REALITY CONSTRUCTION OF DISASTER DISCOURSES ON TWITTER: ANALYSIS OF CORPUS-ASSISTED DISCOURSE STUDY ON FOREST FIRES IN INDONESIA FROM 2014-2019

RÉALITÉ ET FAITS RAPPORTÉS SUR TWITTER EN CAS DE CATASTROPHE: ANALYSE LEXICOGRAPHIQUE AUTOUR DES FEUX DE FORÊTS INDONÉSIENNES ENTRE 2014 ET 2019

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SUMMARY. This paper takes the form of a case study of forest fires that occurred in Indonesia from 2014 to 2019 and were reported on the social media of Twitter. The study was a corpus-assisted discourse study (CADS) using data scraping or text mining on Twitter based on the keyword *"kebakaran hutan"* [forest fire] and discourse analysis. The actor-network theory was used to map the actors involved. This study concludes that five discourses show a consistently large pattern of Twitter users responding to the problem of forest fires in Indonesia. Regarding the actors, the government takes an essential role of leadership and information arbitrage on Twitter. Seeing as it is the state's responsibility to ensure the safety of all people, the government must appear to be the main holder of control in managing disaster information traffic to avoid irresponsible information or hoaxes disseminated by parties or actors. These results indicate that the availability of information obtained from every conversation of Twitter users can be used as a study or input in the formulation of evidence-based policy about forest fires. It should be given more attention as an alternative means of solving the issue of forest fires, which has become an annual problem in Indonesia.

Keywords: disaster communication, social media, corpus-assisted discourse study (CADS), actor-network theory (ANT)

RÉSUMÉ. *Nous rapportons ici l'étude des feux de forêts survenus en Indonésie entre 2014 et 2019, tels que rapportés sur Twitter. Nous réalisé une analyse lexicographique des tweets repérés par les mots clés « feux de forêts », à partir des captures d'écran. Les acteurs impliqués ont été cartographiés selon la théorie sociologique de l'acteur-réseau. On peut alors répartir la grande majorité des utilisateurs de Twitter dans 5 catégories. Le gouvernement a des rôles d'information et de modération majeurs dans ce contexte. Ayant pour responsabilité d'assurer la sécurité de la population, il doit apparaître comme le régulateur principal du corpus de l'information, en évitant la dissémination de canulars et autres infoxes. L'ensemble des informations relayées par Twitter peut être utilisé pour construire un discours objectif qui pourrait être utilisé dans la gestion du problème des feux de forêts, qui se reproduisent chaque année en indonésie.*

Mots-clés : *catastrophes, communication, réseaux sociaux, analyse lexicographique, théorie de l'acteur-réseau*

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Introduction

Communication technology has evolved extremely rapidly and become a crucial part of human life. Wood[1] stated that communication technology can accelerate the influence levels of interactions between people, how humans think, function, and form more coherent relationships. Communication also aims to share information and minimize rigidity in the organization.[2] Related to disasters, communication can serve as a social radar that provides certainty to other parties about a disaster in a particular place. Shaw[3] explained that crucial aspects of disaster communication include information, coordination and cooperation. All three play an essential role in the stages before the disaster, during the disaster, after the disaster, and in disaster mitigation.

Disaster communication through social media was utilized as a tool to explore government policies on controlling and anticipating public panic around the emergency issue of the leakage of toxic chemicals into rivers in China.[4] In South Korea, strategies in the use of social media are aimed at understanding the effects of its use on the resilience of organizations involved in emergency response.[5] In another study, disaster communication was used by the medical tourism industry during the hurricane season in the Caribbean in 2017.[6] According to Potts,[7] in recent years people are increasingly utilizing social media to respond to major incidents and collect relevant information regarding victims and events, a task that traditionally takes a long time to navigate through government media channels or major media. Liza Potts and Dave Jones[8] mentioned that services such as Facebook and Twitter have developed into a vast collection of information which users create and share while interacting with each other. On the other hand, according to Severo,[9] in the past few years many decision-makers have reported difficulties with the use of official statistical data in public policy. Difficulties are in the form of too long delays in publication, inadequate topic coverage, and the top-down process of data production. A large amount of data available online is a potential answer to this issue, with social media data specifically as an alternative to strengthen or even replace the traditional one.[10]

Twitter as a social network has a usefulness that is similar to other social media. It is an interaction service between users that provides access to other users to send short messages consisting of a maximum of 140 characters (called tweets) in the form of text or photos.[11] Tweets allow users to post what they are thinking, doing, about what just happened, and the latest news. Research on the use of social media platforms, particularly Twitter, in the context of a disaster have been conducted worldwide.

