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Actor Networking in Forest Fires Mitigation, Ogan Komering Ilir District, South Sumatra Province, Indonesia

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Abstract

Forest fire is a seasonal environmental problem in Indonesia. The Government of Indonesia has introduced a new policy that promotes a networking approach. This paper attempts to analyze the existing networks that emerge during the process of forest fire prevention/mitigation in Ogan Komering Ilir (OKI) District. Drawing on empirical research using social network analysis (SNA), we identify various actors participating in forest fire governance. The local government has promoted the principle of voluntary civil society and plantation corporation participation in the networks, which, however, based on findings does not seem to be effective. Our findings show that mitigation of forest fires in OKI District is plagued by low cohesiveness. The prominent role of the police in the network underscores the approach that the local government is using to tackle forest fires, which is, that it is a security problem and not as a disaster that requires intensive collaboration among multi-stakeholders. To that end, based on the research results, policy recommendations include, the need for the Central Government to establish a 'stick and carrots' mechanism for the local government to foster the adoption of collaborative forest fires mitigation management; the need for the local government, especially the provincial government and the district government, to reduce the role of the police while at the same time strengthen the role of non-state actors in forest fire mitigation; the need for the central and the local government to strengthen the capability of civil servants to work under the collaborative ecosystem through systematic learning.

Keywords: *forest fires,natural disaster, policy networking, social network analysis, South Sumatera*

INTRODUCTION

Forest fires have become a recurring manmade disaster in South Sumatra Province, Indonesia, that had a local, regional and global impact (Aditama, 2000; Clover & Jessup, 1999; Frakenberg, McKee, & Thomas, 2005; Harrison, Page, & Limin, 2009; Kunii et al., 2002). This event is part of forest fires in Indonesia which has been assumed to have great significance because of its severity and impact since 1997 (Dauvergne, 1998). The latest forest fires in South Sumatra Province occurred in 2015 and burnt down 736.587 hectares. The epicenter of this event is the OKI District which has the largest burned area (of 377,365 hectares). The 2015 forest fires in Indonesia release 857,48 million tons of carbon dioxide or 11.3 million tons per day in September and October 2015. This number is more than the 28-nations of the European Union's daily emissions of 8.9 million tons during the same period (Anonymous, 2016). The forest fires and haze in 2015 cost Indonesia an estimated of IDR 221 trillion (1.9% of GDP) – more than twice the reconstruction cost after the 2004 Aceh tsunami (The World Bank, 2015).

Previous research on forest fires in South Sumatra has identified poor forest fire governance as one of the factors that are responsible for the recurrence of the problem (Purnomo, 2017; Mutiara, 2016). To redress the problem, in 2015, Jokowi, the President of the Republic of Indonesia, issued Presidential Instruction No. 11/2015 on enhancing Forest Fire Mitigation, which was expected to mark a new policy change in forest fire risk management in Indonesia in general, Sumatra and Kalimantan, in particular. Based on the regulation, government institutions at the national and local levels (province, district) are obliged to intensify forest fire management efforts through collaborative management, citizen participation, and law enforcement. Besides, the regulation recommends the establishment of a new institutional arrangement that is underpinned by a network approach as a strategy to formulate and implement public policy.

The issuance of President Instruction No. 11/2015 was a quick response to an increase in the intensity and duration of forest fires during 2012 – 2015. Based on the previous research, the aftermath of the implementation of the region (2015 – 2018 period) has been characterized by a significant reduction in forest fires (Figure 1). Nonetheless, what is not clear is whether the reduction in forest fires in the aftermath of the enacting of the regulation is attributable to the existence of collaborative management and citizens participation forest fire management at the local level, which is the core of the provisions of the instruction. Moreover, there is no clarity on the nature of the existing network in forest fire management in Indonesia in general and OKI district in particular. The meaning and importance that can be attached to such networks. Understanding the network is very important in informing the Indonesian government in its efforts to achieve the goal of making Indonesia a free or zero-haze area. Specifically, this research will fill the gap in the extant literature on forest fire governance in OKI district and shed more light on assessing such governance based on a social network analysis perspective (SNA)

Previous research on forest fires in Indonesia has been conducted by scholars from various disciplines including geography (Aiken, 2010); ecology (Certini, 2005; Marlier et al., 2015; Page et al., 2002; Vayda, 2006); anthropology (Bizard, 2011); political science (Dauvergne, 1998; Gellert, 1998; Sunderlin, 1999; Tacconi, Moore, & Kaimowitz, 2007); forestry (Chokkalingam et al., 2007; Dennis, Hoffman, Applegate, & von Gemmingen, 2001); atmospheric sci-

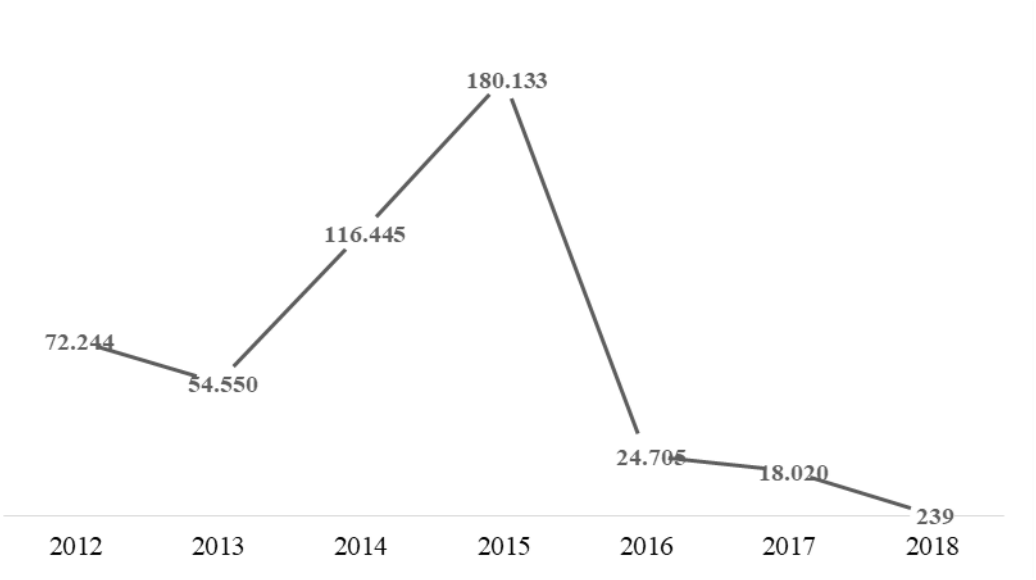

Figure 1. Trend in Hotspots in Indonesia, 2012—2018
Source: Global Forest Watch, 2018

ence (Gaveau et al., 2015; Hamada, Darung, Limin, & Hatano, 2013; Hayasaka, Noguchi,

