads	33	0,65
2	**Implementation of Disaster Management (3431)**		0,00
	a. Preparedness Phase		0,00
	Disaster preparedness	585	11,52
	Disaster education	128	2,52
	Disaster simulation	19	0,37
	Extension	296	5,83
	b. Prevention and Mitigation Phase		0,00
	Procurement of disaster literacy	63	1,24
	Environmental governance	12	0,24
	Create a mitigation planning scheme	24	0,47
	Dialog	30	0,59
	Reforestation	1	0,02
	Mapping	84	1,65
	Assemesnt and environmental research	34	0,67
	New technology-procurement applications	130	2,56
	c. Emergency Response Phase		0,00
	Use of complaint services on social media	33	0,65
	Disaster response attitude	360	7,09
	d. Recovery Phase		0,00
	Logistics delivery	193	3,80
	Trauma Healing	965	19,00
	Relocation	30	0,59
	Recovery infrastructure	56	1,10
	Health care	388	7,64
3	**Political-based Disaster Management (144)**		0,00
	a. Enforcement	33	0,65
	b. Have a good leader of the country	110	2,17
	c. Freeing the ideology of the state	1	0,02
4	**Human Attitudes in Social Interaction (151)**		0,00
	a. Open donation	354	6,97
	b. Reprimanding and reminding each other	24	0,47
	c. *Gotong royong*	83	1,63
	d. Tolerance	40	0,79
	e. Join a community organization	14	0,28
TOTAL		**5079**	**100,00**

Source: Primary data analysis with MAXQDA software

involved and the disaster management efforts described on Tables 4 and it can be known the condition of social resilience of the community that affects disaster resilience conditions. Based on this, further analysis was carried out using SWOT analysis. This is because a SWOT analysis is a strategic planning analysis method used to monitor and evaluate a situation [23]. The following is Table 5 of the SWOT analysis table based on data analysis.

The results of the SWOT analysis described in Table 5 show various strengths, weaknesses, opportunities and threats related to disaster management based on the opinions of twitter users in Indonesia. The value of the weight is determined from the results of a discussion of research results between the authors and disaster experts in Indonesia. While determining the rating based on the level of influence of these factors on the disaster. The score is obtained by multiplying the weight by the rating. Calculations from this analysis produce a negative X value (−0.05) and a positive Y value (0.17). So, the meeting location of the two points is in quadrant three with an alternative strategy for W/O which is a category of turnaround strategy. Turnaround strategy is a strategy to reverse declining profitability back towards recovery and achieve a sustainable future [24]. This situation shows that the state or institution has a very large opportunity, but on the other hand also has internal weaknesses. The focus that must be taken is to minimize internal problems so as to seize better opportunities.

Based on this, the strategic plan in disaster management efforts is as follows:

1. The use of effective models, strategies, learning media in benignity education to improve students' cognitive, affective and psychomotor abilities against disasters in various units and levels of educational institutions
2. Giving *da'wah* or lectures by religious leaders about ecological and disaster values
3. Sustainable use of technology in disaster management
4. Availability and ease of access to literacy on disaster management for the community
5. Conducting disaster training and simulation for students and the general public

Table 3
Actors in disaster management efforts according to twitter users.

No	Actors	Segments	Percentage
1	**Government (9866)**		
	a. Government Officials	412	3,76
	b. Security forces	8110	74,06
	c. Indonesian Red Cross	65	0,59
	d. National Disaster Management Agency	354	3,23
	e. Meteorology, Climatology and Geophysics Agency	193	1,76
	f. National Research and Innovation Agency	11	0,10
	g. National *Amil Zakat* Agency	41	0,37
	g. State Intelligence Agency	680	6,21
2	**Education Actors (175)**		
	a. Students	135	1,23
	b. Educators	40	0,37
3	**Psychic**	32	0,29
4	**Artist**	14	0,13
5	**Political figures**	165	1,51
6	**Religious Figures**	137	1,25
7	**Human/Society**	26	0,24
8	**Organization (535)**		
	a. Religious Organizations	230	2,10
	b. Political Organization	278	2,54
	c. Community Organizations	27	0,25
TOTAL		**10950**	**100**

