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Fire economy and actor network of forest and land fires in Indonesia

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ABSTRACT

Forest and land fires are a recurrent phenomena in Indonesia and little progress has been made in reducing their occurrence. The mineral and peat fire in 2015 burnt 2.6 million hectares, mostly in the provinces of Riau, South Sumatra, Jambi, Central Kalimantan, West Kalimantan and Papua, and costed USD16.1 billion as estimated by the World Bank in 2015. Although only 30% of the fire was on peatland area, it had a much higher impact than that on mineral land because of its fire density. Fires in Indonesia are caused by human both individually or collectively. Indonesian President Joko Widodo has committed to reducing fire during his term of office. Government actions have focused on fire suppression, biophysical and technological issues such as canal blocking and an early warning system. Significant actions on the underlying causes of fires such as providing economy incentives for land preparation without burning are rare. We conducted a political economy study of fire and haze to provide policy makers with an understanding of the economic, social and political causes of forest and land fires. The study focused on four districts in Riau Province, which experienced fires and forest transition to palm oil plantations. We collected social, policy and economy data from survey in ex post fire sites and carried out focus group discussions with the key stakeholders. We implemented value chain and social network analyses to the collected data. We found a diversity of actors were involved and gaining benefits from fires. We found that farmer group organizers obtained enormous benefits, as much as USD486 per hectare. These actors influence decision-making processes through their patronage network for their own interests. The networks provide power, support, protection and access to various resources. To effectively reduce fire, governments need to disempower these farmer group organizers through law and policy.

1. Introduction

Forest and land fires in Indonesia are of local, national and global concern (Edwards and Heiduk, 2015). These anthropogenic fires and hazes caused the death of 19 people and half a million of cases of acute respiratory infections in 2015 (Glauber and Gunawan, 2016). However, the premature death was much higher and estimated 100,300 people (Koplitz et al., 2016). They also caused environmental, economic, and public education losses, mostly in Sumatra, Kalimantan and Papua. Seven provinces were severely affected by haze: Riau, Jambi, South Sumatra, West Kalimantan, East Kalimantan, Central Kalimantan and Papua. Of the 2.6 million hectares of burnt area, 33% was peat land with the remainder mineral land (LAPAN, 2015). However, the peat land emitted much more haze compared the mineral soil. It was estimated the total emissions from Indonesian fires in 2015 were 1.2 billion tonne CO_2 equivalent (Huijnen et al., 2016), a figure which may not be balanced by re-growth following the fires (van der Werf et al., 2010). The economic disruption caused by the haze has been enormous. In 2015, the cost of fire and haze was USD 16.1 billion (Glauber and Gunawan, 2016). These losses consisted of water resource damage, carbon emissions, destruction of vegetation, biodiversity loss, health expenses, business travel disruption and the cost of ecosystem restoration. The global effects of the fires included global warming, reduced temperatures and light intensity, and a potential influence on the El Niño Southern Oscillation or ENSO (Harrison et al., 2009).

The fires were ignited by human and exaggerated by dry climatic conditions (Glauber and Gunawan, 2016). For the case of peat, intentional canalization drains and dries peatlands, leaving them susceptible to fire. Peatland need drainage and land clearing often by fire to be adequate for crops such as oil palm to grow. Various actors – small and large – were incentivized by financial benefits to convert forest areas into agricultural land to grow, for example, palm oil and rubber (Suyanto, 2006).

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Fires occurred in both forest and land areas (LAPAN, 2015). Forest areas in Indonesia, amounting to 136 million ha, often have patchy tree distribution. About one third of categorized as production forest area by the government, that is mainly for producing timber, is not well covered by trees (Verchot et al., 2010). The conversion of forest area into palm oil, in particular, was conducted both legally and illegally (Wakker, 2014). High profits from the palm oil business drives this conversion as it benefits various actors (World Growth, 2011).