Putra, Yulianti, & Vadrevu, 2014); and remote-sensing (Cochrane, 2001; Miettinen & Liew, 2005). However, none of the varied previous research explores and analyzes forest fire management using SNA.

Thus, only a few previous pieces of researches used the SNA approach to analyze actor-network in forest fire management. Purnomo (2017) used SNA to identify a diversity of actors involved and deriving benefits from fires in Riau Province, which included farmer group organizers who influence decision-making processes through their patronage network that sere their interests. Networks are a source of power, support, protection and access to various resources. To that end, to reduce forest fires effectively, central and local governments should reduce the power of the farmer group organizers by enacting a law/regulation to that effect. However, issuing a law to reduce the leverage farmer group organizers have over local resources, is likely to undermine and in contradiction to the government policy on improving forest fire management by strengthening the participation of local. In another research, Mutiara (2016) used SNA to analyze the structure of international environmental regime networks that have an influence on actor networks on forest fire governance in Riau Province including ASEAN Agreement on Transboundary Haze Pollution (AATHP), climate change regime (UNFCCC), forest product certification regime (FSC), palm oil certification regime (RSPO), and biological diversity regime (CBD). Results showed that AATHP and CBD are the two networks with a strong influence on forest fire management in Riau Province. Nonetheless, the research focus made it difficult for Mutiara (2016) to delve into actor-network in forest fires governance at the local level.

Meanwhile, research by Purnomo (2017) and Mutiara (2016) on Riau Province, which shares geographical similarity with OKI district concerning peatland, oil palm and forest plantation, and climate. However, the two areas differ concerning the context of culture, local government, history of forest and land fires, and community participation in forest fire governance. That said, the results from Purnomo (2017) and Mutiara (2016) studies may, to a certain ex-

tent inform the understanding of researchers on forest fires in OKI district.

Forest fires are attributable to natural and human disasters. Previous research that links forest fires to natural factors in general and global climate (Jolly et al., 2015); human factors such as the use of slash-and-burn agriculture and land clearing of plantation corporation (Hirschberger, 2016; Varma, 2003) as causes of forest fires. Research on the impact of forest fires cites human health (Jaenicke, Rieley, Mott, Kimman, & Siegert, 2008; Kim, Knowles, Manley, & Radoias, 2017; Mott et al., 2005); nature and environment specially the carbon stock (Hurteau & Brooks, 2011); the quality of soils (Santín & Doerr, 2016); air pollution (Parameswaran, Nair, & Rajeev, 2004; Show & Chang, 2016) for specific timeline (short-term or long-term period) and spatial (local, national, regional, and global).

Disaster usually triggers the involvement of various actors in disaster management, including military institution, government agencies, non-government organizations, mass media, private companies, academia, multilateral organizations, international financial institutions (Coppola, 2007), and grass-root community institutions (Legono, Darmanto, Fathani, & Triatmadja, 2013; Pribadi, Argo, Mariani, & Parlan, 2013). Under such conditions, therefore, the outcomes of disaster governance are partly a confluence of the dynamics of interests, power, and agendas on various parties and how they are managed. Thus, the challenge in disaster management is to take into consideration the interests, agendas, powers, and responsibilities of all groups of stakeholders, who hail from many sectors including the government (both central and local), private sector, non-governmental organizations, multilateral agencies, and the local community (Ha, Fernando, & Mahmood, 2015).

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Like other disasters, such as earthquake (Kusumasari, 2012); volcanic eruption (Legono et al., 2013); floods (Marfai & King, 2008; Marfai, Sekaranom, & Ward, 2015); forest fires practices in Indonesia is operated under a polycentric regime which is characterized by the existence of both contention and consensus among actors and their multi-dimensional perspectives (Carmenta, Zabala, Daeli, & Phelps, 2017) and asymmetric perception (Ekayani, Nurrochmat, & Darusman, 2016). Consequently, given the multitude of stakeholders involved in disaster management, coordination becomes the key issue in contemporary disaster management (Coppola, 2007). Without structure and appropriate coordination mechanisms, disaster management is bound to be plagued by lags, gaps, and inaccurate information.

METHODS

Following the lead by Purnomo (2017) and Mutiara (2016), this research used SNA to analyze the coordination network among participants in forest fires mitigation in OKI district. As a scientific method, SNA starts with the idea that the social environment can be expressed as patterns or regularities in relationships among interacting units, which embodies the structure. Each structure has a structural variable that is quantifiable. SNA assumes that within the structure, *first*, actors and their actions are interdependent rather than independent, autonomous units. *Second*, relational ties (linkages) between actors are channels for transfer or "flow" of resources (either material or non-material). *Third*, network models focusing on individuals view the network structural environment as providing opportunities or constraints on individual action. *Fourth*, network models conceptualize structure (social, economic, political, and so forth) as lasting patterns of relations among actors. The unit of analysis in SNA is not an individual, but an entity consisting of a collection of individuals and the linkage among them. SNA focus on dyad (two actors and their ties), triads (three actors and their ties), or larger systems (subgroup of individuals, or the entire networks) (Wasserman & Faust, 1994).

