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Citizen Participation in Responding to Natural Disasters Through Twitter Messages

Rizky Pamuji[1], Ismiarta Aknuranda[2], Fatwa Ramdani[3]

[1,2,3]Faculty of Computer Science, Brawijaya University, Indonesia
{[1]rizkypamuji.off@gmail.com, [2] i.aknuranda@ub.ac.id, [3]fatwaramdani@ub.ac.id}

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Abstract. Citizen participation in collect and distribute information increase the role of the citizen involvement in local issues and increasing the benefits of society for the government and the environment. The contribution of citizens can be useful in helping to deal with environment problems and assist certain parties in meeting data needs, this is commonly referred to as citizen science. In its development, citizen science involvement in providing information began to involve social media as a platform for sharing information. In this study we try to explore citizen science of Indonesia, we conduct case study exploring how citizen in Indonesia used social media such as Twitter in response to one of the country's worst disaster in 2018 namely Lombok Earthquake. By analyzing these user generate message we may know what the response of Indonesian citizen during event and understand more about citizen science in Indonesia through social media including its role and contribution. The information also may assist local communities in obtaining up-to-date information, providing assistance according to needs of the populace and use to manage and plan disaster relief both during and after the event.

Keyword : Information, tweets, data

1. Introduction

Indonesia historically is one of the countries with a lot of natural disasters in recent time, one of the causes is Indonesia located in the confluence of four earth tectonic plates namely the Asian continental plate, the Australian continental plate, Indian oceanic plates, and Pacific oceanic plates that make Indonesia prone to natural disasters [1]. Various natural disasters such as earthquakes, tsunamis, volcanic eruptions, floods, landslides, and tornadoes often hit almost all parts of Indonesia so that the view that Indonesia is a "home" for natural disasters.

A series of natural disasters that have occurred in Indonesia has resulted in various negative impacts such as loss of life, loss of property, environmental damage and damage to public facilities in the area affected by the disaster [2]. Major economic losses can also be caused by natural disasters that hit [3]. Economic loss disrupts economic flows such as loss of income or swelling of expenditure. Natural disasters also have an impact on the loss of several sectors such as settlement, infrastructure,

social, education, and other cross-sectors.

Natural disasters and their negative impacts make natural disasters an important problem for Indonesia, it requires a lot of attention and readiness of human resources to be able to handle them carefully and thoroughly [4]. One of response and attention are given to face natural disasters is citizen involvement in data collecting and sharing, it is usually refers to citizen science. The natural disasters that often hit Indonesia make the use of citizen science need to be considered as an alternative solution to deal with these natural disasters.

Citizen science is a terminology given to an activity involving individuals and communities that are oriented to gathering information and then sharing that information with the world both directly and indirectly [5],[6],[7]. Citizen science from the social side is useful in democratizing knowledge among the community, increasing the role of the community and increasing community involvement in local issues and increasing community benefits for the government and the environment [8],[9].

The phenomenon of citizen science has developed quite rapidly in various countries, even in recent times citizen science has a significant role and contribution, especially in dealing with natural disasters in several countries as evidenced by the many studies on citizen science in disaster events [10],[11],[12]. However, in Indonesia, the role of citizen science are still not well defined especially in disasters situation. The topic of citizen science is still not much researched in Indonesia, coupled with not many scientific documents that provide facts about citizen science and public involvement in dealing with events that make citizen science in Indonesia increasingly difficult to define. The exploration of the role of citizen science in Indonesia needs to be done so that it can be well defined so that it can be utilized as one of the efforts in dealing with various social and environmental problems and not left behind from other countries that first used citizen science.

Therefore in this study, we explore the role of citizen science in Indonesia through citizen involvement using social media approaches to respond to natural disasters. Natural disasters were chosen because natural disasters become a common problem that must be faced by all elements in Indonesia and requires a variety of possible solutions to deal with it. The use of social media by the citizen can also provide an overview of the extent of citizen participation in providing information on events that occur through social media. In addition, Daume and Galaz [13] in their research stated that the information contained in conversations on Twitter's social media was similar to the information generated by citizen science activities in general.

We also want to provide facts about citizen contributions in helping to build an understanding of events that occur with data obtained from citizen science. This is because the understanding and information about natural disasters in the past few decades happened very slowly and in a long process, this process is usually carried out by researchers in the scope of activities that are closed and in months to find out the characteristics of the events that occurred [14].