Another research example is the response and detection of opinions or arguments on social media in the case of Twitter Earthquake Detector (TED) of the US Geological Survey (USGS).[12] TED uses tweet frequency to identify earthquakes, improve detection capabilities in areas with multiple seismic instruments, increase response times, and enable identification of impacted areas and integration of first-hand citizen reports with scientific information. Therefore, social media utilization, especially in research discussing the use of Twitter for disasters such as forest fires, has the potential to use big data, particularly since it is motivated by the limited use of Twitter in research regarding forest fire disasters.

Studies on the use of social media platforms, primarily Twitter, in the context of disasters have been undertaken globally, such as by Gul et al.,[13] who conducted a study regarding the use of Twitter on natural disaster of floods in India, and Takahashi et al.[14] on the use of communication on Twitter during the hit of Typhoon Haiyan in the Philippines. Kongthon et al.[11] looked at the role of Twitter during the flood that occurred in Thailand in 2011. However, the use of social media, particularly in research discussing the use of Twitter for forest fires, is still limited. This article examines the use of Twitter to see the narratives that emerged from the issues of forest and land fires in Indonesia during 2014-2019. The method used was a corpus-assisted discourse study (CADS) with an analysis of actor-network theory (ANT) to map the actors involved and explore how networks are built and maintained to achieve particular goals.[15]

The actor-network theory (ANT) assists the understanding of the complex character of people and technology in the policy formulation process, as conveyed by Gao[16] that the key factor of the actor-network theory (ANT) is the actors, including human and non-human actors. A discourse analysis conducted by Hamad[17] was used to find the reality behind discourse and learn the language in the use of all types of written text and oral data, from conversation to forms of highly-institutionalized conversation in research. Discourse analysis provides a deeper description of the text since it not only reads the manifested text but also the hidden ideology or meaning behind the text because of its capability to read the presence of context and social cognition in the background.[17] Therefore, discourse analysis is remarkably relevant to looking at a complete textual study since it is accompanied by an analysis of the construction of reality, starting from the formulation of theoretical concepts to the formulation of policies.

Forest and land fires in Indonesia

In Indonesia, forest and peatland fires have become the largest contributor to smog pollution. According to the report of BAPPENAS (1999), forest and peatland fires generated 60-90% of emissions, causing haze and forest fires. They were also a primary source of carbon emissions that spread to Singapore, mainland Malaysia, and Sumatra. Based on the recapitulation of the area of forest and land fires (Ha) from 2014 to 2019 (*Table I*), the rate of forest fires that occurred in Indonesia is considered extremely high.[18]

Table I - Recapitulation of the area of forest and land fires (Ha) in Indonesia in 2014-2019

	2014	2015	2016	2017	2018	2019
Area of land burned	44,411.36 Ha	2,611,411.44 Ha	438,363.19 Ha	165,483.92 Ha	510,564.21 Ha	328,722.00 Ha

Source: sipongi.menlhk.go.id, Directorate of PKHL KLHK RI 2019

These fires are detrimental to the company and to community landowners. The destruction has numerous negative impacts both in terms of economic material and non-material. Social functioning, such as school and work activities of the community, is interrupted. Seen from the health aspect, it is hugely harmful and unsettling for the community, where upper respiratory tract infection (URTI), cough, eye irritation, and even fatalities are all effects of forest and land fires.

Methods

Data scraping used in this study was sourced from the keywords *"kebakaran hutan"* [forest fires], *"asap"* [smoke] and *"karhutla"* (the acronym of *kebakaran hutan dan lahan* or forest and land fires) in the time span between 2014-2019. This period was selected as the first period of President Joko Widodo's leadership in Indonesia. The data retrieved also considered the date of the tweets posted; the user accounts including individual, agency, NGO, or online media; text/tweets; tweet status as replies; the number of replies, retweets, and favorites obtained from a tweet; and a link to the tweets taken (*Table II*). Tweet searching using keywords is called event detection, which is intended to obtain the precise tweets to then be followed by semantic analysis of the keywords that appeared in the tweet.[19]

Table II - The activity of Twitter's netizens based on the time span for the keyword of "*kebakaran hutan*" [forest fires]

No	Time Span	Total tweets	Retweets	Favorites
1	2014 (February 20 - June 30)	41,800	13,382	1,460
2	2015 (June 1 - October 30)	91,521	43,905	11,287
3	2016 (January 1 - August 11)	15,418	2,983	1,035
4	2017 (January 11 - October 21)	3,744	2,061	4,024
5	2018 (January 28 - November 29)	3,598	4,177	5,232
6	2019 (August 1 - September 20)	33,944	355,948	525,175