At the global level, many researcher utilized SNA to understand the disaster in the world, for example a terrorist attack (Kapucu, 2006) and Hurricane Katrina (Kapucu, Arslan, & Collins, 2010) in USA, earthquake in China (Guo & Kapucu, 2015), tsunami in Haiti and Japan (Oh & Lee, 2017), earthquake in Haiti, Japan, and Indonesia (Siciliano & Wukich, 2016), earthquake in India (Vasavada, 2013). The above studies showed that SNA is a powerful method to visualize and to understand complex actors and relations network of a natural disaster. Besides, using SNA, equip researchers with the ability to analyze the influence of structural variable network structure using several inferential statistics, for example the Quadratic Assignment Procedure (QAP), the Random Graph Model (ERGM), and the Latent Space Network (LSN) (Cranmer, Leifeld, McClurg, & Rolfe, 2017).

Specifically, the SNA technique involved collecting primary data through face to face interviews based on a social network questionnaire (Wasserman & Faust, 1994). The informants were officials who were in charge of forest fire mitigation duties in OKI District in 2018. Based on the preliminary survey, we identified several institutions that later on served as key informants including the OKI Disaster Management Body (*Badan Penanggulangan Bencana Daerah OKI*), the OKI Police Station (*Polres OKI*), the OKI Civil Service Police (*Satuan Polisi Pamong Praja OKI*), the OKI Military District Command (*Komando Distrik Militer/0402 OKI*), the OKI Social Affairs Agency (*Dinas Sosial OKI*), the OKI Health Agency (*Dinas*

Kesehatan OKI), the OKI Fire Brigade (*Manggala Agni*), plantation company, non-government organization, village government, and the village residents. To visualize and to compute network metrics that include centrality, closeness, and betweenness from social network data, the researcher used the UCINET application (Borgatti, Everett, & Freeman, 2002). Besides, the research team collected secondary data that relates to forest fires in South Sumatera, Indonesia, which were used to supplement the primary data.

FINDINGS AND DISCUSSION

Current Practice on Forest Fire Mitigation

OKI district government has adopted several strategies to mitigate forest fires in the area that falls under its jurisdiction. *First*, strengthening legal institutional framework, by enacting a new local regulation on forest fires, which is based on Law No. 24/2007 on Disaster Mitigation and the Presidential Instruction No. 11/2015 on Enhancing Forest Fires Control and establishing ad hoc organizations (ad hoc disaster emergency command unit to tackle land and forest fires) as the command center that comprises policy actors drawn from various organizations at the district, sub-district, and village level (Figure 2, Figure 3, & Figure 4). The Governor of South Sumatera through the Gubernatorial Regulation of the South Sumatera Province No. 134/KPTS/BPBD-SS/2017, determines the structure and pattern of the organization of the command center. However, the lower-tier government levels (OKI district, sub-district, and village government) have the discretion to recruit people to fill the positions in the organization. For instance, in 2017, OKI district secretary had the head of the command center, which was based on the recommendation of OKI disaster management. The division of labor within the command center based on subdivisions of the primary task of forest fires mitigation, including ground operations (led by military apparatus), socialization (which involves public campaigns using outdoor advertising or social media, villager education using stakeholder meetings); law enforcement (led by the resort police); and public health (led by the OKI district health agency).

At the sub-district level, *Camat* (the Head of Sub-district Government), heads the forest fires mitigation command center, which carried out primary tasks similar to those at the district level. However, unlike the command center at the district level, that at the sub-district tier has a leaner organizational structure that comprises three divisions, inter alia, the socialization, prevention, and law enforcement divisions. Individuals who serve in various divisions are recruited from both civilians and government security institutions and village firefighting groups (Figure 3).

Meanwhile, at the village level, the village head is vested with the authority to recruit village members who are then formed into firefighting groups (Figure 4). By 2017, OKI district government had established 53 firefighting groups which are spread in 13 sub-districts. Financing the groups comes from resilient village disaster Program (*Desa Tangguh Bencana*/DESTANA), which falls under the National Disaster Mitigation Agency (*Badan Nasional Penanggulangan Bencana*/BNPB) based on Law No. 24/2007 on Disaster Mitigation and the Fire Awareness Community Program (*Masyarakat Peduli Api*/MPA). Based on the Ministry of Environmental protection and Forestry regulation No. 2/IV-SET/2014 on the Establishment and Fostering Fire Awareness Communities NDMA/NDRA falls under the Directorate General of Forest Protection and Nature Conservation, Ministry of Environmental protection and Forestry. Firefighting groups receive financial and technical assistance from plantation companies partly through a corporate social responsibility pro-