Source: Primary data analysis with MAXQDA software

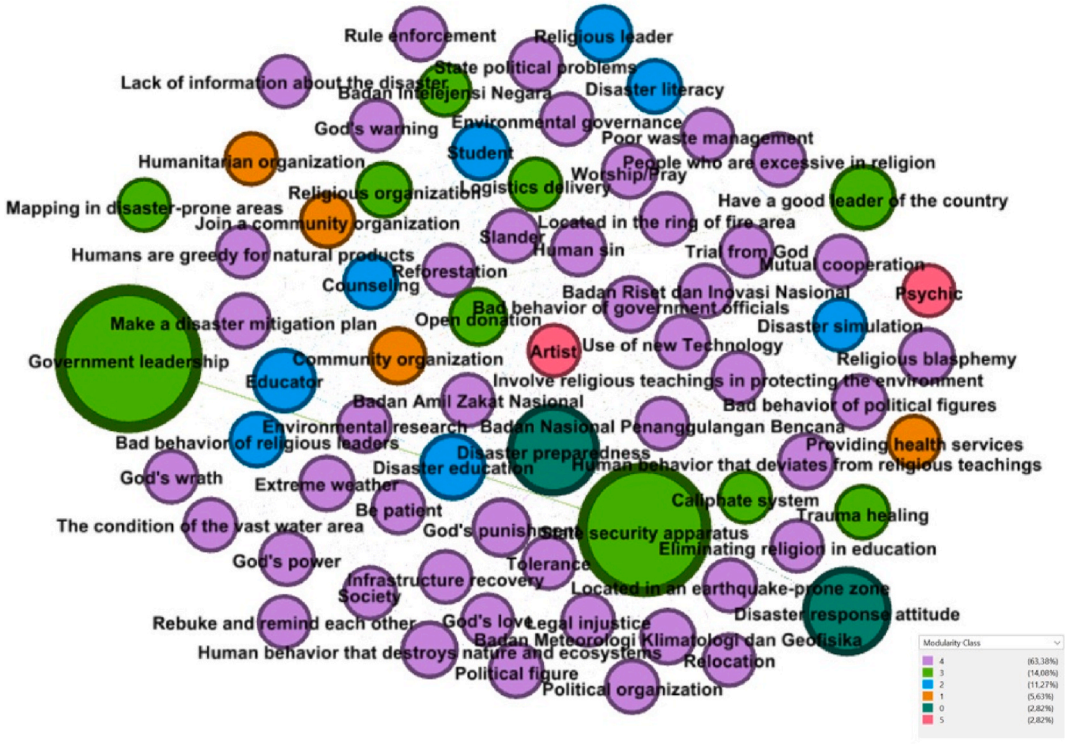

Fig. 2. Overview of twitter's user data about disaster, source: primary data processing using gephi version 0.10.1.

6. Holding a forum for joint activities in the religious field and entering content that teaches positive things such as tolerance, anti-fanatics, mutual assistance etc.
7 Organizing a discussion forum on disaster for disaster management officers, organizations and the general public
8. Organizing counseling from experts related to environmental management systems to the community
9. Implement systematic management of material and non-material assistance during disaster management to be more effective and efficient.