2. Research Case

2.1 The Lombok Earthquake 2018

From July to August 2018, Lombok was hit by a series of severe earthquake events along with its aftershocks. On July 29, 2018, an earthquake measuring 6.4 magnitudes became the beginning of a series of large earthquakes that hit Lombok

followed by another large earthquake that occurred on August 5 and August 19, 2018, which caused severe damage in various places on the island of Lombok. The location most severely affected during the big earthquake on 5 August 2018 was North Lombok Regency. Indonesia's national disaster management agency (BNPB) report that about 80% of houses and buildings were damaged and more than 212 people died in 2018 because of Earthquake attack.

2.2 Twitter

Twitter can be a useful source of information for the public and researchers because the information is shared freely and freely by millions of users spread all over the world. This is because one of the characteristics of social media as an interactive, practical and mobile digital communication tool that can be accessed easily by users, social media in addition to disseminating information can also create or influence the content of that information [15]. Twitter is a social media that has received acceptance from the community and has been used by millions of people in the world to stay socially connected with friends, family members and coworkers through their computers and cellphones [16] and share information about anything. Twitter allows its users to share information about social activities they do or an event that they experience. Twitter provides space for professionals and lays people to post their experiences and suggestions about disaster events, this is a common choice for disaster management [17].

Since the great earthquake reached the part of West Nusa Tenggara province that began in July 2018, the number of Twitter messages in Indonesia regarding the earthquake has increased significantly and varied. Messages contained on Twitter or called tweets come from citizens, these messages can be in the form of reports or other information about the earthquake that occurred. This indicates that many people gave attention and response to the earthquake that occurred.

3. Tweet Analysis

3.1 Tweet Collecting

To understand the various types of information disseminated by the public through the Twitter network during the 2018 Lombok earthquake, we collect tweets data from the three major earthquakes that struck Lombok separately, namely period one (07/29/18), period two (05/05/18) and period three (08/19/2018). A part of these tweets are collected using the streaming Twitter API. As Twitter allows to collect only past seven days data using streaming Twitter API, there is no provision to collect historical data using it. So, the most data are collected using web scrapper application and Twitter advance search feature to track Twitter historical data.

To collect these historical tweets data about Lombok earthquake we used hashtag '#gempalombok'. The "#" symbol, called hashtag on social media, is used to tag keywords or topics in Tweets. Hashtags are often used by Twitter users to indicate that their message content is specifically related to the intended or specified topic. Hashtag is also widely used for purposes such as product branding. Our dataset only includes earthquake-related messages specifically referring to the hashtag "#gempalombok". The tweets that have been collected are grouped based tweet sent by citizens, and tweets sent by the government and news media. The purpose of grouping is to maximize the tweets obtained are the result of community participation

that has concern and interest in the earthquake disaster that occurred. The tweets used in this study are tweets that come only from the citizens. The way to determine tweets belonging to a government or news media account and ordinary citizens is by identifying the tweet contents and profiles owned by the account manually.

3.2 Tweet Information Categorization

An analysis of the tweets was conducted to determine the themes of information disseminated on Twitter regarding the Lombok earthquake. The author groups the collected tweets into several categories according to the contents of relevant information that are found at least five times. This categorization can be used to know the themes of information that is being spread when a disaster occurs, and as a reference in carrying out management and actions against disasters that occur either this current time or those that occur in the future.

To identify information themes contained in tweets, researchers used a thematic analysis that was done manually on the tweet data that had been collected. This method is a way of identifying what is common to a topic being discussed or written and understanding these similarities [18]. Thematic analysis can be used to try to find out about people's views, opinions, knowledge, experiences or values from a collection of qualitative data such as interview transcripts, social media profiles, or survey responses. Researchers usually use thematic analysis in examining data to identify common themes of a topic, ideas and meaning patterns that emerge repeatedly. Thematic analysis can be applied to a series of texts in a tweet. Thematic analysis is used as a technique in determining the theme of information contained in the tweets that have been collected. The following stages of thematic analysis according to Braun and Clarke [18]:

1. Data Familiarization
   The first step is to recognize the data we have. It is important to get a comprehensive picture of all data that has been collected before starting to analyze each data. Data recognition can involve copying audio, reading text and making initial notes, and generally looking through the data to get to know him.
2. Coding
   Conduct data analysis systematically through coding. Encoding means highlighting the text part of the data that is owned, usually a phrase or sentence and appears with a label or code to describe the content of the text. The code identifies and provides labels for data features that are potentially relevant to the research question.
3. Searching for Themes
   In this phase, the analysis of the researcher begins to form when it has switched from code to theme. A theme captures something important about data in relation to a research question, and represents some level of response or meaning patterned in the data set.
4. Reviewing Potential Themes
   This phase involves a recursive process in which developing themes are reviewed with respect to code data and the entire data set. This phase is basically about quality inspection. This is very important for novice researchers and for those who work with very large data sets, where it is not possible to store the entire data set in the head.