Source: Processed by the authors

In this data scraping stage, various characteristics emerged and affected the number of tweets obtained each year. The various characteristics depended on the intensity of fires, trending topics on Twitter, or political intensity such as the presidential and legislative elections in Indonesia. All tweets that had been scraped were then processed through the Ant-Conc software program, which is specifically used to process corpus data and analyze text to find particular patterns in a language. The data in this study were then analyzed using a corpus-assisted discourse study (CADS), which was a combination of discourse analysis (DA) and critical discourse analysis (CDA) aimed at identifying the hidden meaning of a narrative (Partinton, 2010; van Dijk, 1993; Fairclough, 1989; Wodak, 2001). In the CADS approach, the Ant-Conc program serves to assist the corpus linguistics method, a textual analysis method used to study and analyze the number of tweets with computer software that allows texts to be searched quickly to find, list, sort, and count words, phrases, and grammar patterns.[20] Structurally, corpus linguistics is part of the corpus-assisted discourse study (CADS) and is generally used as a method of collecting statistical data. The data provision in this study used the corpus linguistics method and the focus of the data collected was the corpora. Corpora are a collection of large amounts of text (up to billions of words) stored electronically and used to analyze how words, phrases, and languages are used (Baker, 2010; Partington, 2008). In this study, the focused corpora served to see the extent of the number of tweets that appeared on the issue of forest fires in Indonesia in 2014-2019.

Findings

The process of forming discourse in this study was carried out using a reality construction (*Fig. 1*). Hamad[17] stated that discourse is the product of the work of the discourse makers, using (verbal and nonverbal) language to represent reality. It aims to find the reality behind the discourse and learn the language in the use of written texts and oral data from conversations to highly institutionalized conversation forms.

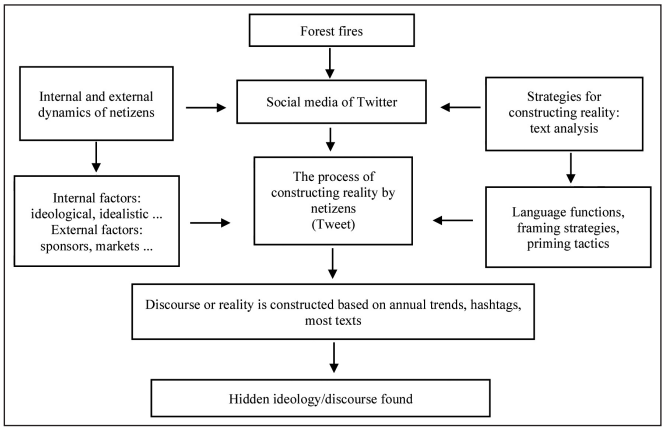

Fig. 1 - The process of reality construction in shaping discourse (adapted from Hamad[17])

The results obtained from various data scraping, both on the characteristics of each year and the variety of discourse, show that over the six-year period of data collection, there were dominant and marginalized discourses each year. According to Faucault,[21] the main issue of discourse is who produces the discourse and what effects emerge from the production of the discourse. Alternatively stated, in every discourse production, there is always a marginalized effect. It is in line with this study, where dominant and marginalized discourses were found each year (*Table III*).

Domination does not always automatically become a benchmark in showing actual discourse, which can also be influenced by buzzers or bot accounts. Therefore, the characteristics as stated above become one of the influences in the emergence of a big discourse if conclusions are drawn across the entire span of six years during the leadership of President Joko Widodo from 2014 to 2019.

