

DISASTER COMMUNICATION PATTERNS AND BEHAVIORS ON SOCIAL MEDIA: A STUDY SOCIAL NETWORK #BANJIR2020 ON TWITTER

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Abstract

Purpose of the study: The purpose of this research is to analyze the disaster communication patterns and behaviors of Twitter users. Flood disaster in the *Jabodetabek* area became an unexpected event in early 2020. The flood inundated 23 areas in Bekasi, two regions in Bogor, and 17 areas in Jakarta. Information about floods became a trending topic on the 1st of January 2020.

Methodology: The method used is social network analysis and text analysis #Banjir2020 on Twitter, using Netlytic and Gephi. The sample analyzed 1000 tweets from 304 users and 670 edges. The data was selected from the 10th to 13th of January 2020. Netlytic.org limits that we can only retrieve tweets data from Twitter for less than 2 weeks due to API limitations.

Main Findings: The result shows that #Banjir2020 disaster communication patterns on Twitter formed five significant clusters on its network. The communication occurred as one-way communication. A low level of network density showed that the quiet intensity of communication and slow information to be able to spread throughout vast networks. Every twitter user involved can directly provide information to others. Judging from the messages conveyed, the most formed behavior is the behavior of information dissemination regarding this flood. The next significant response is the defense of DKI Jakarta Governor.

Implications of this study: The disaster communication behaviors on #Banjir2020 is dominated by flood disaster information in some areas. Communication patterns form vast networks but still lack in terms of intensity, two-way communication, and slow information to move throughout the system.

Novelty/Originality of this study: The research of #banjir2020 through Twitter using the analysis of SNA and disaster communication behavior has never been done by other researchers.

Keywords: #Banjir2020, Behavior, Disaster Communication, Social Media, Twitter, Social Network Analysis.

INTRODUCTION

Flooding in Jakarta is a five-year cycle with various causes, one of which is very high rainfall, and it causes inundation and flooding. Some areas in Jabodetabek are flooded with varying heights from 30 cm to 200 cm. There are seven sub-districts in South Jakarta and ten sub-districts in Bekasi that are flooded. The distribution of points in some areas is in DKI Jakarta and South Tangerang and Bekasi ([BNPB, 2020](#)). Claims of Information and Documentation Management Officer (PPID) of DKI Jakarta Province released the joint data among DKI Jakarta Regional Disaster Management Authority (BPBD), Indonesian Ministry of National Development Planning (Bappenas), Meteorological, Climatological, and Geophysical Agency (BMKG), and Jakarta Open Data related to handling flooding in Jakarta on a scale of the last five years ([Priyasmono, 2020](#)). Flooding in early 2020 was known to have higher rainfall per day rather than in 2013 and 2015, which is 377 mm compared to 100 mm and 277 mm ([Radityo, 2020](#)). The area flooded in 2020 was 156 km in width, and it is different from 2013 and 2015. With the rainfall per day, which is smaller than in 2020, the total area flooded is 240 km in 2013 and 281 km in 2015. In 2020, the total of displacement posts is 269 posts with 31,232 refugees, comparing to 2013, in which there were 1,250 posts, and in 2015, there were 409 posts. For the refugees, in 2013, there were 90,913 people, and in 2015, there were 45,813 people ([Priyasmono, 2020](#)).

Although there were claims from DKI Jakarta Regional Government for the areas that were affected by flooding, which are getting smaller, the loss caused by the flood disaster in early 2020 was estimated to reach 5.2 trillion rupiahs. A total of 4.5 trillion rupiahs is a private / community assets, and the remaining of 650 billion rupiahs is damage or loss of government / SOEs / ROEs. The losses consist of the retail sector, tourism, restaurant, transportation, and infrastructure ([Priyasmono, 2020](#)).

Nowadays, the most efficient way to send emergency messages to many people is by using social media ([Dhey and Parabhoy, 2017](#); [Wooley, 2013](#); [Gil Appel, Lauren Grewal, Rhonda Hadi, Andrew T. Stephen, 2019](#); [Amedie, 2015](#)), and language ([Sharon O'Brien & Federico Marco Federici, 2019](#)). The disaster communication patterns in the community have changed due to the influence of technological development ([Naim Kapucu and Brittany Haupt, 2016](#)). Old media was defeated by social media as a source of information for people who want to share and get information about disaster immediately ([Benedikte Bjerger, Nathan Clark, Peter Fisker, and Emmanuel Raju, 2016](#)). For example, the @infoBMKG account is the most popular and important account for distribution information about climate predictions,

weather, and earthquakes in Indonesia (Fatoni, 2019). The effective disaster communication in disaster management is the communication that is carried out not only during the emergency response but also during the pre-disaster or preparedness and after disaster or rehabilitation and reconstruction periods (Arlita, 2015).