5. Defining and Naming Themes

   Mendefinisikan tema yaitu merumuskan dengan tepat maksud dari masing-masing tema dan mencari tahu bagaimana itu membantu peneliti dalam memahami data. Penamaan tema melibatkan membuat penamaan yang ringkas dan mudah dimengerti untuk setiap tema.
6. Producing The Report

   Unlike in quantitative research, in conducting qualitative research the researcher does not complete the data analysis and then write it down. Writing and analysis are carefully interwoven in qualitative research from the informal writing of notes and memos to the more formal process of analysis and report writing. The purpose of the report made by the researcher is to provide an interesting story about the researcher's data based on the analysis conducted by the researcher. The explanation must be convincing and clear but complicated and embedded in the scientific field.

3.3 Development of Disaster Knowledge Based on Tweets and Spatial Data

Based on the results of the tweets collection conducted in three periods of earthquake events, several tweets contain earthquake spatial information such as the location of the earthquake, the time of the earthquake, the strength of the earthquake and so on. Information about the earthquake event is in the tweet category of 'earthquake event' but only partially not a whole.

In this study, tweets containing information about the time, location and strength of the earthquake contained in period one collaborated with information about the time of the earthquake from the United States Geological Survey (USGS) data. The information on the time of the earthquake which is owned by USGS has been changed into the Indonesian local time zone (UTC+07:00) Jakarta, namely western Indonesia time (WIB). While for the tweets that have been collected, the time zone is already in the WIB, it is because the publish time stated on the tweet depends on the time zone setting of the researcher on twitter, in this case the researchers are using the WIB, so the time zone of the collected tweets is WIB even though the tweets sent are from different time zones.

The results of this data combination are in the form of a plot of earthquake occurrence based on the time sequence of its occurrence. This is expected to help understand the earthquake events more easily, and also be able to see how precise earthquake information provided by citizens through Twitter to satellite data. Meanwhile, earthquake location information obtained from tweet data is analyzed to find out the coordinates of these locations. Based on the coordinates that are known from the location of the earthquake, a mapping of earthquake locations and their intensity can be made.

4. Results

4.1 Tweet Collecting and Grouping Result

To understand the various types of information disseminated by the public through the Twitter network during the 2018 Lombok earthquake, we collect 1128 Tweets from the three periods of major earthquakes that struck Lombok. Separately

tweet collected in period one as many as 147 tweets, period two as many as 703 tweets and period three as many as 278 tweets.

The collected tweets then grouped into tweets sent by citizens, and tweet sent by government and news media. The number of tweets that sent by citizens that became our dataset in this study was 979 tweets, the number of tweets in period one is 129 tweets, in period two is 602 tweets, and in period three is 248 tweets. The different amount of collected tweets before and after grouped can be seen in Figure 1.

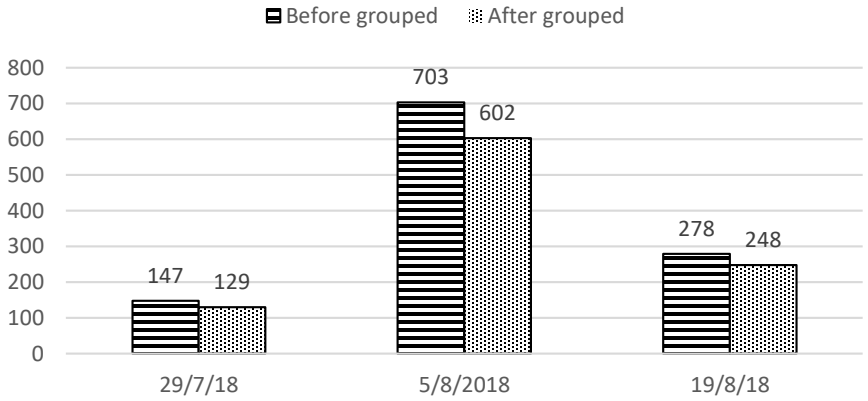

Fig.1. Comparison between the numbers of tweets before and after grouped

4.2 Tweet Information Categorization

The more tweets that appear about certain information, the greater the tendency for the theme of that information. This can indicate that the information is important and can be followed up on. This information can be used as a reference in carrying out management or action against disasters that occur both now and those that occur later. By using a thematic analysis approach to citizens tweet messages, we managed to group that 979 tweets into several different categories by its theme of information:

1. Prayers, Support, Grief, and Hope
   This category contains tweets that contain information about prayers, support, condolences and hopes conveyed by the community to the earthquake situation that occurred in Lombok as a form of empathy, compassion, and condolences to people affected by the disaster. These tweets can indirectly arouse the curiosity of other users about the conditions that are happening.
2. Earthquake event
   This category includes tweets that contain information about earthquake events and earthquake shocks felt or known by the public. This Tweet also includes information on the location of the earthquake or earthquake-affected, the time of the earthquake, the strength of the earthquake, the frequency of the earthquake and aftershocks.
3. Dead victim
   This category contains messages or tweets about the condition of the victims caused by the earthquake that occurred. The information contained in this category's tweet is information about the number of victims who died and the handling of dead victims.