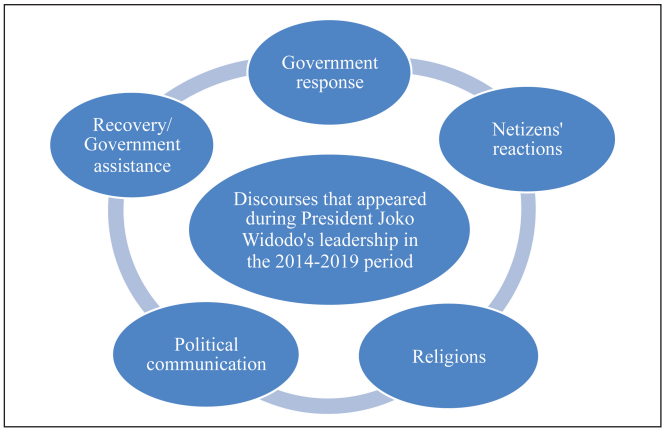

Fig. 2 - Hidden ideology/discourse found

Table III - Samples of the corpus elements and discourse found

Year	Tokens/Words	Selected keywords	Findings/Hidden meanings
2014 Word types: 28496 Tokens: 684354	45584 45218 25310 9308 7609 7173 5519 3654 3337 3232 Dst	*hutan* [forest] *kebakaran* [fires] *Riau* *sby* [susilo bambang yudhoyono] *lahan* [land] *asap* [smoke] *tni* [Indonesian national army] *presiden* [president] *perusahaan* [company] *api* [flame*]* etc.	Dominant Discourse 1. Netizens' reaction 2. Government response 3. Recovery 4. Political communication 5. Religions Marginalized Discourse 1. Highlights/Emergent issues
2015 Word types: 62111 Tokens: 1553591	100875 18801 15623 11013 8723 8425 7706 7366 6965 6183 Dst	*kebakaran* [fires] *asap* [smoke] *lahan* [land] *Indonesia* *jokowi* [Joko Widodo] *twitter* *kabut* [fog] *pemerintah* [government] *padamkan* [extinguish] *gunung* [mountain] etc.	Dominant Discourse 1. Netizens' reaction 2. Recovery 3. Government response 4. Law 5. Religions 6. Political Communication Marginalized Discourse 1. Two causes of fires: a. Company/Individual b. Nature 2. Emergent issues
2016 Word types: 8428 Tokens: 134131	8113 8067 1741 1638 1461 1291 1281 780 735 620 Dst	*hutan* [forest] *kebakaran* [fires] *kasus* [cases] *gugatan* [lawsuit] *lahan* [land] *hakim* [judge] *pemerintah* [government] *jokowi* [Joko Widodo] *masyarakat* [community] *tolak* [decline] etc.	Dominant Discourse 1. Government response 2. Netizens' reaction 3. Recovery 4. Religions Marginalized Discourse 1. Law enforcement 2. Emergent issues are classified into: a. National issues b. International issues
2017 Word types: 7508 Tokens: 62636	4218 4104 1254 932 576 485 440 371 306 290 Dst	*hutan* [forest] *kebakaran* [fires] *twitter* *lahan* [land] *Riau* *cegah* [prevent] *jokowi* [Joko Widodo] *presiden* [president] *darurat* [emergency] *siaga* [standby] etc.	Dominant Discourse 1. Government response 2. Netizens' reaction 3. Religions 4. Technology/recovery Marginalized Discourse 1. Community expectations 2. Developed issues 3. Law
2018 Word types: 9058 Tokens: 81468	4944 4415 1746 1027 834 543 537 519 377 359 Dst	*hutan* [forest] *kebakaran* [fires] *lahan* [land] *twitter* *Tiau* *info* [information] *jokowi* [Joko Widodo] *karhutla* [forest and land fires] *siaga* [standby] *Indonesia* etc.	Dominant Discourse 1. Netizens' reaction 2. Government response 3. Recovery 4. Religions Marginalized Discourse 1. Emergent issues are classified into: a. National issues b. International issues 1. Law 2. Expectations
2019 Word types: 49605 Tokens: 881450	41150 40193 8768 6899 5293 5112 4124 3715 3696 2801 Dst	*hutan* [forest] *kebakaran* [fires] *lahan* [land] *asap* [smoke] *jokowi* [Joko Widodo] *Riau* *Kalimantan* *karhutla* [forest and land fires] *Indonesia* *kabut* [fog] etc.	Dominant Discourse 1. Netizens' reaction 2. Recovery 3. Government response 4. Religions 5. Political communication Marginalized Discourse 1. Two causes of fire: a. Company/Individual b. Nature 2. Law 3. Emergent issues

Source: Processed by the authors

Fig. 2 shows the results of the CADS analysis that was carried out based on tweet data processing per six-year period or throughout the leadership of President Joko Widodo. The five hidden meanings or discourses include government response, netizens' reaction, religions, political communication, recovery/government assistance.

Disasters and government response

The conversations of Twitter's netizens that refer to the discourse of "Government Response" often appear in Twitter activities (*Table IV & Fig. 3*). Mirza[22] illustrated the differences between developed and developing countries in terms of the readiness and ability of governments to respond to the effects of disasters, which can have a considerable effect on the number of deaths and on reconstruction efforts. In terms of financing, social media enables individuals, private parties, and the government to create particular content and popular topics, making it easier to disseminate information faster and allow various perspectives to be shared and distributed on social media.[23]

Table IV - Keywords on the discourse of government response

Government response		
padamkan [extinguish]: 11.448	*tni* [Indonesian national army]: 10.118	*satgas* [unit officer]: 2.493
helikopterbombing [helicopter bombing]: 1.599	*siaga* [standby]: 1.350	*kanalisasi* [canalization]: 1.085
waterbombing [water bombing]: 950	*masker* [masks]: 848	*hijaukan* [preserve]: 670
satelit [satellite]: 620	*tangkappembakar* [catch the burners]: 597	*terjunkan* [jump down]: 524
alokasikan [alocate]: 437	*konservasi* [conservation]: 359	*restorasi* [restoration]: 325
cabuthgu [withdraw hgu]: 318	*mitigasi* [mitigation]: 317	*konsesi* [concession]: 295
manggalaagni: 240	*evakuasi* [evacuation]: 221	*anggarkan* [budget]: 200

Source: Wordlist of Twitter data in 2014-2019 (data processed)