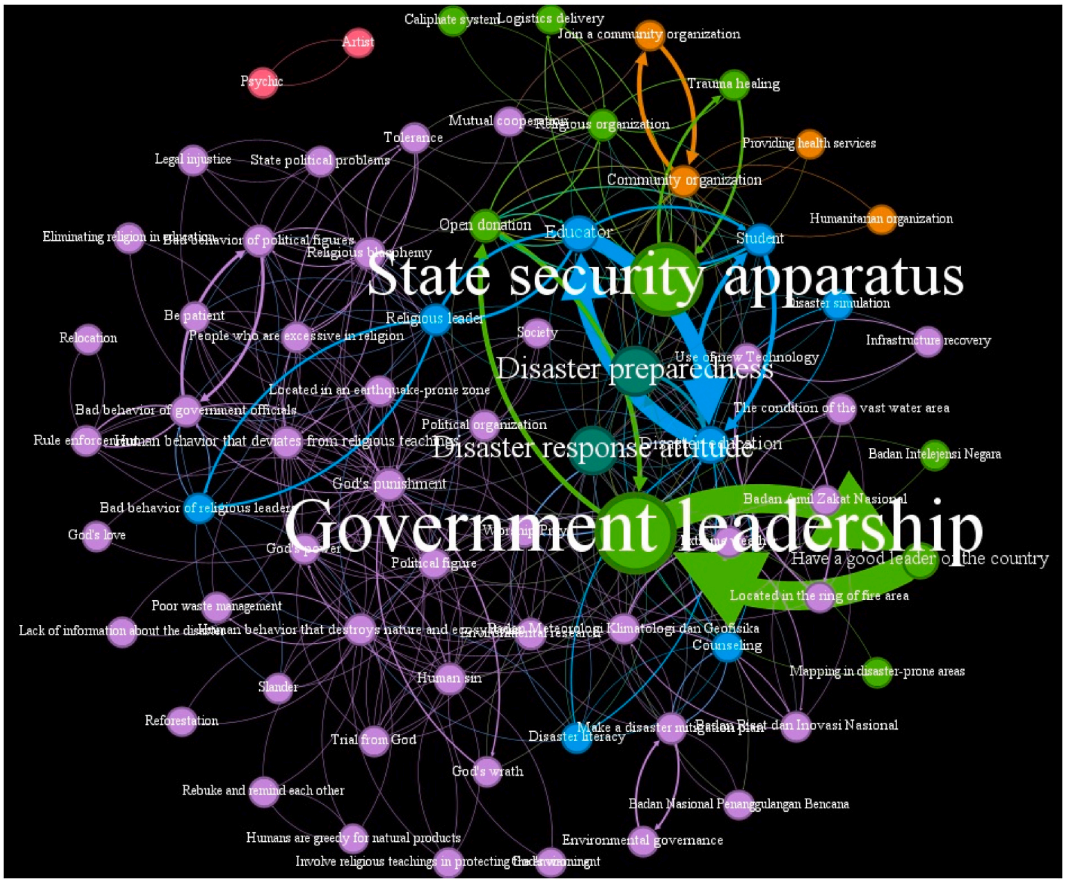

Fig. 3. Relationship among the causes of disaster, the actors, and the effort of disaster management.
source: primary data processing using gephi version 0.10.1

4. Discussion

The results of research on the causes of disasters show that people have many perceptions. Of the 28 descriptions, 5 were grouped into themes. The theme that contains the most data is the cause of the disaster related to religion, at 60.33%. Meanwhile, if you look directly at the description without being limited by the theme, most of them think that disasters are caused by extreme weather (26.27%), the existence of a caliphate system (22.69%), and human behavior that deviates from religion (10.28%). It can be seen that the first research finding in this research is that the Indonesian people, especially Twitter users, often associate religious violations as a cause of disaster.

The condition of people who think that disasters are related to religious elements cannot be separated from that of people who have a belief system. In addition, Indonesia is also a country that places the principle of God as a state ideology in the first place out of the five existing principles. Indonesia's plural state also results in a diversity of beliefs, and religion is often used as an argument in various matters. In the arguments presented by Twitter users, many mentioned disaster management efforts. The three biggest opinions regarding disaster management efforts that were most often mentioned were trauma healing (19%), worship (14.35%), and handling physical health (7.64%). Based on this, it can be concluded that the implementation of disaster management in the recovery phase is a more important concern.

In addition, disaster management through religious activities is also considered the right step. In addition, Twitter users also mentioned the actors involved in disaster management. Of the 9866 data points related to actors, the security forces (74.06%) were mostly mentioned as figures involved in disaster management. Meanwhile, opinions about the community as disaster management figures were only 26 statements (0.24%). Lack of awareness of the importance of the community's role in disaster management efforts is a research finding. The results of the analysis of the social relations data of the opinions in this study can be seen in Fig. 3 and are explained in detail in Table 4.

In this study, the stages of the process were passed through to formulate a disaster management strategy. The nine strategies that have been proposed need to be implemented because they are suitable for overcoming existing weaknesses. The first strategy relates to disaster education by using effective models, strategies, and learning media to improve students' cognitive, affective, and psychomotor abilities towards disasters. This is based on the results of the correlation analysis, which show that the community believes that

Table 4
Relationships and roles of actors.