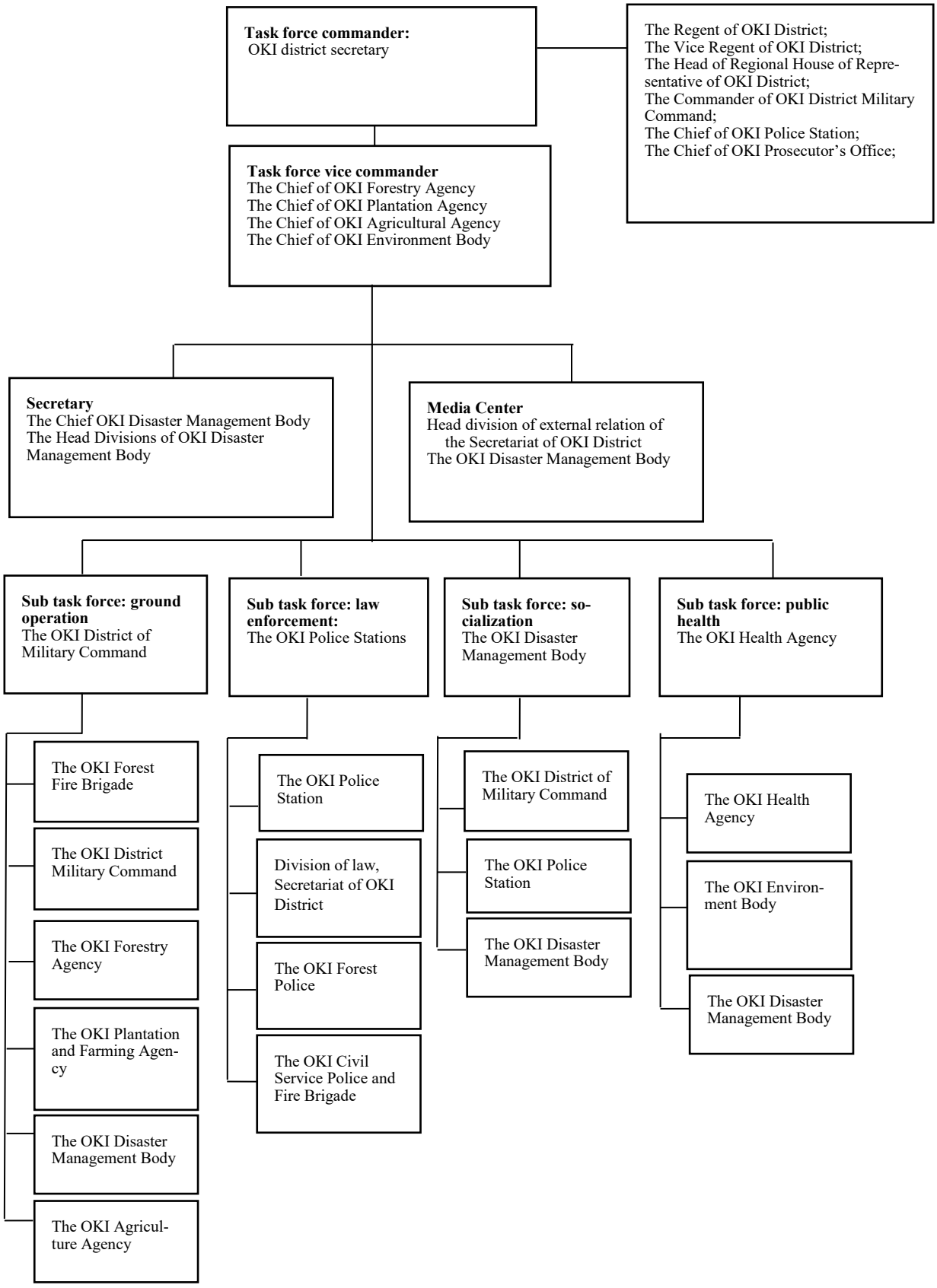


Figure 2. Organizational Structure of The Command Post of Forest and Land Fires Haze Disaster Emergency Preparedness Task Force at the District Level

Source: Decree of the Governor of South Sumatera Province Number 134/KPTS/BPBD-SS/2017

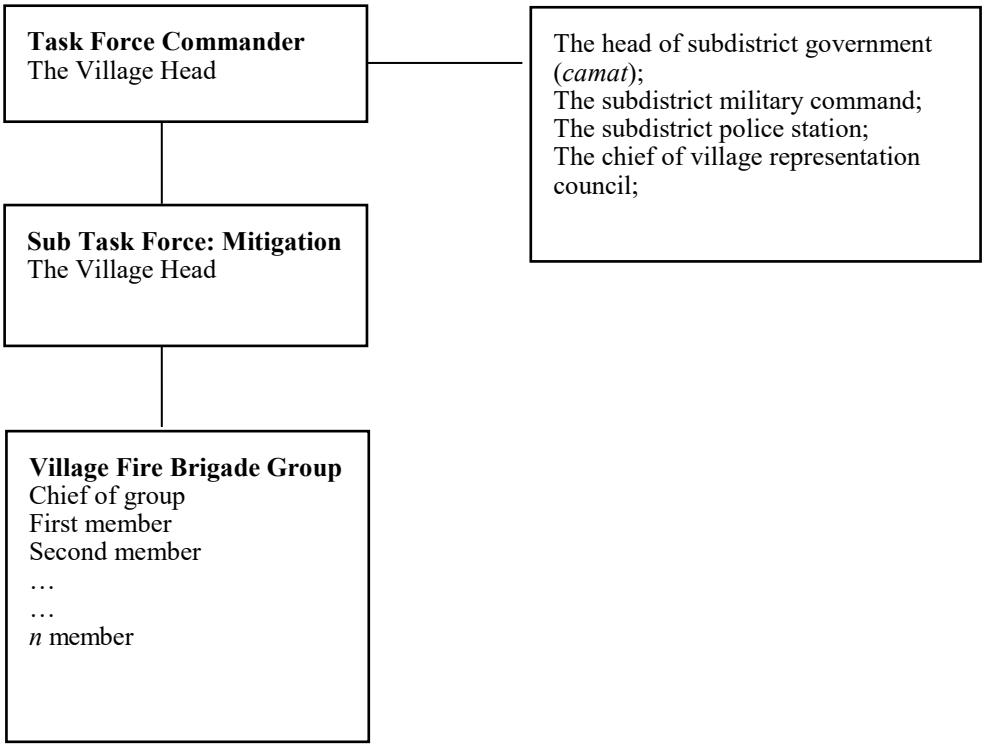


Figure 4. Organizational Structure of The Command Post of Forest and Land Fires Haze Disaster Emergency Preparedness Task Force at The Village Level

Source: Decree of the Governor of South Sumatera Province Number 134/KPTS/BPBD-SS/2017

Village and Fire Care awareness programs (*Desa Makmur Peduli Api*/ DMPA) at the village level. The formation of DMPA was aimed at increasing the ability and capacity to anticipate forest fires, while at the same time generate economic benefits for rural communities living in the vicinity of forests. Under the programs, villagers and village groups receive training, facilities, and equipment used in preventing forest fires. Besides, APP Sinar Mas also provides training in organic and ecological farming methods to cultivate vegetables, and rearing livestock. Thanks to such training, village members and groups acquire knowledge they use to create economic activities that improve and sustain their livelihoods, enhance food security, enables them to reduce expenditure on buying food, obtain additional income by selling vegetable harvests, and most importantly no longer clear land for cultivation using slash and burning methods which improves environmental protection. By 2017, DMPA program had reached 160 villages (covering 8,605 households) with the total value of program assistance to date estimated to be in the order of Rp28.07 billion. Today, farmers who have been DMPA program beneficiaries manage 14,645 birds, 895,161 fisheries, 1,926 goats, 415 heads of cattle and 50 pigs. APP Sinar Mas has the target of establishing 500 villages that will be spread across South Sumatra, West Kalimantan, East Kalimantan, Riau, and Jambi provinces.