4. Handling survivor
   This category contains tweets regarding the handling or development of survivors after main-shock in an earthquake-stricken area such as information, injuries, displaced victims, evacuation of victims and the like.
5. Condition of citizens after the main-shock
   In this category, there are tweets that contain information about the condition of residents after a major earthquake occurs. Most of the information contained in the tweet in the category contains the condition of residents who fled to certain places, set up tents for temporary shelter and other things that people do to survive after the main-shock.
6. Appeal and Warning
   Tweets in this category contain appeals or warnings on disaster situations that occur to avoid more casualties or as an effort to remind one another of the dangers of the situation.
7. Request for Assistance
   In this category, tweets or messages are containing various requests for assistance or assistance to cope with disaster situations such as food, water, medical supplies, protection, and others.
8. The Condition public Infrastructure / facilities after main-shock
   This category consists of tweets that contain information about the condition of infrastructure or facilities after the main earthquake that hit Lombok. Various post-earthquake conditions such as building damage, building operations, or the inability of the infrastructure to operate fall into this category.
9. Rinjani Mountain Climber
   In this category, various tweets contain special information about the development of the mountaineers of Mount Rinjani who are experiencing difficulties due to the impact of the earthquake and are trapped around Mount Rinjani. Information about the mount Rinjani climber was only available during the period one earthquake.

10. Others
    This category includes tweets that have no relation or relation to earthquakes, tweets that contain video links or images that were not detected at the time of data collection, tweets containing information about the earthquake but are still unclear, and tweets with the appropriate information but the amount is less than five.

4.2.1 Tweet Categorization Period One

An analysis of the tweets was conducted to determine the theme of information that was spread on Twitter regarding the Lombok earthquake. The theme of information contained in a tweet is identified by doing a thematic analysis of the tweets. From 129 unique tweets in period one, approximately 36%, 27%, 9%, 7%, 7%, 5%, 5%, and 4% belong to the 'Prayers, Support, Grief, and Hope', 'others', 'earthquake event', 'dead victim', 'handling survivor', 'appeal and warning', Rinjani mountain climber', and 'request for assistance' categories, respectively. A chart displaying the distribution of eight tweet categories is shown in Fig. 2.

4.2.2 Tweet Categorization Period Two

An analysis of the tweets was conducted to determine the theme of information that was spread on Twitter regarding the Lombok earthquake. The theme of information contained in a tweet is identified by doing a thematic analysis of the tweets. From 602 unique tweets in period two, approximately 41%, 34%, 9%, 8%, 2%, 2%, 2%, and 2% belong to the 'Prayers, Support, Grief, and Hope', 'others', 'earthquake event', 'appeal and warning', 'citizen condition after main-shock', 'request for assistances', 'handling survivor', and 'dead victim' categories, respectively. A chart displaying the distribution of eight tweet categories is shown in Fig. 3.

4.2.3 Tweet Categorization Period Three

An analysis of the tweets was conducted to determine the theme of information that was spread on Twitter regarding the Lombok earthquake. The theme of information contained in a tweet is identified by doing a thematic analysis of the tweets. From 248 unique tweets in period three, approximately 44%, 23%, 20%, 5%, 4%, 2%, and 2% belong to the 'others', 'pray, support, grief and, hope', 'earthquake event', 'handling survivor', 'appeal and warning', 'the condition of public infrastructure/facilities after main-shock', and 'citizen condition after main-shock' categories, respectively. A chart displaying the distribution of eight tweet categories is shown in Fig. 4.