No	Actors	Relation	Efforts Made in Disaster Management
1	Government Leaders	State Intelligence Agency/*Badan Intelejen Nasional* (BIN), community organizations, political organizations, political figures	Having good state leaders, open donations, procurement of disaster literacy, mapping
2	Security forces	Government leaders, religious organizations	Disaster preparedness, trauma healing, health care, logistics delivery
3	Indonesian Red Cross/*Palang Merah Indonesia* (PMI)	Community organizations	Health care
4	National Disaster Management Agency/ *Badan Nasional Penanggulangan Bencana* (BNPB)	Government leaders	Mitigation planning
5	Meteorology, Climatology and Geophysics Agency/*Badan Meteorologi dan Geofisika* (BMKG)	National Research and Innovation Agency	Attitude to disaster response, mitigation planning, use of technology/application procurement, assessment and environmental research
6	National Research and Innovation Agency/*Badan Riset dan Inovasi Nasional* (BRIN)	Climatology and Geophysics Agency, National *Amil Zakat* Agency	Disaster response attitude Assessment and research
7	National *Amil Zakat* Agency/*Badan Amil Zakat Nasional* (BASNAZ)	National Research and Innovation Agency, Meteorology, Climatology and Geophysics Agency	Disaster response attitude
8	State Intelligence Agency	Government leaders	–
9	Students	Educators, religious organizations, community organizations	Disaster preparedness, disaster response attitude, disaster education, open donation
10	Educators	Students, religious leaders, religious organizations, community organizations	Disaster preparedness, disaster response attitude, disaster education, open donation
11	Psychic	Artist	–
12	Artist	Psychic	Open donation
13	Political figures	Government leaders, political organizations	Worship/prayer together
14	Religious Figures	Educators, religious organizations	Disaster preparedness, patience
15	Human/Society	Political organization	Disaster preparedness
16	Religious Organizations	Security forces, educators, students	Delivery of logistical assistance, open donations, trauma healing, *gotong royong*, tolerance
17	Political Organization	Government leaders, political figures, citizens	Open donation, worship/prayer together
18	Community Organizations	Government leaders, educators, humanitarian organizations	Disaster preparedness, disaster response, open donations, disaster education, health handling, joining community organizations

Source: Primary data analysis based on graft overview and preview gephi version 0.10.0

educators have a relationship with disaster education, while their perception states that the community is a small part of the actors involved in disaster management efforts. This strategy is very important because the effects of disaster education can spread to other parties. The results of other studies state that through disaster education, it is possible to encourage children or students to discuss and share knowledge with their parents and have a positive effect on the attitudes, knowledge, and behavior of their parents towards disasters [25].

In addition, educators will have a great influence on their students because all students agree that teachers in schools are the main source of information about disasters [26]. However, student preparation in facing disasters must be supported by a curriculum that contains disaster education with various learning models or strategies and can be started by providing a comprehensive understanding of the characteristics and processes of these disasters [27,28] These statements are supported by the findings of proven previous research that states the various types of disaster education have a positive impact on perceptions of disaster risk reduction [29,30]. So, this is very important because the use of appropriate learning techniques in disaster education is an efficient approach to forming attitudes so that people are able to manage disasters well. Schools are a vital means of developing human resources, so disaster mitigation efforts must be made [31].

The second strategy is to give *da'wah* or lectures by religious leaders about ecological and disaster values. This strategy is based on the fact that the community has a perception that the causes of disasters and disaster management efforts are related to religious values. In addition, they also mentioned that religious leaders and religious organizations were actors involved in disaster management. In Indonesia, there are six trusts that are legally recognized by the government.

Research with an Islamic perspective explains that disasters occur due to human actions, both because of mistakes in preserving the environment and because of their sins as well as God is the main cause of everything, including disasters [32,33] Research with the perspective of Christian and Catholic also states that most natural disasters that occur are caused by human deliberate elements that irresponsibly exploit nature and as part of His presence in educating and punish His people [34,35]. In research on the relationship between disasters and religion, Hindu also explained that the chaos carried out by humans could have an impact on the chaos of the universe [36]. In Buddhist, disasters are often associated with the law of cause and effect [37]. In Khonghucu's teachings, natural disasters that occur need to be observed because it does not rule out the possibility of disasters occurring as a result of human failure and greed [38].