Actor Networking

To build forest fire mitigation network in OKI district, the research team conducted interviews with eleven informants who were drawn from various organizations, including the OKI Social Affairs Agency (1 person), the OKI Environmental Body (1 person), the OKI Heath Agency (1 person), the Awareness Community (1 person), the OKI

Forestry Agency (1 person), the OKI Plantation and Farming Agency (1 person), the OKI Information, Communication and Transportation Agency (1 person), the OKI Police Station (1 person), the OKI Military District Command (1 person), the OKI Civil Service Police (1 person), and the OKI Forest Fire Brigade or *Manggala Agni* (1 person). Informants were requested to write down ten people who they contacted frequently through mobile phones or communicated with directly during forest fire mitigation exercises. Based on the name list informants provided (question B1), we then requested the informants to provide answers to two questions, namely, (a) based on the name list you have provided in question B1, to whom do you send information about forest fires in the OKI district? (b) Based on the name list you provided in question B1, who is the source of information you receive concerning forest fires in OKI district? During the first round, the research team collected one hundred and ten names of people. To calculate the network structural variable, UCINET requires a symmetrical matrix. That means that the research team had to build a matrix based on the assumption that the relationship among actors is symmetrical (if A calls B, then B calls A). After the data cleaning process, the research team developed a symmetrical matrix comprising 80 rows and 80 columns. UCINET application was used to visualize the matrix into an actor -network diagram.

As is evident in Figure 3, the network consists of 79 nodes and 198 connections/ ties. Theoretically, the maximum number of connections/ties/linkages for the matrix should be 6,240 (n * n – 1). Based on the formula, an inference can be made that the network is not a dense one (sparse) because it has only 3 percent of connections. Hanneman & Riddle (2005) argues that if the network has a high score on density, that means that the network does not have have a social constraint, characterizes the low level of social capital, and quick information exchange within a network. Based on that argument, an inference can be made that forest fire mitigation network in OKI district, faces serious obstacles. This is especially so in the area of collaboration among actors. The low-density score means that the forest fires mitigation network in OKI district lacks cohesiveness. In other words, not all participants are fully integrated into the network. Differences in interests that motivate members to participate in the network may be one of the factors that are attributable to that.

The transitivity score can explain group cohesiveness within the forest fire mitigation network in OKI district. UCINET result showed that the network in Figure 3 has a transitivity score of 3 percent. Transitivity means that if A connects to B, B connects to C, then A will connect to C (AB à BC à AC). In other words, transitivity represents the relationship among the three actors, as well as an indication of the degree of social cohesion and individual embeddedness into the network. A high transitivity score for a network implies that participants in the network are embedded or strongly integrated into it. To that end, a low transitivity score for forest fire mitigation networks in OKI district confirms the previous finding that established low social cohesion.

Besides, Figure 4 identifies the prominent actors in the forest fire mitigation network in OKI district. The size of the box in Figure 4 represents the value of the degree of actor centrality. Based on their centrality scores, the prominent actors in the network are in descending order: TR (The OKI Police Station, red box, with the centrality score of 0.244); IW (the OKI Health Agency, yellow box, centrality score of 0.205); SH1 (the OKI Forestry Agency, light green box, centrality score of 0.179); SF (the OKI Civil Service Police and Fire Brigade, grey box, centrality

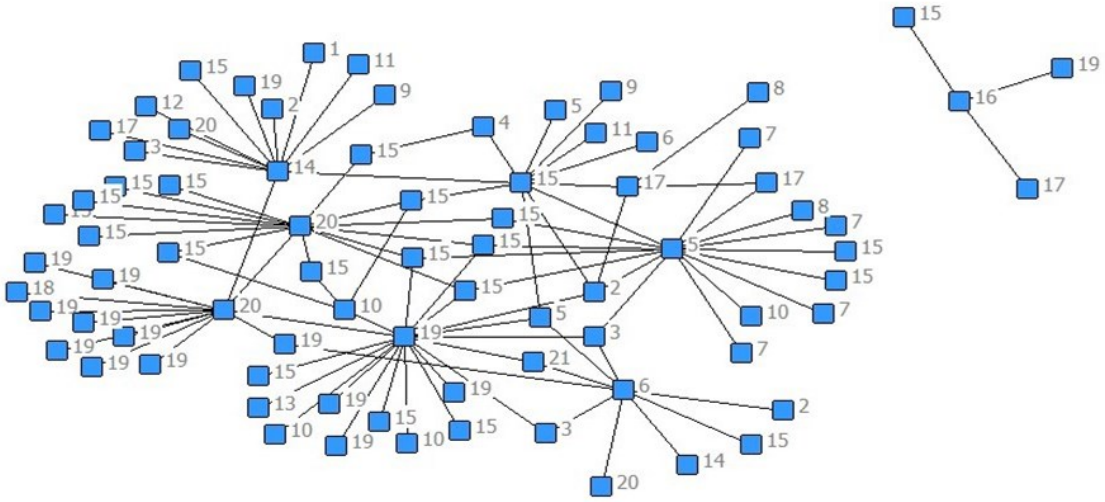


Figure 5. Actor-Network in Forest Fire Mitigation at OKI District Based on Organization of Origin

Source: Output Data Analysis using UCINET 6 for Windows

Legend:

1 The OKI Land Agency (*Badan Pertanahan OKI*)

2 The OKI Environment Agency (*Badan Lingkungan Hidup OKI*)

3 The OKI Disaster Management Agency (*Badan Penanggulangan Bencana Daerah OKI*)

4 The OKI Investment and Licensing Agency (*Badan Perizinan dan Penanaman Modal Daerah OKI*)

5 The OKI Health Agency (*Dinas Kesehatan OKI*)

6 The OKI Social Office (*Dinas Sosial OKI*)

7 The South Sumatera Plantation Office (*Dinas Perkebunan Provinsi Sumatera Selatan*)

8 The OKI Plantation and Farming Office (*Dinas Perkebunan dan Peternakan OKI*)

9 The OKI Transportation, Information, and Communication Office (*Dinas Perhubungan, Informasi, dan Komuniasi OKI*)

10 The OKI Foresty Office (*Dinas Kehutanan OKI*)

11 The OKI Agriculture Office (*Dinas Pertanian OKI*)

12 The OKI Food Security Agency (*Badan Ketahanan Pangan OKI*)

13 The village head (*kepala desa*)

14 The OKI National Unity and Political Agency (*Badan Kesatuan Bangsa dan Politik OKI*)

15 The OKI District Military Command (*Komando Distrik Militer OKI*)

16 Private corporation (*korporasi swasta*)

17 The OKI Forest Fires Brigade (*Manggala Agni OKI*)

18 The South Sumatera Regional Police (*Kepolisian Daerah Provinsi Sumatera Selatan*)

19 The OKI Police Station (*Polres OKI*)

20 The OKI Civil Service Police and Fire Brigade (*Satpol PP & Damkar OKI*)

21 The citizens (*warga masyarakat*)

score of 0.179); SF (the OKI Civil Service Police and Fire Brigade, grey box, centrality score of 0.167); MU (the OKI National Unity and Political Body, pink box, centrality score of 0.154); DI (the OKI Military District Command, orange box, centrality score of 0.141); and AP (the OKI Social Agency, solid green box, centrality score of 0.115). Meanwhile, at the group level, the network has 0.2142 of the degree of centrality.

Theoretically, prominent actors in a network are those who are intensively involved in relationships with other actors or participate in many interactions. It makes them more visible to the others. It also means that prominent actors occupy strategic positions that enable them to control access and control over resources, and broker or intermediate information (Wasserman & Faust, 1994). For example, if TR sends information, distributes resources, or undertakes policy dealing with forest fire mitigation, such actions influence 24 percent of the network space. At the same time, as the recipient of information from other network participants, TR will receive more information than other actors. That pattern, according to the interpretation of the research team, represents and epitomizes a security approach, which has characterized forest fire mitigation in OKI. While there is no doubt that forest fires constitute a security problem, it is to indulge in problem reductionism to consider forest fire disaster in such a perspective. Since 2017, the South Sumatera Police Region has arrested fifteen suspects (twelve village members and two plantation companies) as perpetrators of forest fires (Siregar, 2017). If forest fires are indeed a disaster problem, which is what they are, it is logical and consequential that the OKI Disaster Management Board (*Badan Penanggulangan Bencana Daerah Kabupaten OKI*) should be the most prominent actor in forest fire mitigation network rather than the OKI Police Station.

In OKI forest fire mitigation network, EF (private corporation) is an isolated actor because is only connected to IS (*the OKI Police Station)*, WI *(the OKI district military command)*, and IO (the OKI Forest Fires Brigade or *Manggala Agni)* (Figure 4). The implication is that EF (private corporation) does not have access to the network. Thus, although EF interacts with IS, WI, and IO, the relationships are not integrated into the network. As an isolated actor or being part of an isolated network, EF, IS, WI, and IO cannot participate, control, influence, or collaborate in the forest fire network. Such a situation is contrary to the political commitment which President Jokowi (the President of the Republic Indonesia) and Alex Nurdin (the Governor of South Sumatera Province) made that pledged promoting collaborative management as the underlying principle of forest fire mitigation in South Sumatera Province, including OKI district.

In this network, the village member (HS) and the village head (ST) are not isolated actors. However, the two stakeholders have limited roles in the network. As Figure 3 shows, village member (HS) interacts with the OKI Police Station and the OKI Social Affairs Agency, while the village head (ST) only interacts with the OKI Police Station. This finding corroborates the previous finding that identified the OKI Police station as the most prominent actor in the forest fire mitigation network. The high intensity of interaction between the OKI Police station on one hand and village members the village head on the other serves as empirical evidence that police officers have developed a fire mitigation process based on the security approach at the grass-root level. This is the task that is easy for the police institution to accomplish considering the reach of the institution right from the sub-district level. Meanwhile, the interaction between the village head (ST) and OKI Social Affairs Agency reflects the reality that the Government of