Fires are often used to clear land for agriculture such as oil palm because this method is cheap and easy. Land conflict, land claiming and lack incentive to conduct land preparation without burning are the causes of fires (Suyanto, 2006). Currently, the demand for land in Indonesia is mostly driven by a global demand for palm oil (Sandker et al., 2007). Palm oil is a lucrative business. Indonesia already provides 52.9% of the world's palm oil supply and aims prolong this success (Workman, 2016). >11.4 million hectares of palm oil plantations produce 27 million tonnes of palm oil for export, reaping revenues of USD 18.6 billion in 2015 (MoA, 2015). Indonesia further plans to allocate millions of hectares of land to agricultural development, including 9 million hectares for smallholders (Cabinet Secretariat, 2015).

The Indonesian government has been attempting to address the problem of forest and land fires for 18 years without great success. Indonesian President Joko Widodo has committed to stopping the production of haze from forest and land fires through, among others, the Peatland Conversion Moratorium of 23 October 2015, the establishment of the Peatland Restoration Agency (BRG) in January 2016 and a plan for a palm oil plantation and mining extension moratorium. However, it is doubtful that these government actions can really reduce fire given its failure for 18 years. The public distrust government institutions due to a lack of transparency (Tacconi, 2016).

This paper focuses on the political economy of forest and land fires in Riau. It highlights how the driver of fire which link to profit, the actors involved, rent-seeking activities and the social networks associated with forest and land fires. It identifies the actors involved and their benefits, through surveys and value chain analyses (VCA), while their roles and relationships with other actors are analyzed using social network analyses (SNA). Economic power is the determining factor in how these actors influence decision-making processes and implementation to work in their own interests.

The research questions were (a) what is the policy environment resulting fire; (b) Who gets benefit from fire and how much? (c) How do the fire actors connect each other and link to decision making processes. Although fire is often perceived as being anthropogenic, there is little literature addressing how actors benefit from it. The research results will be of use to policy makers, civil society organizations, business communities, academics and others, allowing appropriate lessons to be learned and further measures to be executed.

2. Political economic analysis of fires

Political economy views politics as a crucial factor in determining economic outcomes (Drazen, 2000). Specifically, political economy refers to the economic analysis of decision-making processes and their implementation. As such, policy change and the politics of 'who gets what, when and how' are intimately related (Lasswell, 1958). Political economy focuses on how power and resources are distributed and contested in different contexts, and the implications for development outcomes. It is concerned with the interaction of political and economic processes in a society, i.e. the distribution of power and wealth between different groups and individuals, and the processes that create, sustain and transform these relationships over time (DFID, 2009). Governance and political economic approaches are often used to understand and transform national development based on natural resources towards sustainable development. Getting resources out of the ground does not translate into development. Natural resource rents must be collected by government institutions and channeled through the budgetary process so that they can be transformed into productive public assets and sustainable development (Barma et al., 2012).

Actors and their political affiliations need to be scrutinized in natural resource policy reform. In democracy, policy makers need to operate in ways that respond to their citizens' needs and desires, balance special interests against equity and distributional considerations, and generate political backing. Policy makers need capacity to assess the political environment for decision-making and the ability to develop strategies that will obtain additional resources for the policies (Brinkerhoff and Crosby, 2002).

Within a forested landscape, agriculture usually has greater added value than forest, which drives deforestation (Chomitz, 2007). The direct drivers of deforestation differ in each country (Kissinger et al., 2012). In Indonesia, these can be categorized into direct drivers and underlying causes. The direct drivers are natural causes and human activities, including logging, illegal logging, forest fires related to land preparation for forest plantations and estate crops, and mining. The underlying causes of deforestation and degradation are market failures, policy failures, governance weakness, and broader socio-economic and political issues (Contreras-Hermosilla, 2000). Geist and Lambin (2001) review proximate causes of deforestation, which include agricultural expansion, wood extraction and infrastructure extension. The prioritization of development over conservation also clearly causes deforestation (Hansen et al., 2010). Miettinen et al. (2016) have described the land-use change and forest conversion into plantations from 1990 to 2015 in Sumatra, Kalimantan and Peninsular Malaysia.

Forest and land fire related projects have long been carried out in various provinces in Indonesia, with and without bilateral cooperation, and a number of technical, economic, social and political recommendations have been generated (Dennis, 2009). Gaveau et al. (2016) underlined the role of small-scale landholders in causing fires. Ekadinata et al. (2013) stated as small- and large-scale operators, a third category of 'local, midlevel entrepreneurs' has economic and environmental impact on fires in Sumatra.