The research explains the disaster communication patterns and behavior after flooding in early 2020. The hashtag of flood 2020 (#Banjir2020) became a trending topic on twitter timeline. According to *Trends24.in* website, the hashtag of flood started echoing on twitter at 3:00 a.m. the flood hashtag has been tweeted more than sixteen thousand times so that the hashtag has topped the line of trending topic (Oktarini, 2020). Twitter users used #Banjir2020 to classify the information about flood occurred in the early of January 2020 (detikInet, 2020). Twitter users shared information during and after the flood disaster on twitter in the forms of texts, images, and videos. The accounts taking part in #Banjir2020 conversations came from personal accounts, organizations, and mass media.

LITERATURE REVIEW

Social media and Disaster Communication

Social media is a term used for the activity of technology use that facilitates creation, dissemination, and content sharing through virtual network communities (Obar & Wildman, 2015; Whiting and Williams, 2013; Fasae and Adegbilero-Iwari, 2016). Facebook, Twitter, and Youtube offer anyone the knowledge and the use of the internet to access opportunities in connection from one to many, or from many to many around the world (Hogan & Quan-Haase, 2010). Social media allows users to build networks and personal online communities that are based on interests (Lagrosen and Grunde'n, 2014). These networks are primarily formed based on offline relationships but remade online (Ellison, 2007). Social media networks open up the opportunities to find old friends, make new friends, share content, images, videos on their networks.

Social media makes a significant change in how people accept and view their world (Simos, 2015). Twitter as a microblogging tool has been shown a lot of user growth since it was launched in October 2006 (Java, 1970). The use of twitter functions makes information adopted and spread quickly to users (Zhang, Gao, & Liu, 2016). The retweet is a mechanism of the ability of an account to select and share information from other account tweets to their followers (Kwak, 2010); mention is the mechanism that allows users to be in one conversation without limit; while, a hashtag is a sharing mechanism that helps some users to join a topic freely (Zhang, Gao, & Liu, 2016).

Connecting the disaster studies and social media research is difficult because it involves multidisciplinary, applied, and practice-oriented (Resnyansky, 2014). Disaster response authorities in many countries are increasingly using social media data for emergency management (De Stefani, 2017). The existing study indicates that the role of social media as a disaster communication tool is very significant. (Sutton & Shklovski, 2008) categorize two social media users: (1) Personal Communication, dissemination of information passively, and (2) Systematic use as a tool in disaster management, which defines that social media will be affected indirectly by how the prevention team works and community behavior in an emergency. Social media for communication plans to continue developing, and its application is also formed by the context, user, and the nature of the natural disaster (Finau, et al., 2018). The information shared on social media is entirely accurate and that people rely on the information shared by relatives, friends, and trusted pages (Finau, et al., 2018).

Behavior

Behavior is the study of human behavior, which has a vast range of meanings. Some scholars regard behavior as social activities that either directly observed and cannot be observed from outside (Notoatmodjo, 2003). The behavioristic theory was coined by B.F Skinner (Staddon, 2017; Naik, 2015). Behavioristic approach concerns observing behavior in studying individuals. The theory emphasizes that the behavior exhibited by a person is a result of the interaction between stimulus and response. According to Skinner (Fulmerr, 1976), mostly, every incentive given interacts with each other, and this interaction ultimately affects the responses produced. While the reactions are given also provide various consequences, this, in turn, affects individual behavior (Haryanto, 2004). The stimulus is something that creates a specific action (Chung, Ryu, and Lee, 2016; Chung, Ryu, Green, and Kang, 2015). Skinner divides two types of responses, namely Respondent's response and Operant response (Ruth Anne Rehfeldt and Linda J. Hayes, 1998). The respondent response is a response that arises from a particular stimulus spontaneously. The reactions can be disappointment, sadness, or anger. The operant response is a response that occurs and develops, which is followed by a specific stimulus (da Silva and Williams, 2019). When a person listens to information from others, that person then spreads the news through social media (Chung, Ryu, and Lee, 2016).