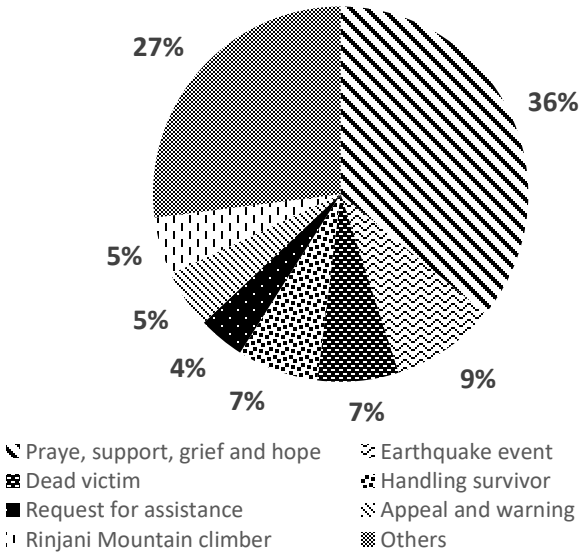

Fig.2. Distribution of information trends in period one

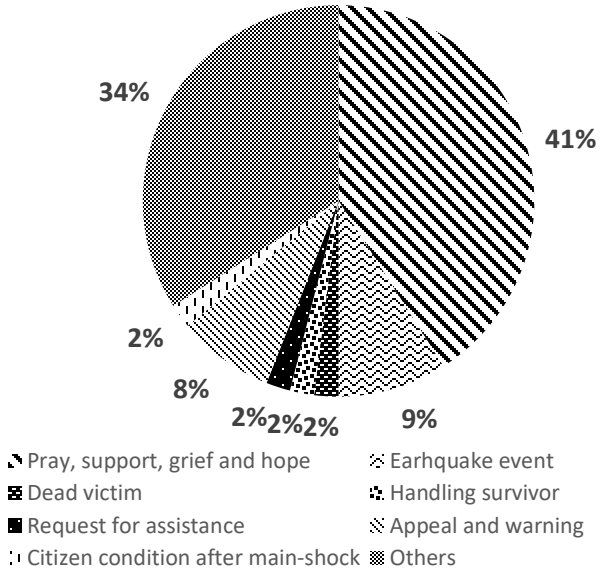

Fig.3. Distribution of information trends in period two

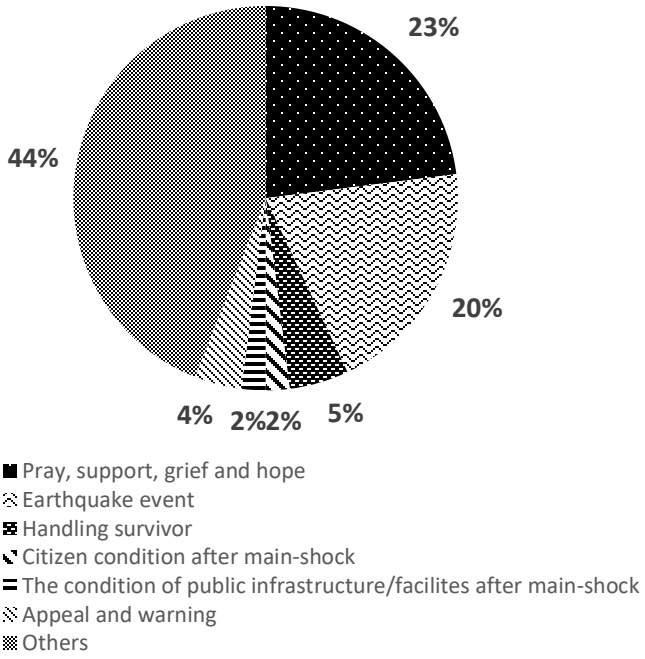

Fig.4. Distribution of information trends in period three

4.3 Development of Disaster Knowledge Based on Tweets and Spatial Data

In the development phase of the knowledge-based disaster on tweets and spatial data, we use tweets data in period one as a representative sample. Information about the time, location and strength of earthquake events in the tweets of period one is collaborated with information on earthquake event time from USGS data that has been converted into Indonesian local time, namely Western Indonesia Time (WIB).

In Table 1 there is spatial information and earthquake time obtained from tweets in period one, more precisely in 'earthquake event' category, while earthquake information generated by USGS period one can be seen in Table 2. Information on earthquake event times contained in each period combined with information on event time earthquake from the USGS data from each periods. The results obtained from the combination of the time of this earthquake event is the flow of events resulting from a combination of tweet and USGS data for each period can be seen in Figure 5. While information about the location of the earthquake that was obtained from the tweet data of the category of 'earthquake event' period one was analyzed to find out the coordinates of it to then make a mapping of locations affected by the earthquake. The result of this mapping is a map showing which areas are affected by shocks and which receive their impacts based on information obtained from the 'earthquake event' category. The results of the mapping can be seen in Fig.6.