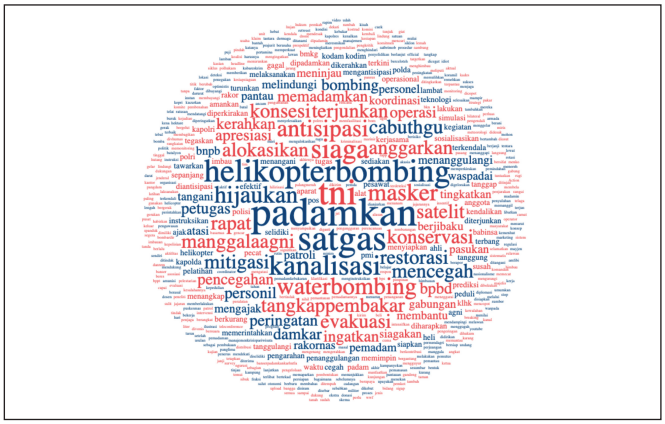

Fig. 3 - Wordcloud of the dominant words that appear on the discourse of government response
Source: Wordlist of Twitter data in 2014-2019 (data processed)

Based on the dominance of the data obtained in this study, words that emerged from Twitter conversations during fire disasters from 2014 to 2019 included *satgas* [task force], *kanalisasi* [canalization], *kerahkan* [mobilize], *padamkan* [extinguish], *anggarkan* [budget], *evakuasi* [evacuation], *helicoterboombing* [helicopter bombing], *cabuthgu* [withdraw hgu], and *masker* [masks]. By combining the 700 MHz radiofrequency multimedia services launched by the Indonesian government and the help of communication data on social media, disaster conditions that occurred in the field could be monitored and analyzed more effectively and efficiently. The command post of disaster management could directly receive video data and other sensory data in real-time, and from the side of social media, the public could get information and provide feedback about the real-time conditions of their homes affected by the forest fire disaster.

The development of technology and information can make all parties involved in disaster problems more responsive to helping minimize their adverse effects. Collaboration in handling and integrating services is expected to improve disaster management in Indonesia. Most importantly, there will be many opportunities to rescue victims more quickly and minimize the impact of disasters on Indonesian society.

Disaster and netizens' reaction

During emergencies, social media can express several aspects of a country's mental and emotional condition through the tendency to unite opinions.[23] This theory is relevant to the data in this study,

which shows the frequent use of words such as Riau with 34,859 words, Kalimantan with 6,948 words, *sawit* [palm] with 2,956 words, *gambut* [peat] with 3,369 words, *kalimantanbutuhoksigen* [Kalimantan needs oxygen] with 369 words, *realitarakyat* [community's reality] with 473 words, *riaudibakarbukanterbakar* [Riau is burned intentionally not unintentionally] with 233 words (*Table V & Fig. 4*).

Table V - Keywords on the discourse of netizens' reaction

Netizens' reaction		
Riau: 34.859	Kalimantan: 6.948	*gambut* [peat]: 3.369
sawit [palm]: 2.956	*hukumpembakarhutan* [punish forest burners]: 1.747	*saveriau* [save Riau]: 679
habitat [habitat]: 518	*donasi* [donation]: 490	*kabutasap* [smog]: 463
realitarakyat [community's reality]: 473	kalimantanbutuhoksigen *[Kalimantan needs oxygen]*: 369	*asiangames* [Asian games]: 318
perusahaansawitbangsat [screw palm oil company]: 297	kebakaranhutanmakinmenggila [forest fires are getting wild]: 268	*kritik* [critics]: 251
riaudibakarbukanterbakar [Riau is burned intentionally not unintentionally]: 233	bersamatanganikarhutla [together handle the forest and land fire]: 206	*asma* [asthma]: 187

Source: Wordlist of Twitter data in 2014-2019 (data processed)

Fig. 4 - Wordcloud of the dominant words that appear on the discourse of netizens' reactions
Source: Wordlist of Twitter data in 2014-2019 (data processed).

Social media promotes cross-platform accessibility and a constant flow of information. Situational updates can be equipped with geographical and location data.[24] Timely information can be provided on how to deal with the developing situation. Besides, social media provides a framework for the work of journalistic, discussion and public debate so that the reactions arising can be variations in the collection of information. Therefore, it is in line with this research that social media has great potential to be a forum for public interaction, or can show the reaction of the community and monitor public concerns.[23]

Disaster and religions

Religious factors influence how people respond to disasters, how they experience and understand risks, and how religious beliefs affect vulnerability and resilience when facing danger and experiencing a disaster.[25,26,27] The above theory is strengthened by the data found in Twitter conversations during forest fire disasters in this study. It shows the frequent use of words such as *musibah* [disasters], *tuhan* [god], *indonesiamilikallah* [Indonesia belongs to allah], and *azab* [punishment] throughout 2014 to 2019 (*Table VI & Fig. 5).*