Social Network

Humans live in networks, either in a small network whose members we know intimately or vast system whose members we do not recognize. A social network is built on the idea that there is a structure determining how people get to know others, both directly and indirectly (Churchill & Halverson, 2005). People are increasingly interested in online communication, often they communicate with people who they had never met before the advent of the internet (Churchill & Halverson, 2005). With the advent of the internet, connections are no longer bound by closeness; rather, people can cross national borders to communicate with others.

The network is a communication channel formed due to the relations between the sender and recipient, then makes them in a social organization. The system contains a collection of objects and mapping or description of the relationship between objects (Kadushin, 2004). The most straightforward network contains two actors and one edge that was connecting them. If the relation between one person and another person is drawn in a line, then the interaction between the network members will be drawn (Eriyanto, 2014). Hanneman and Riddle (Galuh, 2013) state that a network has important actors who can provide their own advantages and disadvantages (Galuh, 2013). When analyzing a system, it can be seen the link coming from the communication between individual and group (Littejohn & Foss, 2009). Three main network concepts that have been carried out by researchers about the effects of networks are centrality, cohesion, and structural equality (Liu, Sidhu, Beacom, & Valente, 2017).

METHODOLOGY

This research was conducted in the range of time 10th-13th of January 2020 when the flood disaster had passed. Netlitic.org limits that we can only retrieve tweets data from Twitter for less than 2 weeks due to API limitations. A post-positivist approach (Samatan, 2017; Ardianto and Q-Anees, 2015; Ali Imran, 2014) is used in this research because, in the study of social communication network, it requires some quantitative and qualitative data collection (Williams & Shepherd, 2017; Samatan, 2018; Ardianto and Q-Anees, 2015; Ali Imran, 2014). This research uses the method of communication network analysis and text analysis method that will describe the patterns in the form of structure in the network.

Tsvetov and Kouznetsov (2011) defines Social Network Analysis (SNA) is a study that studies human relationships by utilizing graph theory (Susanto, Herlina, & Chrismanto, 2012). The network perspective focuses on the relationship between actors such as those that occur when people exchange information about disasters. There is an essential characteristic of network research (Marin & Wellman, 2011). First, pay attention to the relation, not to the attribute. Second, focus on the network, not the group. Third, the need for a particular relational context for the relationship becomes meaningful. Social Network Analysis (SNA) has several levels of analysis that can be performed, such as actor level, group level, and system level. Actor Level Analysis on a complete network, the measure used centrality. There are four measures of centrality that are most widely used, namely the degree centrality, closeness, intercession, and eigenvector. At the system level, the commonly used measures are density, reciprocity, diameter, and distance, centralization (Eriyanto, 2014). The research uses the analysis of the actor level and system level. The actor level is used to find the main actor in the disaster communication of #Banjir2020 on twitter. Besides, the research wants to see the actor who has influence the network and system level, describes the overall network in the network structure.

The study of the text is basically a data analysis that examines the text in depth both regarding the content and it is meaning as well as the structure and discourse (Rahardjo, 2017). Krippendorff (2004) defines content analysis as a research technique to infer the meaning of text through procedures that can be trusted (reliable), can be applied in different contexts (replicable), and valid Krippendorff (2004). All texts have narrative structure and persuasive power and are intended to convey specific meanings based on the author's intention (Rahardjo, 2017). The study of the text is not intended to look for 'correct' interpretations of the text, but rather to find the types of interpretation is used (Rahardjo, 2017).

The design used in this study is descriptive (Samatan, 2017). The data used as the sample are 1000 Tweets. The analysis process and crawling data on Twitter use Netlytic.org dan software Gephi. Netlytic and Gephi can automatically create a network chain based on Twitter account names and generate the data that can be used to analyze at the system and actor levels. Then the collection of qualitative data is done by downloading the conversations that occur on Twitter. The data obtained are analyzed and discussed in more detail in regards to how the disaster communication pattern and behaviors occur in #Banjir2020.