Table 1. Tabular Data of Tweet of Lombok Earthquake in Period One

NO	Event	Location of Occurrence in citizens Tweet	Time Descriptions in Content	Time in Tweet (WIB)	Description in citizens tweet	Tweet Content (Original/Not original)	Account Name
1	Earthquake	Sembalun, Lombok Utara, NTB	-	Tgl: 29/7/18 Pkl: 14:04	Gempa bumi	Not original (Amateur video)	@infobencana
2	Earthquake	Kec.Sambelia dan Sembalun	-	Tgl: 29/7/18 Pkl: 14:05	Gempa 6.4 SR, satgas menuju wilayah Kec. Sambelia & Sembalun	Not original (Amateur video)	@infobencana
3	Earthquake	-	Morning	Tgl: 29/7/18 Pkl: 14:07	Kejadian gempa	Not original (Amateur photo)	@infobencana
4	(Shaking) Earthquake	-	Afternoon	Tgl: 29/7/18 Pkl: 14:57	Sore terjadi goyangan (gempa)	Not original	@ulfhamii
5	After shock	-	Afternoon	Tgl: 29/7/18 Pkl: 17:16	Ratusan gempa susulan	Original	@Wahyuniyas
6	Earthquake	Lombok, Bali dan Sumbawa	Sunday (29/7/18)	Tgl: 29/7/18 Pkl: 19:23	Gempa 6.4 SR	Original	@WawanCakdjuned
7	Earthquake	Lombok Timur	-	Tgl: 29/7/18 Pkl: 20:07	Kerusakan akibat gempa di Lombok Timur	Not original (Amateur video)	@infobencana
8	Earthquake	ombok Timur, sekitar Gn. Rinjani	Sunday (29/7/18)	Tgl: 29/7/18 Pkl: 20:40	Gempa disekitar Gn. Rinjani menyebabkan longsor	Not original	@infobencana
9	After shock	-	Day	Tgl: 29/7/18 Pkl: 20:41	Hingga siang 85 kali gempa susulan	Not original	@Jat_210998

NO	Event	Location of Occurrence in citizens Tweet	Time Descriptions in Content	Time in Tweet (WIB)	Description in citizens tweet	Tweet Content (Original/Not original)	Account Name
10	Earthquake	-	-	Tgl: 29/7/18 Pkl: 21:03	Gempa Lombok Akibat Aktivitas Sesar Naik Flores	Not original	@infobencana
11	After shock	Sembalun, NTB	-	Tgl: 29/7/18 Pkl: 21:50	Listrik mati usai gempa 6.4 SR	Not original	@infobencana
12	Earthquake	-	-	Tgl: 29/7/18 Pkl: 23:56	Kekuatan Gempa berskala (1) 6.4 SR, (2) 5.5 SR, (3) 5.0 SR	Not original	@kita87
13	Earthquake	Gn. Rinjani, Lombok	-	Tgl: 30/7/18 Pkl: 04:31	Saat terjadi gempa di Gn. Rinjani	Original (Amateur video)	@Bro_ming
14	Earthquake	Gn. Rinjani	-	Tgl: 30/7/18 Pkl: 04:39	Suasana gempa di Gn. Rinjani	Original (Amateur video)	@Bro_ming

Table 2. Tabular Data on Period One of Lombok Earthquake (USGS)

no	time	latitude	longitude	mag	updated
1	2018-07-29T10:05:01.990Z	-8.2378	116.4203	4.2	2018-10-09T16:43:29.040Z
2	2018-07-29T04:22:50.950Z	-8.3037	116.4664	4.2	2018-10-09T16:43:28.040Z
3	2018-07-29T03:04:28.000Z	-8.2755	116.487	4.4	2018-10-09T16:43:28.040Z
4	2018-07-29T02:20:08.550Z	-8.4127	116.5145	4.8	2018-10-09T16:43:29.040Z
5	2018-07-29T01:50:32.220Z	-8.3133	116.4514	5.3	2018-10-09T16:43:29.040Z
6	2018-07-29T01:44:24.260Z	-8.3605	116.5625	4.8	2018-10-09T16:43:29.040Z
7	2018-07-29T00:37:34.140Z	-8.2441	116.5669	4.2	2018-10-09T16:43:27.040Z
8	2018-07-29T00:18:32.720Z	-8.1939	116.5863	4	2018-10-09T16:43:27.040Z
9	2018-07-29T00:05:30.050Z	-8.3172	116.4413	4.3	2018-10-09T16:43:28.040Z
10	2018-07-28T23:39:33.030Z	-8.1745	116.3593	4.6	2018-10-09T16:43:27.040Z
11	2018-07-28T23:19:35.640Z	-8.2053	116.5143	4.3	2018-10-09T16:43:27.040Z
12	2018-07-28T23:16:26.230Z	-8.287	116.5426	4.9	2018-10-09T16:43:29.040Z
13	2018-07-28T23:15:59.180Z	-8.2054	116.563	4.4	2018-10-09T16:43:27.040Z
14	2018-07-28T23:06:48.820Z	-8.2204	116.4624	5.4	2018-10-09T16:43:27.040Z
15	2018-07-28T22:58:44.060Z	-8.1808	116.4971	4.7	2018-10-09T16:43:27.040Z
16	2018-07-28T22:56:45.160Z	-8.3065	116.4997	4.8	2018-10-09T16:43:28.040Z
17	2018-07-28T22:55:36.080Z	-8.2139	116.5888	4.8	2018-10-09T16:43:27.040Z
18	2018-07-28T22:47:38.740Z	-8.2395	116.508	6.4	2018-10-09T16:43:27.040Z