Table VI - Keywords on the discourse of religions

Religions		
prayforriau [pray for Riau]: 1.484	*ulama* [clerics]: 721	*kiamat* [doomsday]: 718
musibah [disaster]: 627	*khilafah*: 541	*azab* [punishment]: 475
tuhan [god]: 402	*ibadah* [worship]: 389	*indonesiamilikallah* [Indonesia belongs to allah]: 340
meninggal [die]: 337	*sholat* [prayer]: 306	*radikal* [radical]: 239
ikhlas [sincere]: 235	*astaghfirullah*: 227	*berdoa* [pray]: 216

Source: Wordlist of Twitter data in 2014-2019 (data processed).

Fig. 5 - Wordcloud of the dominant words that appear on the discourse of religions
Source: Wordlist of Twitter data in 2014-2019 (data processed).

Holmgaard[28] added that this religious perception refers to the way people observe, understand, interpret and evaluate an object, event or experience. Bentzen[29] also said that people do not need to be directly affected by natural disasters to improve their religious side, but rather through experience from the surrounding environment.

Disasters and political communication

Social media serves as a communication tool in managing disasters, and traditional news media also provide a means for those affected by disasters and the wider community to receive information.[30,31] Words appearing in Twitter conversations included *jokowi* [Joko Widodo] with 15,867 words, *sby* [susilo bambang yudhoyono] with 9,994 words, *prabowo* with 3,202 words, *tetapdipimpinjokowi* [still led by Joko Widodo] with 311 words, *setahunjokowijkgagal* [one year of Joko Widodo and Jusuf Kalla's failure] with 217 words, *pencitraan* [imaging] with 1,593 words, *konspirasi* [conspiracy] with 350 words, *korupsi* [corruption] with 399 words, and *indonesiadaruratasap* [Indonesia smoke emergency] with 421 words (*Table VII & Fig. 6*).

Table VII - Keywords on the discourse of political communication

Political communication		
jokowi [Joko Widodo]: 15.867	*sby* [susilo bambang yudhoyono]: 9.994	*prabowo*: 3.202
pencitraan [imaging]: 1.593	*pinokioingkarjanji* [pinocchio broke promises]: 558	*prabowohatta* [prabowo hatta]: 558
cebong [tadpole]: 492	*kampret* [bat]: 441	*indonesiadaruratasap* [Indonesia smoke emergency]: 421
korupsi [corruption]: 399	*konspirasi* [conspiracy]: 350	*jokowidatangasapberes* [Joko Widodo comes smoke is solved]: 327
supportpresidenri [support republic of Indonesia's president]: 322	*tetapdipimpinjokowi* [still led by Joko Widodo]: 311	*setahunjokowijkgagal* [one year of Joko Widodo and Jusuf Kalla's failure]: 217

Source: Wordlist of Twitter data in 2014-2019 (data processed)

Fig. 6 - Wordcloud of the dominant words that appear on the discourse of political communication
Source: Wordlist of Twitter data in 2014-2019 (data processed).

Ewart's[32] research revealed that the credibility of political actors in relation to the provision of information about the disaster was previously identified as issues and a lead of opinion. The politicization of disasters intensifies as the society or affected community proceeds from the emergency to the recovery and reconstruction phases.[33] The recovery phase in particular will be a stage for politicians. Olson and Gawronski[34] described it as a 'special time', where both victims and the public expect a 'meticulous' response from the government. Priest[35] in his study mentioned that media exposure can affect public opinion on particular issues, showing that the media has the power to influence society. Even if some people disagree with public opinion, those who have different views tend to be silent and reluctant to oppose the opinions explored by the media.[36] It is consistent with Talson's statement[37] that politicians reflect their performance, activeness and interactivity during disasters through the media for their own interests.

Disasters and recovery

As disclosed in the research of Menon et al.,[38] disaster recovery and reconstruction operations have always been a challenging task for central government, regional government, and the community. Issues emerge from the local government in terms of financing long-term disaster recovery, since the local government must depend on the Central Government to access a greater source of funds.[39] It is in line with the data in this study, where particular words appearing frequently include *anggaran* [bud-

get], *kerugian* [loss], *pasokan* [supply], Malaysia, *bantuan* [aid], *alokasi* [allocation], *posko* [command post], *hujan* [rain] and *bantupadamkanapi* [help extinguish the fire] (*Table VIII & Fig. 7*).