RESULT AND DISCUSSION

Disaster Communication Pattern

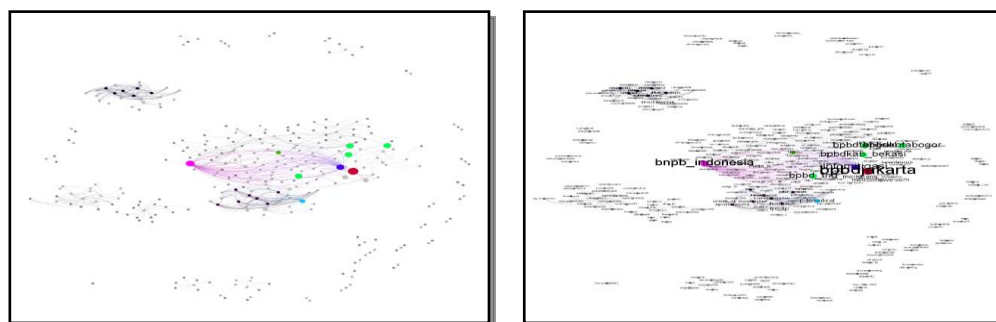


Figure 1: Disaster Communication Pattern #Banjir2020

Source: Processed data results by Gephi software

In the #Banjir2020 network, there are 304 nodes (Actor) and 670 Edges (Lines/Relationship). Some actors are grouped in clusters based on their communication patterns. Clusters are virtual social groups that are connected and establish communication among members in a cluster or with members in other clusters. Netlytic clustered this network into five big clusters and several smaller clusters. The colors of the nodes in this network indicate that these actors are in the same cluster.

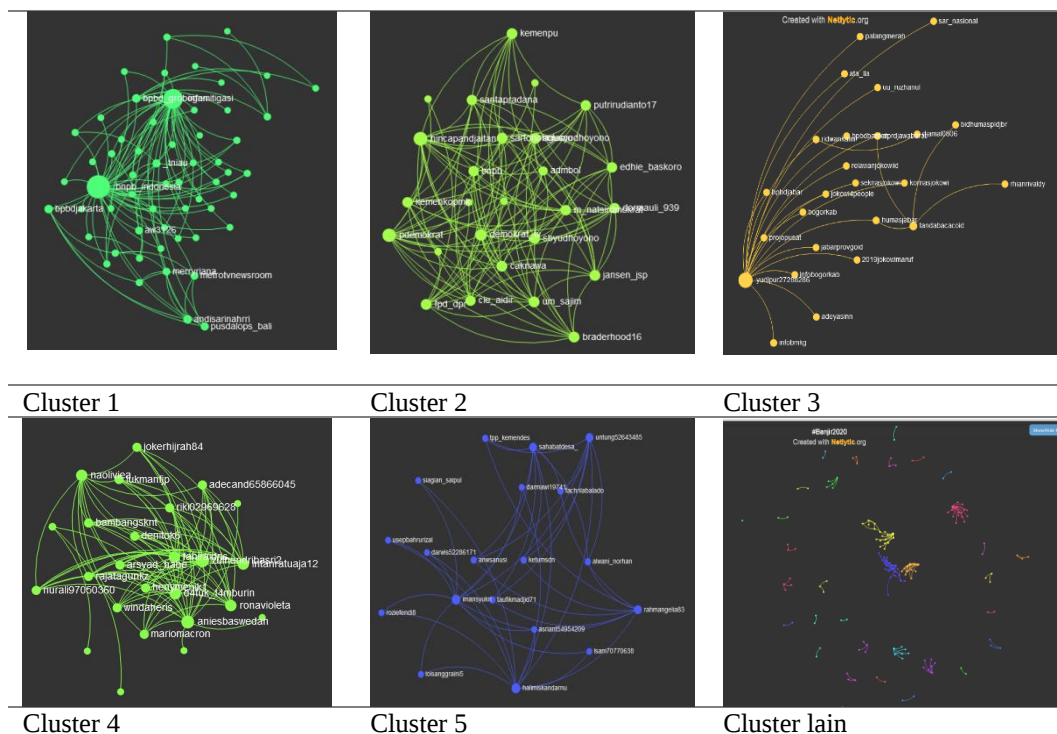


Figure 2: Disaster Communication Cluster #Banjir2020

Source: Processed data results by Netlytic.org

The network #Banjir2020 has a network diameter of 55 points, which explains the farthest distance needed by one actor to go to another actor as far as 55 steps. The density in the network of #Banjir2020 is 0.005895, which means that this network has a very low density. With this very low density, the intensity of communication between actors in the #Banjir2020 network is very low as well. Therefore the information flow can be concluded to be very slow. The delay factor in the information can occur due to cultural factors and “bridges” of data (Gultom, 2016), including language (O’Brien and Federici, 2019). Reciprocity determines the level of mutuality of communication among actors in the network of #Banjir2020. The point 0 in the reciprocity network shows that communication relations occurring only in one direction, and the two-way communication do not occur because the actors do not reply to the messages from other actors addressed to them. Centralization in this network is at a low score of 0.077120, showing that the information on the network of #Banjir2020 is not dominated by one actor. The actors in this network give each other information to other actors. In the network of #Banjir2020 on Twitter, many users are involved in the conversation. The people involved in this conversation have different diversity as the actors in the #Banjir2020 comprises and from different countries. This can be seen from the points of modularity (0.8428), which is greater than 0.5.