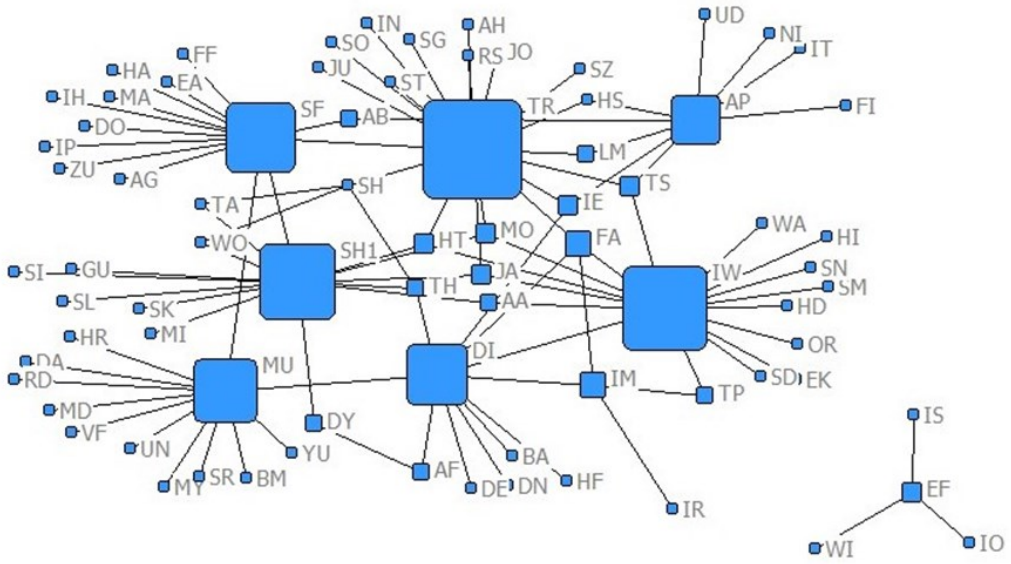


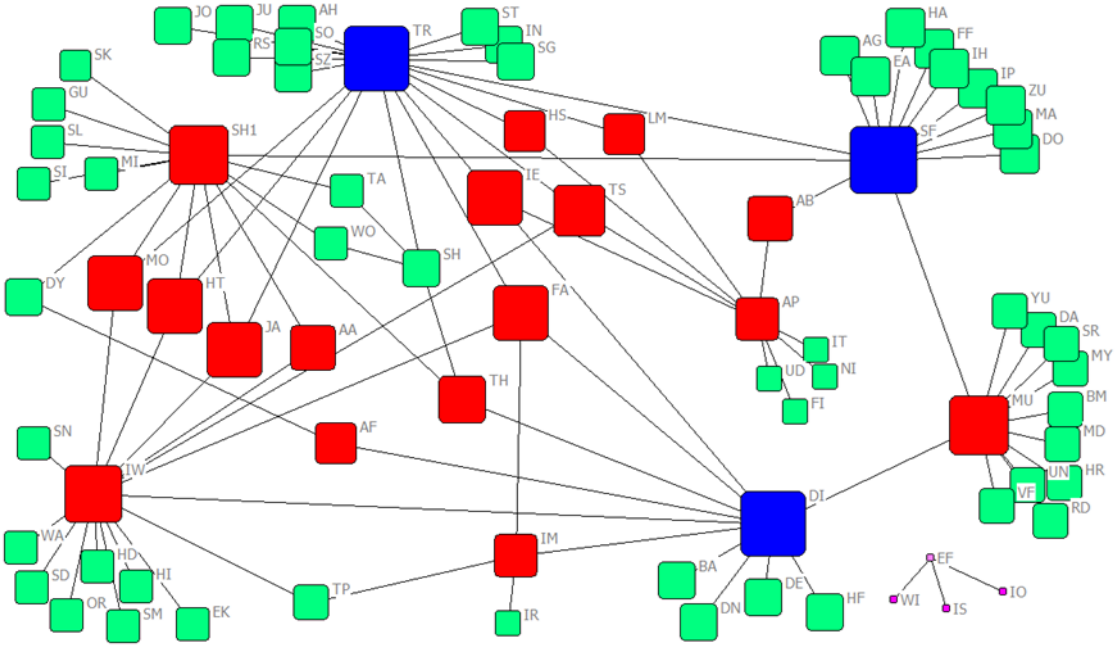
Figure 6. Actor Network based on Centrality Score
Source: Output Data Analysis using UCINET 6 for Windows

OKI District plays a caritative role in forest fire mitigation. For example, the Government of OKI District give basic foods, shelter, and health service to the villagers, especially for the vulnerable group (older people, baby, kids, pregnant woman, and the disable), as the victims of forest fires.

Closeness score is another indicator that can be used to analyze Forest fire mitigation network. As Figure 5 shows, SF (the OKI Civilian police unit and Fire Brigade, 0.411), TR (the OKI Police station, 0.406), and DI (The OKI district of Military Command, 0.402) have the closeness scores that are relatively higher than other actors in the network. Closeness emphasizes the distance of an actor relative to all others in the network (Hanneman & Riddle, 2005). Thus, SF ranks fourth concerning the centrality score. Despite not being a prominent actor, SF is very close to all other actors in the forest fire mitigation network in OKI district. For example, if SF shares a resource with another actor, the process is faster than the moving of a resource from for instance TR or DI. Also, to preventing forest fires, extinguishing fires is one of the main activities in forest fire mitigation.

SF and OKI Civilian police unit and Fire Brigade play vital roles in extinguishing forest fires because they are equipped with requisite resources (fire truck, money, firefighters) to do the job professionally. As SF has the largest closeness score, it has the ability and capacity to send resources in its possession to other actors within the network quickly. Based on this finding, an argument can be made that SF occupies a strategic position in the forest fire mitigation network in OKI district.

Finally, betweenness score is another indicator that can describe the nature of the forest fire mitigation network in OKI district SF and TR actors have first and second largest betweenness score (Figure 6). The Betweenness score refers to the situation where X has ties to Y and Z. Y has ties to A and B; Z has ties to C and D. Under such a condition, X has high betweenness score, because it has two branch connections, and lies on many geodesic paths (Hanneman & Riddle, 2005). Thus, SF and TR actors are powerful actors because of the dependency of other actors on them to have a connection with other actors in the network. This finding does not only lend the credence to



Note: size and color indicate the value of closeness score

Blue box	:	0.402 – 0.411	Green box	:	0.242 – 0.297
Red box	:	0.304 – 0.382	Pink box	:	0.171 – 0.172

Figure 7. Actor Network by Closeness Score

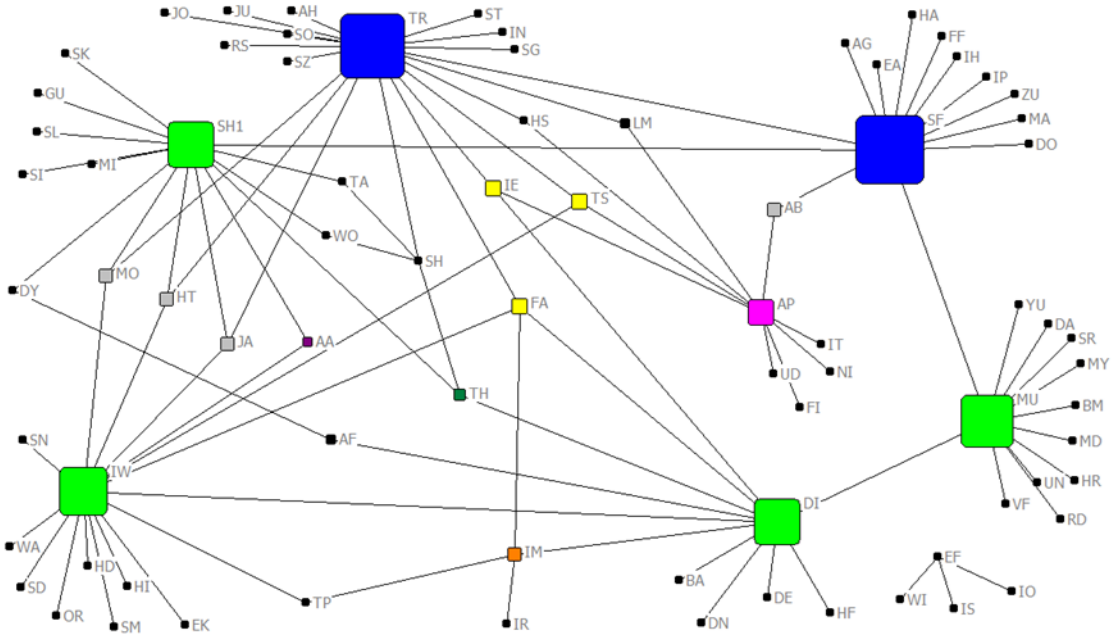
Source: Output Data Analysis using UCINET 6 for Windows