Carmenta et al. (2011) described the incongruence between the causes of fires and proposed management solutions occurs in countries all over the world. In Indonesia and Brazil, the underlying causes of fires are social-politic problems, while action plans prioritize technical research into firefighting. This hampers efforts to overcome the problem of forest and land fires This problem is also highlighted by Salvini et al. (2014), who reported that 32% of REDD + interventions did not have linkages to direct and indirect causes of deforestation and forest degradation. Regional cooperation and funds, such as the ASEAN Transboundary Haze Fund need to consider the benefits gained from the existence of forests such as timber logging for its additional funding sources (Tacconi et al., 2008). Scientists have an important role in promoting efforts to make forest and land fires a policy priority and a global concern (Ekayani et al., 2015).

Political economy has emphasized the embeddedness of economic activity within larger political institutions. While political economy is highly macro level with the nation-state as its most frequent unit of analysis, SNA operates at a more micro level, with individual actors or firms as its units (Mizruchi, 2006). Networking with powerful people (patrons) to receive support, protection and power to access available resources for receivers (clients), the so-called patronage network, is a common practice in Indonesia, Malaysia and Singapore (Varkkey, 2016). Political actors tend to aggregate into groups to allow them to influence policy within existing institutions (lobbies, parties and government) or against existing institutions (Frieden et al., 2000). Purnomo et al. (2012a) showed that for REDD + actors, networking is a way to get access to power and elites. Van Noordwijk et al. (2014) identified rent-seeking elites among government officials who played important roles in deforestation.

SNA is based on the idea that the most important components of social life the nature of the relations that actors have with one another (Mizruchi, 2006; Borgatti et al., 2013). The network approach

emphasizes that power is inherently relational. Social network analysis methods provide some useful tools for addressing the sources and distribution of power. The network perspective suggests that the power of individual actors is not an individual attribute, but arises from their relations with others. Power arises from occupying advantageous positions in networks of relations. The main approach that social network analysis has developed to study power is the concept of centrality. Degree, closeness and betweenness centrality describe the locations of individuals in terms of how close they are to the "center" of the action in a network. Degree centrality emphasizes having more ties to other actors may be advantaged positions. Closeness centrality emphasizes the distance of an actor to all others in the network by focusing on the distance from each actor to all others. Betweenness centrality views an actor as being in a favored position to the extent that the actor falls on the paths between other pairs of actors in the network (Hanneman and Riddle, 2005).

Centrality in the social network reflects power and status. Brokerage or 'betweenness' is a good predictor of the opportunity for taking advantage of 'structural hole' benefits. A structural hole is a gap between two individuals who have complementary sources to information. The between-group brokers are more likely to express ideas, less likely to have ideas dismissed and more likely to have ideas evaluated than those who are not at that position (Burt, 2004). An individual or group who acts as a mediator between two or more closely connected groups of people can gain important comparative advantages. Using SNA in fire actor chains, we aim to identify the most powerful and most benefited actors. Brokers in value chains of forest products obtain significant benefits (Purnomo et al., 2014). Van Noordwijk et al. (2008) describes the contribution and benefit of different actors in carbon credit value chains under REDD + initiatives. Rent seekers often sit in important positions in networks; another underlying contributor to land and forest fires.

VCA is frequently used to understand the distribution of benefits and added value to actors participating the product chains. VCA is used to understand how added value and benefits are distributed between each actor along production and marketing value chains (Herr et al., 2006). VCA describes activities that are required to bring a product or service from conception or design, through different phases of production, to delivery to final consumers and disposal after use (Kaplinsky and Morris, 2001; Schmitz, 2005). A value chain provides a systemic view of a particular product. New values will be added over time, and existing areas of value will be eroded through the forces of competition (Schmitz, 2005). Per actor added value can be calculated using benefit and cost analyses.