Table 1: Network Properties by Netlytic.org

Network Properties	
Diameter	55
Density	0.005895
Reciprocity	0.000000
Centralization	0.077120
Modularity	0.842800

Source: Processed data results by Netlytic.org

Social network analysis observes the relations among the actors that occur in a conversation. The measurement of centrality is analyzed to find out how important an actor is in a network. Four factors that can be observed, namely the points of degree, closeness, intercession, and eigenvector.

The popularity of an actor in social media can be seen from the degree score. The degree score shows the number of links from actors to other actors. In-Degree indicates the number of links that lead to the actor, while the Out-Degree indicates the number of links that leave the actor. The account of @bnpb_indonesia is the most popular actor in this social network with 53 links from other actors connected to @bnpb_indonesia and eight links coming out of that account. The account of @Vickih_worsnop is the account that has the largest information dissemination capability (with the point of Out-Degree 57) on the social network of #Banjir2020.

Table 2: Account with Degree Statistic

Account	In-Degree	Out-Degree	Degree
bnpb_indonesia	53	8	61
vickih-worsnop	0	57	57
metro_tv	57	0	57
infomitigasi	35	10	45
yudipur27288286	0	32	32
pdemokrat	26	0	26

Source: Processed data results by Gephi Software

Table 3 shows the closeness centrality that illustrates how close the actor is to other actors on social networks. The result shows 110 actors who have the level of closeness with other actors so that they have freedom in communicating with other actors on their networks.

Table 3: Closeness Centrality by Gephi

Closeness Centrality Value	The Number of Actor
1.0	110
0.9 – 0.81	8
0.8 – 0.71	2
0.7 – 0.61	6
0.6 – 0.51	35

Source: Processed data results by Gephi Software

Table 4 shows the position of an actor as the intercession of relation from an actor to other actors on the network. The account of @bnpb_indonesia has a high point because it connects the accounts that have a large network, such as the account of @infomitigasi.

Table 4: Account with Intercession Centrality by Gephi

Label	Intercession Centrality
bnpb_indonesia	218.933333
infomitigasi	98.066667
demokrat_tv	6.0
hincapandjaitan	4.0

Source: Processed data results by Gephi Software

With the high point of intercession centrality, the account of @bnpb_indonesia has control over the information it has from other accounts to distribute to other accounts. The account of @bnpb_indonesia has a high point because it connects the accounts that have a large network, such as the account of @infomitigasi.

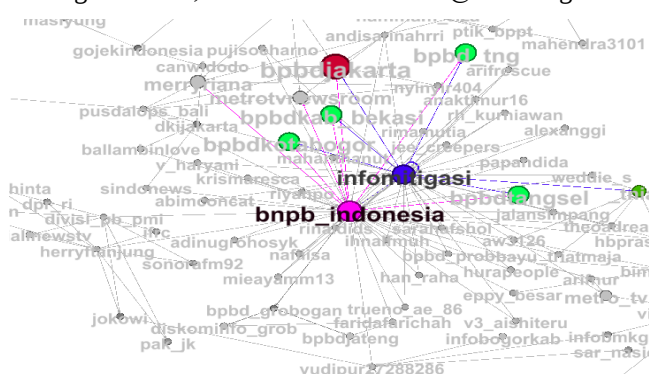


Figure 3: Intercession of account @bnpb_indonesia

Source: Data visualization by Gephi Software

On a social network, knowing the most important or valuable actor can be seen by looking at the point of the eigenvector. Table 5 shows that the account of @bnpbjakarta becomes the most important actor on this network, and the other most important actors are the accounts of @bnpb_indonesia, @bpbd_indonesia, @bpbd_tng, @bpbd_bekasi, @bpbdkotabogor, @bpbdtangsel.