From statements based on religious concepts it can be concluded that human activities, divine power (compassion, curses, punishments etc.) can be the cause of disasters. However, due to the bigotry and plurality of Indonesian society, many narratives are

Table 5
SWOT analysis.

INTERNAL FACTORS				
	Strategic Factors	Weight	Rating	Score
Strength	Government leaders participate heavily in disaster relief efforts	0,25	4,00	1,00
	Security forces are capable of carrying out extensive disaster management	0,25	4,00	1,00
	People are starting to understand about disaster management	0,15	2,00	0,30
	Many leaders and communities have joined disaster management efforts	0,25	3,00	0,75
	Indonesian culture that ends the noble value of *gotong royong*	0,10	2,00	0,20
				3,25
Weakness	People still strongly believe that disasters are related to beliefs (punishment of human sin, blasphemy, the existence of a caliphate system etc.)	0,20	4,00	0,80
	Minimal use of technology in disaster management	0,10	3,50	0,35
	Lack of information about disasters in the community	0,10	3,00	0,30
	A society that is too fanatical	0,10	3,00	0,30
	Lack of cooperation between leaders/communities in disaster management efforts	0,10	3,00	0,30
	Not all organizations/communities have a disaster preparedness and response attitude	0,10	3,00	0,30
	Disaster management is more centered in the recovery phase	0,05	3,00	0,15
	Lack of disaster response attitude in the community	0,10	4,00	0,40
	Low public awareness to join the disaster management community	0,10	3,00	0,30
	Bad waste management	0,05	2,00	0,10
	Total Score Weaknesses			3,30
EXTERNAL FACTORS				
	Strategic Factors	Weight	Rating	Score
Opportunities	The beginning of *da'wah* ecological and disaster values	0,15	3,00	0,45
	Awareness began to emerge of the importance of disaster literacy	0,15	3,00	0,45
	There is a forum for worship/prayer together during disasters	0,15	4,00	0,60
	There is disaster education in some educational institutions	0,15	4,00	0,60
	The amount of assistance both material and non-material during a disaster	0,20	3,50	0,70
	Disaster training from government/institutions	0,10	3,00	0,30
	The existence of a community discussion forum related to disasters	0,10	3,00	0,30
	Total Score Opportunities			3,40
Treats	A plural society is very prone to division	0,25	3,50	0,88
	Indonesia's disaster-prone location	0,25	4,00	1,00
	Political figures, political organizations and other figures who carry out prestige-raising activities during disaster management	0,15	3,00	0,45
	Land use change by communities	0,15	2,00	0,30
	Community activities that damage nature by overexploitation of natural products	0,20	3,00	0,60
	Total Score Treat			3,23

incompatible with religion and the causes of disasters. This supports previous research if religion is an important component of the social and cultural makeup of many disaster-affected communities. Many religions offer narratives for understanding and interpreting disasters and provide initiative in policy making. Religious activities such as listening to sermons and the like, and participating in prayer together are the activities that cannot be separated from the community in responding to disasters [32,39]. Religion actually also has studies in post-disaster actions on development such as rehabilitation of public services and reconstruction [33,40]. Other researchers also recommend focusing on spirituality as a way to bring together social and environmental injustices so that faith-based strategies are effective for addressing psychological problems due to catastrophic events that bring mental trauma. Therefore, the strategy step of giving da'wah about ecological and disaster values is very necessary because the Indonesian people strongly believe in the concept of God.

The third strategy is to increase the sustainable use of technology in disaster management. This strategy was formulated because the public's perception of disaster management efforts is mostly still focused on the recovery phase, namely trauma healing and handling physical health. Only 2.65% stated that the use of new technology is a way of handling disasters. Supposedly, in the era of digitalization and great technological developments, the community can also use it to respond to disasters. This has been tested in previous studies which state that sustainable and renewable technology can transform communities into truly resilient societies against natural disasters [41] The use of technology in disaster education is also able to improve cognitive, affective and psychomotor abilities in disaster preparedness [42] The use of technology also proves its effective role in various stages of disaster management [43]. So, the use of sustainable technology in disaster management must be applied, especially in a disaster-prone country like Indonesia.