Table VIII - Keywords on discourse of recovery

Recovery		
Malaysia: 4.841	*bantuan* [aid]: 3.855	*hujan* [rain]: 3.758
Australia: 2.673	*korporasi* [corporates]: 2.159	*singapura* [Singapore]: 2.129
air [water]: 1.869	*kerugian* [loss]: 1.333	*anggaran* [budget]: 1.136
apresiasi [appreciation]: 561	*alokasi* [allocation]: 484	*tegastanganikarhutla* [firmly handle forest and land fires]: 446
bantupadamkanapi [help extinguish the fire]: 442	*malaysiabaharu* [new Malaysia]: 355	*posko* [command post]: 340
malaybersih [clean Malaysia]: 253	*mahatir*: 248	*togetherpossible* [together possible]: 229

Source: Wordlist of Twitter data in 2014-2019 (data processed)

Fig. 7 - Wordcloud of the dominant words that appear on the discourse of recovery
Source: Wordlist of Twitter data in 2014-2019 (data processed)

The data on keywords obtained in this study reveal that the dominance of frequently-used words show the form of responses from various sides, like neighboring countries including Malaysia, Singapore and Australia, to aid and its allocation. In this study, the problem arose from the Indonesian government's rejection of the offer of aid from neighboring countries. As reported by BBC News Indonesia,[40] the Indonesian government was determined to extinguish its forest fires on the grounds of 'not wanting to be underestimated', claiming to have enough firefighting personnel, although the Malaysian and Singaporean governments had expressed their intention to help. It is strengthened by the data in this study, particularly on frequently-used words such as *mahatir*, *singapura* [Singapore], *malaysiabaharu* [new Malaysia], *malaysiabersih* [clean Malaysia], *bantupadamkanapi* [help extinguish the fire], and *togetherpossible* [together possible].

The role of social media in disasters

Reporting a disaster situation

Reporting a disaster situation is divided into two perspectives, a personal perspective and as a second-hand reporter. The former refers to the use of social media to provide and receive disaster information and warning from a personal perspective. This also includes warning others about a situation that is experienced and the location of the incident. In the context of Twitter, these reporters are individuals and communities who voice their aspirations in the form of raw tweets directly using their social media accounts. Accounts that spread such tweets can also be accounts of media, NGOs, government, and individuals that directly tweet about the problem of forest fires.[41,42]

Meanwhile, reporting the disaster situation as a second-hand reporter is related to providing signals and detecting disasters. The focus is on recording and ascertaining what happens in the disasters and delivering news and reporting on events. Typically, these second-hand reporters are netizens who retweet, reply, and favorite tweets posted by personal perspective reporters. Therefore, it shows that the use of social media in disaster communication, in the context of disaster reporting, results in a discourse on government response and citizen reaction based on personal perspectives and second-hand reporters. In terms of government and citizens, it shows the existence of delivering information.

Criticizing the government

Tweets criticizing the government contain discussion about socio-political cases, their implications for disasters, and accountability for events. A study by

Takahashi et al.[14] tried to convey that such tweets lead to the form of follow-up when the disaster took place and after the disaster occurred. In the context of forest fires in this study, it is concluded that the tweets lead to criticism of the government, which results in a discourse on recovery/government assistance as well as the tweets about the discourse of netizens' reaction. The keywords found referred to the hope of assistance and recovery from the forest fire disasters.

Discussing the case

These forms of use of social media, according to Takahasi et al.,[14] target every interaction of Twitter's netizens who try to convey their aspirations as pictured by the tweets. This is usually found from a thread of a Twitter account that is responded to with various comments from other Twitter accounts. These comments subsequently produce a variety of tweets, which bring up various discussion groups on the issue of the forest fires. In the context of forest fire disaster in Indonesia, a variety of discussions took place during the leadership of President Joko Widodo from 2014 to 2019 and lead to two large discussions that are often discussed and are appealing to discuss, which are related to religion and politics.

Implementation of actor-network theory (ANT)

Human actors

Fig. 8 shows that the participation of Twitter's users/netizens in using the keyword of *"kebakaranhutan"* [forest fires] tends to fluctuate throughout President Joko Widodo's leadership from 2014 to 2019.

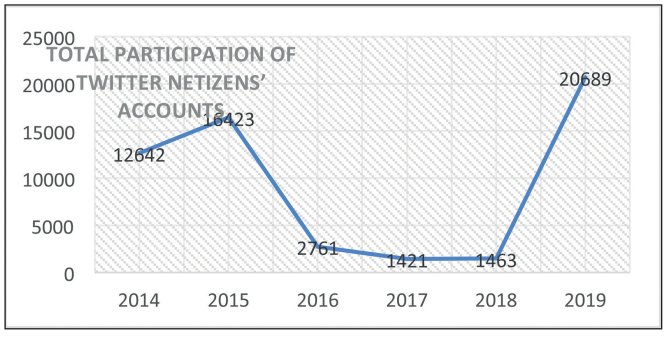

Fig. 8 - The trend of total participation of Twitter accounts that use the keyword of "*kebakaranhutan*" [forest fires]