Table 5: Account with Eigenvector Centrality by Gephi

Account	Eigenvector Centrality
bpbdjakarta	1.0
bnpb_indonesia	0.777535
bpbd_tng	
bpbdkab_bekasi	0.633591
bpbdkotabogor	
bpbdtangsel	

Source: Processed data results by Gephi Software

Netizen's Behavior on Twitter

Data in figure 4 shows that tweets tweeted by users using #Banjir2020 have six types of messages, namely: information, empathy, the defense of DKI Jakarta Governor, news about DKI Jakarta Governor, emotions (hope, concern, anger), and other information. Five hundred and three tweets containing the information about floods that occurred in Jabodetabek area, as the following messages from the account “@BPPT_RI: The Head of BPPT @hammam_riza accompanying the Minister of @KemenristekBRIN Bambang P.S. Brodjonegoro visit the Operation Post #TeknologiModifikasiCuaca” this message informs about the activities of the Minister who came to the operation post which was conducting the weather engineering. Forty-five tweets pitched empathy about the flood occurred in Jabodetabek, as stated by the account “@syahlanafilla: The photos are quite calm my mind down, since last night still thinking about it, not all cats can immediately find shelter.” This tweet contains empathy from the account @syahlanafilla for cats trapped in flood, and they are finally rescued by some people.

People's Behavior on Twitter

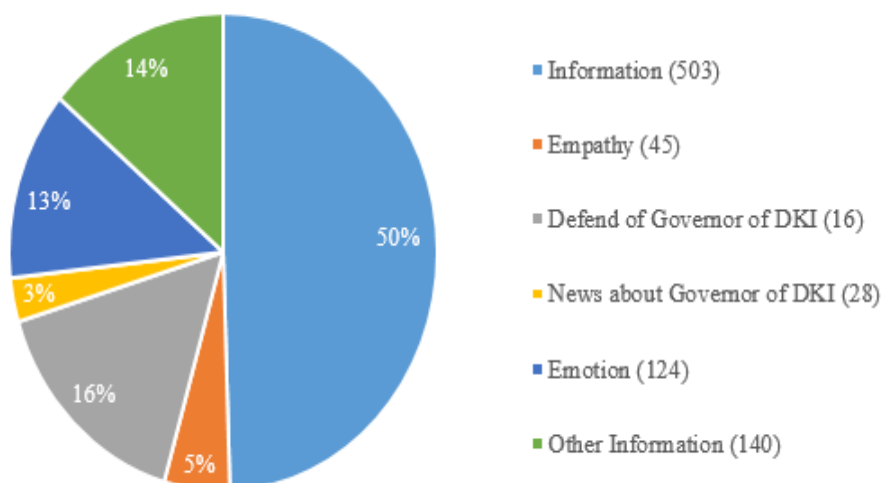


Figure 4: Messages on social media Twitter

Source: tweets in #Banjir2020 network

There are also a lot of tweets addressed to the DKI Jakarta Governor. The tweets contain about the activities of the Governor, the defense to the Governor, and the tweets containing criticism. One of the examples of tweets that defend the DKI Jakarta Governor is from @aniesupdate “2013, Bunderan HI was drowned, was there any Special Committee for Flood? 2020, Bunderan HI wasn't drowned, why there's Special Committee for Flood?” and the example of a tweet that criticizes the Governor is from @abihasantoso “Trash Denied Flood in Capital city due to the Governor #Banjir2020 #TrendingTopic.”



Figure 5: Tweets from account @abihasantoso

Source: Twitter timeline @abihasantoso

The messages on Twitter about the flood also have some meanings that lead to emotions, consisting of hoping (29 tweets), concern (59 tweets), and anger (36 tweets). The example of tweets about hope is from an account @YandiChidir21 *“Those who're crying, quickly stop crying, wet rain with tears. Keep on sharing stories and worries, quickly getting better, all anxious.”* From this tweet, it can be seen that the message shows hope for the flood victims to recover from the disaster immediately. The account of @NarasiNewsroom tweeted about the flood concerns related to the analysis of the environmental impacts on a building layout, and the message is: *“If the Government deletes the EIA, what will happen, huh? #NarasiFlash #NarasiTV #MataNajwa #banjir2020 #Banjir”*. Another example of tweet related to the anger of society. The account of @Kamalarrofiqi tweeted about: *“Do you understand the function of Forest? Earth: you're dead! You're flooded. You cut down the forest, and you throw away trash.”* The tweet shows the expression of anger against the flood disaster caused by the natural damage created by humans.