The fourth strategy is the use of disaster literacy. In the disaster management phase regarding prevention and mitigation, literacy is important. However, only 1.24% of Twitter users stated the importance of disaster literacy. This is because a text is able to provide insight to decision-makers on how to improve emergency response plans [44]. This strategy is supported by previous research which states that risk reduction in developed countries is currently focused on improving access to information services for the general public, one of which is through literature [45]. The results of other studies also stated that literacy of disaster theme material can increase students' knowledge and understanding by 91.6% [46]. Thus, a systematic literature review can be used as a method to identify the current situation.

The fifth strategy is the holding of training and disaster simulation. Simulation activities are included in the preparedness phase of disaster management efforts. Only 19 statements (0.37%) about the implementation of the simulation were made in this study. In fact,

in this study, there is a narrative of organizational actors who generally carry out various activities in disaster management. The role of the organization in this study was found more in open donation activities, holding prayers together, and distributing logistical assistance. Through training and simulation, it can be known the responsibility and role of institutions to reduce the impact of disasters [47] A centralized control from government elements or institutions is needed for successful disaster risk management [48]. This strategy is also supported by research results which state that cooperative disaster simulations are able to build a systematic framework in disaster management [49].

The sixth strategy is to hold a forum of joint activities in the religious field that are given content in teaching positive things such as tolerance, anti-fanatics, mutual assistance etc. This is very important because Indonesian society is a plural society with a large population, many tribes and diverse beliefs so that there are often actions that damage the unity of the nation. This is evident in the findings of this study, there are still many narratives related to religion, culture, and social groups in discussions about the causes of disasters, disaster management efforts, and the actors involved. In fact, the key in a disaster resilience is the closely related to social resilience and national unity. Previous research has shown that activities in religious landscapes can form an important component of disaster recovery from all affected individuals, communities, and religious communities as disaster risk reduction agents [50].

The seventh strategy is through discussions involving various groups. This is important to do based on research results that explain the involvement of many actors in disaster management. In addition, there are various opinions that need to be compared because the community has many perceptions about disasters. Therefore, discussion factor is a strategic way in creating disaster resilience. Discussions are able to explore various obstacles of officers handling in charge [51]. Discussions carried out by various groups in a directed manner are also able to know and understand the causes of a situation that is not dynamic so that an in-depth analysis can be carried out to meet the needs of the community [52] Meanwhile, other studies also say that discussions with multi-ethnic communities are effective in providing extraordinary disaster risk reduction strategies and are able to make it a measure to concentrate social resilience [45]. The effectiveness of disaster management activities is better if there is agreement and understanding from several elements, including the government, disaster officials, organizations, and the general public.

The eighth strategy is by conducting counseling related to the environmental management system to the community so that the community does not damage the environment, is not greedy for natural results and as contained in the analysis of the causes of disasters above. In addition, the SWOT analysis on weaknesses also stated that the community has not been fully able to manage waste so that this extension activity is a strategy that must be considered in disaster management efforts. Waste management is a preventive effort in reducing pollution that has an impact on climate change that can cause disasters.

The last strategy is to improve the management of material and non-material assistance for disaster management to make it more appropriate and useful. This strategy is based on research findings that state that there are open donation and logistics delivery activities that are most often carried out by several actors, such as community organizations, political organizations, and religious organizations. Finally, many aids are sometimes homogeneous. Similar recommendations were also stated by previous researchers, namely that in addition to focusing on infrastructure repair and recovery actions, other emergency activities such as disaster relief distribution must be considered properly [53]. Previous researchers based on their findings in the field also provided recommendations that each scenario of a request for assistance should pay attention to location, available facilities, and shipping routes [54]. This is very important because it is part of responding to disasters to be more effective and efficient.

The above strategies are given based on the condition of the country's social resilience. This is because in analyzing the data look for the relationship between perceptions and the role of several actors in disaster management. People, families, organizations, social groups, communities or governments are an inseparable part of social resilience. A social resilience will affect disaster resilience. Fig. 4 shows the stem thoughts related to social resilience in disaster studies.