Table IX - Participation of actors/accounts from 2014 to 2019

2014-2019		
No.	**Account**	**Total Tweets**
1	InfoHutan	1335
2	GEMAWAHYUH	565
3	Bisniscom	430
4	Indberitanews	420
5	Muhfeeb	388
6	_wistu	363
7	Republikaonline	349
8	Sanjayator	343
9	Infobencana	334
10	itsmeRahmat	331

Source: Twitter account data with the keyword of *"kebakaran hutan"* [forest fires] (data processed)

Table IX shows the top ten actors/accounts that consistently tweeted about forest fires on Twitter from 2014 to 2019. This data shows that participation is dominated by media and individual accounts, whereas government accounts are represented by the @infobencana account only from the Ministry of the Environment. Essentially, the role of government should be more vital in voicing and providing more reliable information to the public. This can be assumed due to the major role of the government as the organizer of the state and the guarantor of the safety and welfare of the society. However, its representation is only reflected in a few authorized institutions. While on the other hand, the dominance of individual and media accounts shown above are covered by a variety of different backgrounds with their respective interests. Therefore, it can be assumed that it has influenced the level of participation of the actors involved in the case of forest fires on dialogues on Twitter.

On the other hand, the individual actors involved here can also be assumed to be the directly affected communities and people who are concerned with this problem so that they are also indirectly involved in voicing this matter. Further, in terms of the media, domination occurs as a form of satire on the government and their need to report, so it is reasonable that the level of participation is high enough.

Non-human actors

Twitter becomes the main platform that is used as a non-human actor in this study. The aim is to see the hidden meaning or discourse from the results of corpus-assisted discourse study (CADS) data processing on Twitter in the context of forest fire disasters in Indonesia. There are three main points taken. First, Twitter is used as a platform for communication of disasters, particularly in the case of forest fires. Woerner et al.[43] stated that over the past few years, many organizations and governments have been involved in collecting, analyzing and utilizing big data. Big data comprises the process of collecting, analyzing and storing the data created. Thus, it shows that social media platforms such as Twitter, which is part of the big data era, can be used as a source of information in disaster research, such as the forest fires that occurred in Indonesia.

Second, Twitter is used as a real-time information media. As stated in the study of Willemsen et al.,[44] the introduction of the social media platform was heralded because of its potential to reach the wider community. The ability to send messages in real-time from social media is extremely helpful in the case of disasters, including forest fires. The rapid delivery of information facilitates various related elements to conduct evacuation, extinguishing, disaster management, and supply of relief aid for affected victims of the disaster. The third is government involvement. A study by Yu et al.[45] revealed the crucial role of government in disaster communication through social media. The study of government policies affects how the government responds to disasters appropriately and anticipates public panic. In this case, government accounts on Twitter should play an active role in conveying trusted information to the public, particularly Twitter netizens. However, based on the data on the participation of the accounts, government involvement in the case of forest fires is minimal.

Looking at account participation every period from 2014 to 2019, government activities are not too prominent compared to other accounts. Therefore, it can be assumed that the government's role needs to be leadership and information arbitrage so that the scattered potential can be synergized. Then, when referring to the scheme of actor-network theory, social media should not only be a mere medium of information but can act as a non-human actor that plays a significant role in policymaking at both national and regional levels.[16]

Conclusions and implications

This study allocated tweet data of Twitter's netizens related to forest fire disasters in Indonesia. Using a mixed-method of corpus-assisted discourse study (CADS), this research sought to contribute to academic and professional debates on the role of social media today. The results of research on Twitter about forest fires that occurred in Indonesia during the leadership of President Joko Widodo from 2014 to 2019 produced five major discourses, including government response, netizens' reactions, religions, political communication, and recovery. These five big discourses present a consistently great pattern shown by the Twitter community/netizens in addressing the problem of catastrophic forest fires in Indonesia.

On the other side, after seeing what discourse emerged, this study then tried to identify the role of social media in voicing the problem of forest fires in Indonesia. Referring to Takahasi et al.,[14] disaster communication on Twitter, particularly on forest fires that occurred in Indonesia, can be used as a tool to report disaster situations, criticize the government, and discuss the case. Subsequently, by using the scheme of actor-network theory, actor mapping was carried out to see that the problem of forest fires is no longer a problem that must be borne by the government alone, but also by the wider community.

Finally, based on the findings, the most hidden discourse or meanings are netizens' reactions and relentless highlights of government responses. For this reason, Twitter can be used as a real-time information media for consideration in the formulation and evaluation of forest fire policies in Indonesia. It leads to the need for studies in terms of the use of political communication for a deeper study of the many findings in the case of the forest fire disaster politicized by the parties concerned. Therefore, it is necessary to test the implementation of public policies to create a bureaucracy that is disaster-responsive, and in the future forest fire disasters in Indonesia can be reduced and expected not to reoccur.

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