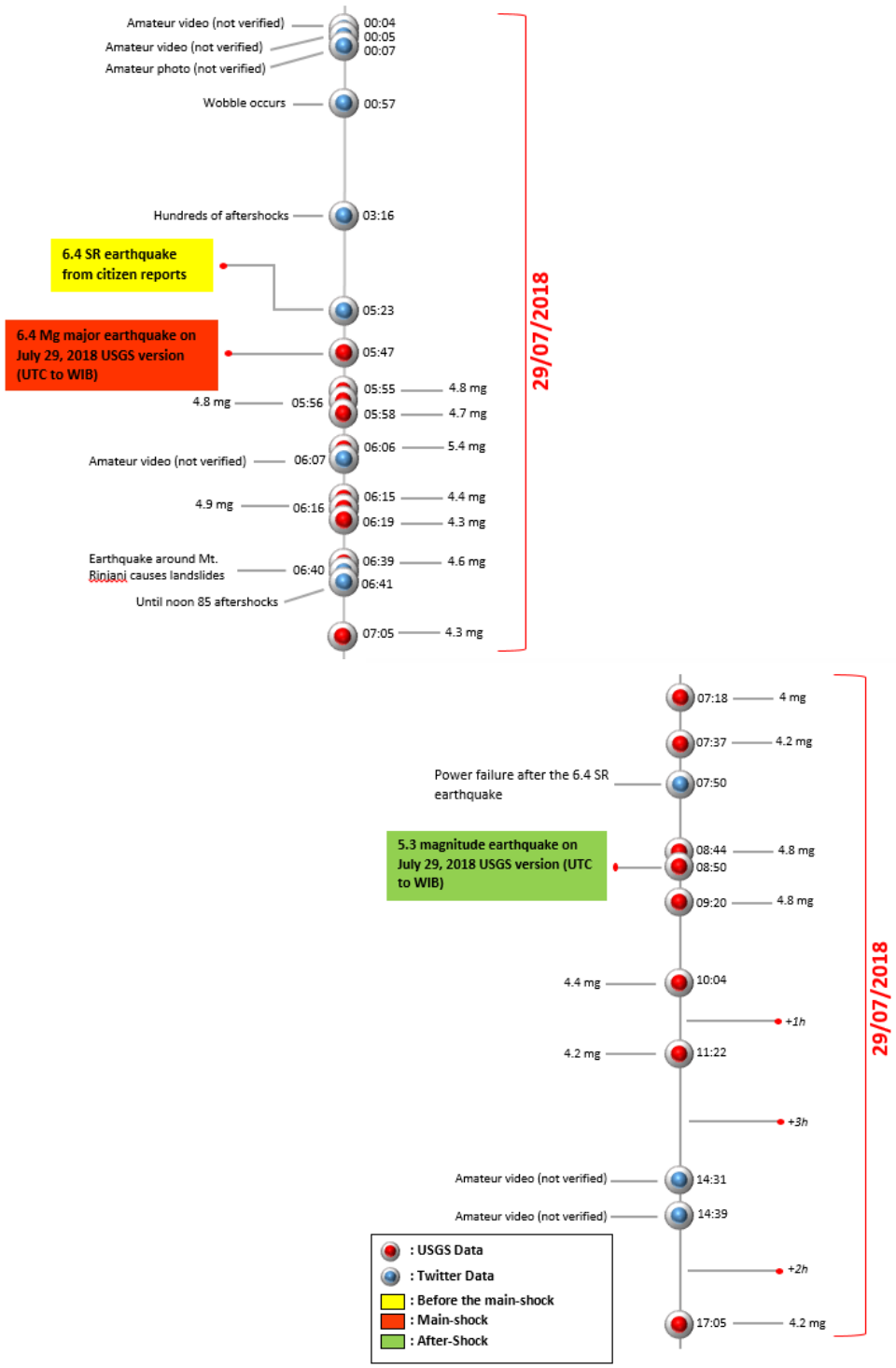

Fig.5. Timeline of geophysical events, acquisition, and observations, and knowledge development via Twitter in hours, minutes and days in WIB during and after the Lombok earthquake in period one.