The chart in Fig. 4 explains the relationship between social resilience and responding to disasters, so systematic thinking like the analysis in this study is needed to increase community resilience to disasters. This is also similar to the statement that systematic thought is needed to define social resilience as the ability of social entities and mechanisms to deal with disasters [6]. Social resilience is a key factor in facing the challenges and disasters faced by a society. Building strong social resilience becomes very important for a country that is vulnerable to various types of natural and social disasters. The level of social security can be influenced by various conditions of individuals, families, organizations, social groups, or communities in a social system (structural characteristics, knowledge characteristics) and social mechanisms (social dynamics, processes in society) such as poverty levels, access to education, health services, as well as the role of government and others. Therefore, people must have a high level of social resilience, such as solidarity, togetherness, and concern for others, so that they are better able to survive and recover during and after a disaster. Good social resilience can help a community overcome the pressures and challenges posed by disasters. Thus, a state's social security condition is obtained from a wide range of data sources. As in this study, the use of data sources from social media is able to collect very large amounts of data to determine social resilience and create strategies for managing disasters. This is in accordance with the recommendations of previous researchers who suggested a wider exploration of data from social media because it would become a systematic and comprehensive review. If this happens, it will support the knowledge of the disaster risk reduction community in carrying out disaster management activities better [55].

5. Conclusion

Based on the results and discussion in this study, it can be concluded that (1) the majority opinion of 1162 narratives (60.33%) out of a total of 1926 narratives (100%) about the causes of disasters states that the causes of disasters are related to religious views, which include slander (3.01%), God's love (0.1%), deviant behavior (10.28%), God's warning (0.31%), God's trials (4.52%), punishment (6.59%), God's wrath (0.93%), God's power (1.77%), human sin (5.76%), bigotry in religion (0.57%), religious blasphemy (1.97%),