the forest fire mitigation process but is also indicative of the same approach being used in the process of extinguishing forest fires in OKI district.

FINDINGS AND DISCUSSION

Forest fires in Indonesia have become a global public problem because of the recurring nature and impact that has transcended national boundaries. To solve this problem, the President of the Republic of Indonesia implemented a new policy that promotes collaborative management, citizen participation, and law enforcement. In other words, the President of the Republic of Indonesia underscores the importance of adopting a network approach as a strategy to formulate and implement a forest fire mitigation policy. This paper analyzed the existing network of forest fire actors in OKI District.

Findings of this paper showed that the existing network of forest fire actors in OKI district *first*, lack of cohesiveness, because not all participants network are fully integrated into it; *second*, forest fire mitigation in OKI district uses a security approach, which implies that the problem is perceived and managed as a security problem rather than a disaster; *third*, private actors play marginal or peripheral roles in forest fire mitigation network in OKI district because of their isolation from other actors. This is contrary to the new paradigm in forest fire management President Jokowi and Alex Nurdin, the South Sumatera province governor have been promoting since 2015. *Fourth*, although village members and the village head are not isolated actors in the OKI district forest fire network, they play a marginal role, in activities, which is contrary to expectations for an effective forest fire management exercise.



Note: size and color indicate the value of betweenness score

Blue box	:	>30	Orange box	:	2
Red box	:	20 – 25	Grey box	:	1
Pink box	:	10	Black box	:	<1
Yellow box	:	4			

Figure 8. Actor Network Based on Betweenness Score

Source: Output Data Analysis using UCINET 6 for Windows

To that end, the finding in this paper corroborates Purnomo's (2017) finding in Riau province, hence lends support to Purnomo's (2017) argument on the need for involving a diversity of actors in forest fires in Riau Province. However, based on finding in OKI district, the research team does not agree with Purnomo's (2017) recommendation to reduce the power of farmer group organization in implementing an effective forest fire policy. This is because implementing such a policy in OKI district is not necessary given the marginal roles that farmers, village members, farmer organizations, or non-governmental organizations play in the forest fire mitigation network. In any case, such a measure would be in contravention of the need to enhance forest fire management governance by increasing the participation of non-state actors including the small village members, farmer organizations, private corporations, and mass media in forest fire mitigation.

Moreover, the findings in this article are different from Purnomo's (2017) concerning the degree of cohesiveness. Forest fire management networks in OKI district lack of cohesiveness due largely to low collaboration among actors. Based on the analysis results, the local police station and fire brigade unit are the two prominent actors in the network, while village members and the village head, who are representatives of grass-roots actors, have limited access and power in the forest fire mitigation network. Moreover, despite having a vested interest in forest fire mitigation and possess resources that can be used in forest fire

mitigation, private corporations, especially plantation companies are not integrated into the network. Based on this finding, the conclusion that can be drawn is that forest fire mitigation in OKI district is based on a security approach, which is not in line with the nature of forest fires as disaster problems. Thus, law enforcement takes precedence in both roles played and mechanisms used to implement forest fire prevention and mitigation activities. The collaboration of all key actors in forest fire management is secondary in importance. Even though the central government and private corporations have established multi-stakeholder institutions at the village level, such institutions are not fully integrated into the forest fire mitigation network in OKI district. In other words, the design of the forest fire management problem is based on bureaucratic command structure and approaches that are incompatible with a multi-stakeholder collaboration approach.

Our finding has practical implications for various stakeholders involved in forest fire mitigation. *First*, the central government should develop and implement a 'stick and carrot' mechanism to encourage local governments to adopt collaborative management in forest fire mitigation. *Second*, the local government, especially the provincial and district government should reduce the prominence of police officers in forest fire management and at the same time, increase the role of non-state actors, including private corporation, civil society organizations, villager community members, and the village administrations in forest fires management. *Third*, the central and the local government should strengthen the capability and capacity of civil servants to work under collaborative arrangements by incorporating learning such skills on and off the job.

Nevertheless, study findings have some limitations. The findings are based on quantitative research design , hence are not informed by qualitative data from network actors. The use of a descriptive social network analysis without combining it with another theoretical perspective, is another limitation, that future research on the topic can alleviate. Further research on forest fire management network improving the quality of results may be obtained by using probability techniques such as Quadratic Assignment Procedure (QAP), Exponential Random Graph Model (ERGM), and Latent Space Network (LSN) (Cranmer, Leifeld, McClurg, & Rolfe, 2017). A better understanding of forest fires can be enhanced by combining social network analysis with another theoretical perspective in-network literature such as Advocacy Coalition Framework (ACF), Multiple Stream Framework (MSF), or Narrative Policy Framework (NPF). It is a challenge that the research team leaves for future research endeavors on this increasingly pivotal topic, given its relevance to current global efforts to reduce greenhouse gases, global warming and climate change, which recurring forest fires in several provinces in Indonesia are important contributing factors.

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