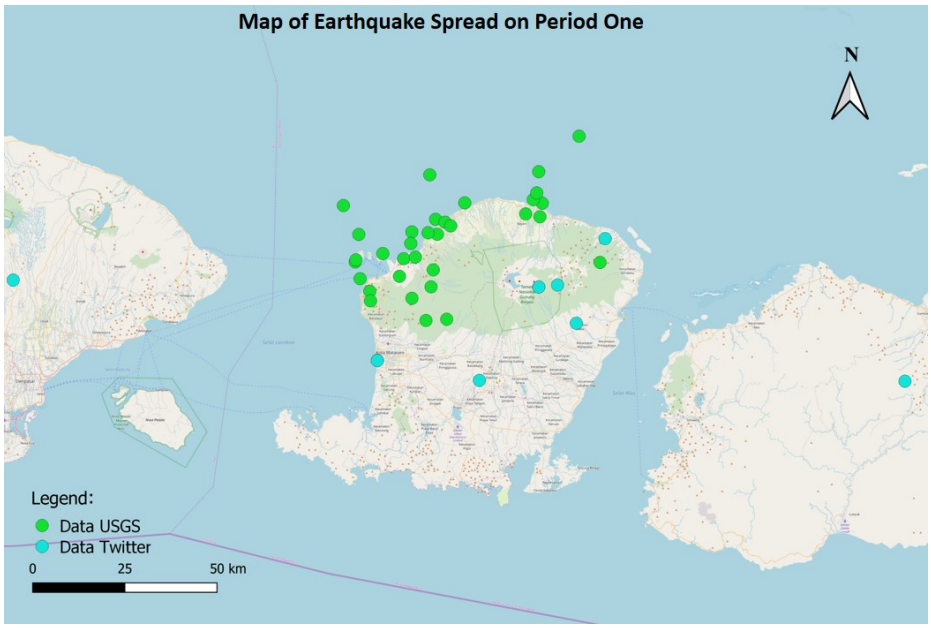

Fig.6. Map of earthquake events based on Twitter information in Period one that was successfully obtained for the area around the Provinces of Bali and West Nusa Tenggara.

5. Discussion

From a total of 979 tweets that have been analyzed, most of the tweets in each period contain is about sentimental information such as support, prayers, grief, and hopes for disasters victim and tweets with no information value that can help in dealing with an earthquake. Not many tweets contain information that can be used for raising aid, disaster management and meeting the needs of disaster victims or information that triggers direct action that can be carried out by capable parties, this can be seen from the small number of tweets that provide information about the needs of victims during disaster. There are not many tweets that provide effective information to help the authorities to multiply references to identify earthquake conditions, and no less important, there is not much scientific information that can help the public or disaster experts, especially in understanding the events that occur.

The condition of Indonesian citizen science like this can occur because of several factors such as the Indonesian people are less educated in providing information when an emergency occurs such as natural disasters, Indonesian people in social media prefer to convey support, prayers or hopes during a disaster, Indonesian people have not included many locations or information that refers to the location of the earthquake or the area affected by the earthquake, even though if a lot of information about the location of the earthquake sent by the community can be used to make a map of the areas of the earthquake. Whereas mapping of earthquake locations can be an important contribution of citizen science activities.

6. Conclusion and Future Work

During the severe earthquake situation that occurred in Lombok, although the value of the information in tweets provided by Indonesian citizen science is less scientific and effective, it has shown the potential to be an effective way to provide and distribute information. With its real-time enabled platform, Twitter allows the citizen to give information about the situation during an earthquake that occurred in Lombok and around it. By analyzing this information, the result can be useful in coordinating resources and efforts and in preparing and planning for disaster relief in the future. In this research we analyzing and categorizing the tweet manually by qualitative method, in our future work, we plan to apply some machine learning techniques such as naïve Bayesian or Support Vector Machine to provide better results.

However, while there may be some potential advantages to using social media in the current crisis, there may be some issues and drawbacks associated with its use. Information that is false, outdated, or inaccurate could complicate situational awareness of a crisis and hence slow down relief efforts. For example, if the government plans to implement social media as a tool for disaster response, it would be well advised to prepare some measures or protocols that help officials verify incoming information and eliminate false information. The citizens should also be educated to take caution when receiving news and information via social media and to think carefully about the potential effect before disseminating certain content.

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