There are 140 tweets are that are categorized as ‘other information’ category. The tweets in this group are the messages in the forms of jokes, advertising, and out of context information that use the hashtag of #Banjir2020 to make this hashtag becomes a trending topic on Twitter.

Table 6: Category of Tweet “Other Information”

Categories	Jokes	Ads	Out of Context
Akun	@kinoot	@acerID	@AnanyaSinghAnn1
Gambar/ Video			
Tweet	<i>“Jakarta butuh orang ini. Kasih watermark jangan? #banjir2020 #BanjirJakarta2020”</i>	<i>“[THREAD ANNOUNCEMENT]Kami hadirkan layanan GRATIS servis + diskon s/d 50% untuk pergantian suku cadang produk Acer & Predator G...”</i>	<i>“#banjir2020 #ปดเกาะ #IWokeUpOnJanuary1stAnd #Traumschiff”</i>

Source: Twitter timeline @kinoot, @acerID, and @AnanyaSinghAnn1

CONCLUSION

A new way of communicating in society comes along with the rise and development of the internet. Communication is not limited to time, distance, and space. Communication can happen anywhere and anytime without having to face to face. When the flood disaster occurred in early 2020 in the Jabodetabek area, disaster

communication emerged on social media, especially Twitter. The Twitter users shared information and commented by using the hashtag #Banjir2020 so that a social communication network was formed. At the system level, the disaster communication pattern from hashtag #Banjir2020 was widely distributed, and the farthest distance among the actors was 55 steps. With the very low network density, the exchange of information (intensity) was very low, too, so the information rate became very slow. It happens because the exchange of information mostly occurs on the accounts that have a very small impact on the network. Based on the reciprocity point, the disaster communication pattern formed is a one-way communication pattern where the actors rarely reply to the messages that mentioning their accounts. The communication occurred is mostly done by the accounts with little effect therefore, there is no actor dominates the information about the disaster. People can directly share their information themselves to their followers or join the network by using the hashtag #Banjir2020.

At the actor level, the account of @bnpb_indonesia becomes the most famous account because it is the official account of the disaster management team. The account of @bnpb_indonesia gets messages/information from other accounts as 53 tweets. Most of the information is about the current flood in some areas, information on evacuation, and all matters related to a flood disaster. The accounts involved in the flood disaster communication network can share the information directly to others without intermediary from other accounts. The freedom of communication on social media Twitter by mentioning or retweeting other accounts make the relationship among several accounts seem to be very close. There are several accounts on this network having control over the information that can be disseminated to their followers. In the network of #Banjir2020, @bnpb_indonesia becomes the account that has authority. As a government account in charge of disaster management, @bnpb_indonesia must select and confirm the information they got before disseminated into the #Banjir2020 disaster communication network. This account becomes the bridge for several big accounts such as @infomitiigasi and the accounts of the Regional Disaster Management Agency (BPBD), especially in the Jabodetabek area.

Social media has a major implication for changing communication patterns in disasters, especially in the flood disaster that occurred in early 2020. Twitter becomes the center of the search and spread of information about the flood disaster in the Jabodetabek area. Twitter users prefer to get recommendations regarding flood information from friends or media on Twitter. Based on the result, some accounts on social media networks use Twitter to share information with their followers. 50 % of the information shared is about flood disasters such as location, evacuation, assistance, etc. Although it's in disaster condition, the political sentiment of the election of the Governor is still carried away in this communication. It can be seen from the conversation containing the defense messages for DKI Jakarta Governor, Anies Baswedan. Flood disaster occurred in Jabodetabek, but the conversation that happened was more focused on floods in Jakarta. Besides, there are other messages on this network such as messages of hope, empathy, anger, joke, and others that are out of the context.

From the degree value, it is expected that BNPB will use the @bnpb_indonesia account in order to be more active in two-way communication when there is a disaster. For the public, they are expected to more utilize social media for sharing important information related to the ongoing disaster. The government is expected to be able to see information on social media to map disasters that are happening and to find areas that have not received assistance.

LIMITATION AND STUDY FORWARD

This research has a limitation on data retrieval on social media. Twitter has limited the users to access the data on the server. Netlytic limits the sampling only to 1000 tweets. For further research, you can use other software to be able to retrieve more data from Twitter such as NodeXL

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AUTHORS CONTRIBUTION

Ahmad Fatoni gives contributions by collecting the data on Twitter and analyzing them through Netlytic and Gephi. Sri Murtiasih has codified the data and the final discussion.

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