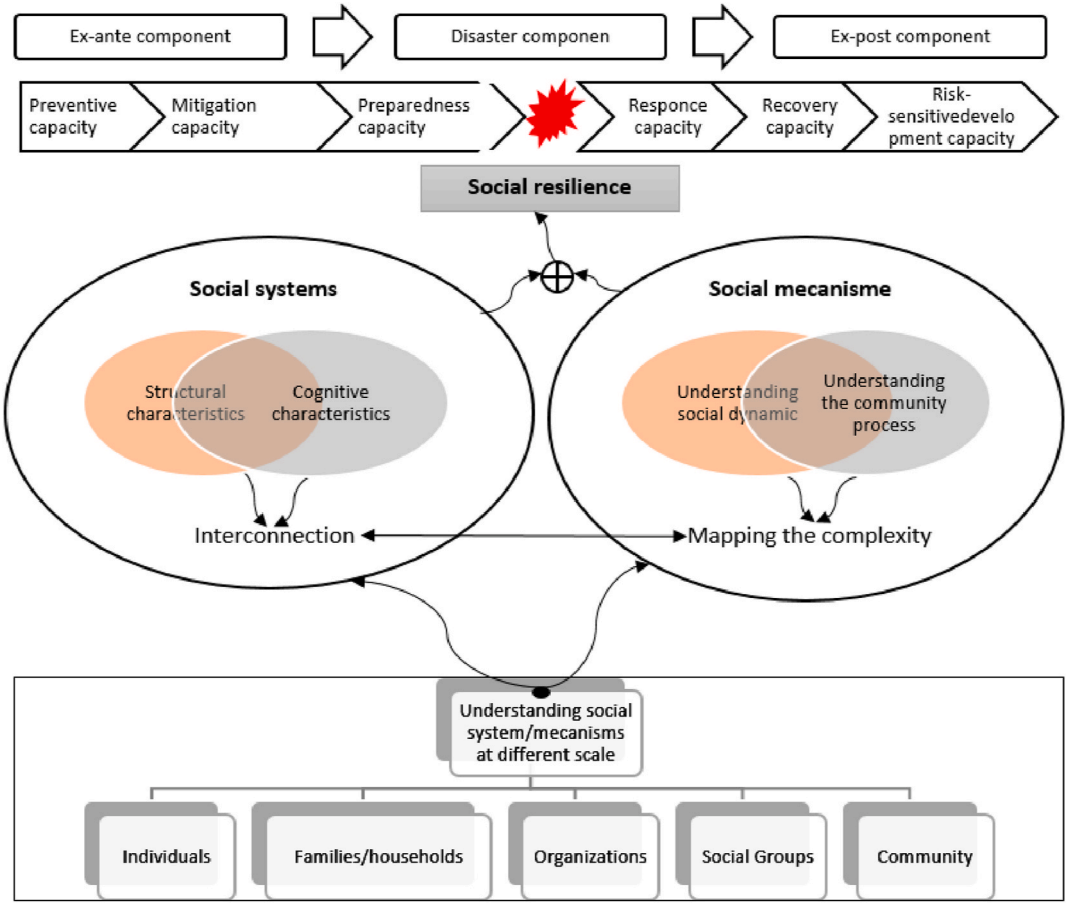

Fig. 4. Social resilience chart.

bad behavior of religious leaders (0.57%), eliminating religion in education (1.25%), and the existence of a caliphate system (22.69%); (2) The most mentioned disaster management efforts (3431 out of 5079 narratives) are implementing disaster management (67.55%). Subsequent opinions mentioned disaster management through religious activities (19.47%), improving human attitudes in society (2.97), and political-based disaster management (2.84%); (3) Out of a total of 10,950 narratives about actors involved in disaster management according to the public's opinion, they are the government (90.10%), community organizations (4.88%), educators (1.60%), political figures (1.51%), religious leaders (1.25%), psychics (0.29%), communities (0.23%), and artists (0.12%); (4) Through analysis using big data, an overview of the strong relationship between social resilience and disaster resilience in Indonesia can be obtained. The relationship between all the measured data forms six clusters. The strongest relationship in this disaster discussion is shown starting from the relationship between leaders of government institutions and security forces, disaster preparedness and disaster response attitudes, disaster education, and educators; (5) through the analysis of the relationship between social resilience and disaster resilience, formulate strategies in disaster management consisting of: the use of effective models, strategies, learning media to improve students' cognitive, affective, and psychomotor abilities against disasters in various units and levels of educational institutions by; giving da'wah or lectures by religious leaders about ecological and disaster values; increasing the use of sustainable technology in disaster management; procurement and ease of access to literacy on disaster management for the community; conducting disaster training and simulation intended for students and the general public; holding a forum for joint activities in the religious field and inserted content that teaches positive things such as tolerance, anti-fanatics, mutual assistance etc.; organizing discussion forums on disasters for disaster management officers, organizations and the general public; counseling from experts related to environmental management systems to the community; and organizing systematic management of material and non-material assistance for disaster management to be effective and efficient. The recommendation of this study is the need for more relationship analysis to create other strategies to reduce disaster risk. The implication of this research is that the analysis method and the results of this research can be used as a reference in disaster management efforts, especially for countries that have a diversity of tribes, cultures, beliefs and are prone to disasters.

This research has limitations because it only examines the causes of disasters, disaster management efforts, and actors involved in disasters according to the opinions of the Twitter user community. So that future researchers can expand their research with similar concepts from other big data sources. This research provides recommendations to the government, organizations, educators, religious

leaders, researchers, and the public on how to carry out the strategies that have been formulated. In addition, future researchers can also carry out a more detailed analysis of the relationships among various aspects and other sources to create additional strategies in an effort to reduce disaster risk. The implication of this research is that the method of analysis and the results of this research can be used as a reference in disaster management efforts, especially in countries that have diverse ethnicities, cultures, and beliefs and are prone to disasters.

Author contribution

Nur Isroatul Khusna: Wrote the paper, conceived, and designed the experiments, and analyzed and interpreted the data.
Sumarmi: Performed the experiments and analyzed and interpreted the data and wrote the paper.
Syamsul Bachri: Wrote the paper and conceived and designed the experiments.
I Komang Astina: Wrote the paper and contributed reagents, materials, analysis tools or data.
Singgih Susilo: Wrote the paper and analysis tools or data.
Idris: Performed the experiments and analyzed data.

Data availability statement

Data included in article/supp. material/referenced in article.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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