3. Methods

3.1. Research sites

The province of Riau was selected for this research because it experiences the most frequent fires in Indonesia (Sizer et al., 2014). Riau has experienced massive forest conversion to palm oil plantations, with the greatest area of palm oil plantation in Indonesia. Fire in Riau regularly impacts the whole region, particularly Malaysia and Singapore.

We selected sites in Riau to observe post-fire occurrences, which mean that fires have happened prior to the research time. Site selection was based on a number of criteria: sites had to represent the largest fire events in 2013 and 2014 (Gaveau et al., 2014). Sites were also representative of the diversity of land ownership (state owned, community or private lands) and forest area. Online mapping of the research sites was developed through CIFOR's GIS at: http://www.cifor.org/map/fire/ (CIFOR, 2015; Gaveau et al., 2014). We identified ten research sites representing large fire occurrences in Riau over the last three years and covering four districts (Bengkalis, Dumai, Rokan Hulu and Rokan Hilir) (Fig. 1).

Table 1 shows the characteristics of each site and the respondents that were interviewed. The sites range from private, government and company lands with both acacia concessions and palm oil plantations. In many cases, the land is legally managed by the company, but managed de facto by the community. Community here means local people that are not government official and company staff. Most burnt sites were formally forest area that had been converted into palm oil plantations. These conversions are illegal. For each site, 4–18 respondents were interviewed across radiuses of 3, 5 and 7 km from the fire occurrence. The respondents were those who knew about, and had experienced, the fires and were available to be interviewed. Some people in the area were unwilling to participate because of the illegality of fire and the risks of speaking out against illegal land occupants, burners and palm oil owners. In total, there were 131 respondents, comprising village government officials, customary leaders, company staff, police, farmers, plantation workers and owners, community members and community organization staff.

3.2. Data collection and analyses

To answer the research questions we collected data and information in two categories. Various meetings and focus group discussions (FGD) answered the question on policy environment resulting fires. Field data collection answered the questions of who the fire actors, benefits and their network. Through their network we identified their policy influences.

We collected contextual data on the Riau fires from bilateral discussion with key fire stakeholders at provincial level in February and March 2015. These discussions were held to elucidate the context and policy direction adopted at provincial level to reduce fires. These stakeholders represented government, business enterprises, civil society organizations, non-governmental organizations (NGOs) and academic researchers. Bilateral discussions were conducted with representatives from the Provincial Forestry Office, Plantation Provincial Office, Provincial Planning Development Agency, Provincial Central Statistics Agency, the acting Governor of Riau and commercial sectors, including large groups of palm oil and acacia plantations. This bilateral meeting was followed by a multi-stakeholder meeting, held on 26 March 2015 in Pekanbaru. The aim of this meeting was to collect perspectives and concerns about fire in Riau. The meeting involved 70 participants, including representatives from the district government, provincial government, MPA (*Masyarakat Peduli Api* - communities concerned with fire), disaster agencies, NGOs, academics and the private sector. During this phase, we also collected reports and statistical information to support the research. From these meetings we identified the current conditions and policy environment resulting fires.

We conducted a FGD with members of JIKALAHARI (a network of environmental NGOs) comprising WALHI Riau (Friends of the Earth Indonesia), WWF (the World Wildlife Fund) Riau and JMGR (Network of Riau Peat Communities) specifically to scrutinize fire actors and their network. Eleven people participated in the FGD.

Field data was collected from ten research sites in four district of Riau. We interviewed 131 respondents across these radii, including representatives of farming communities, farmer group organizers, village officials, village traders, police officers, local employees of palm oil and acacia companies, local NGOs and brokers involved in land transactions. Information was collected on forest conversion, causes of fire, land tenure, land transaction, cost and revenue from land transactions and palm oil development after burning. All respondents were also asked about their connections to others to investigate connections at a local level. These data were then combined with the results of the meetings at provincial level to identify an integrated network of fire actors. The field observations took place from March to June 2015.

Benefit distributions due to fire-related activities among individuals or groups of actors were analyzed using VCA. In this case, we calculated the costs and benefits received by different actors in the fire chain. The chain starts with forest or land claims, connects to fires and ends with palm oil plantations. The roles of actors within the context of how

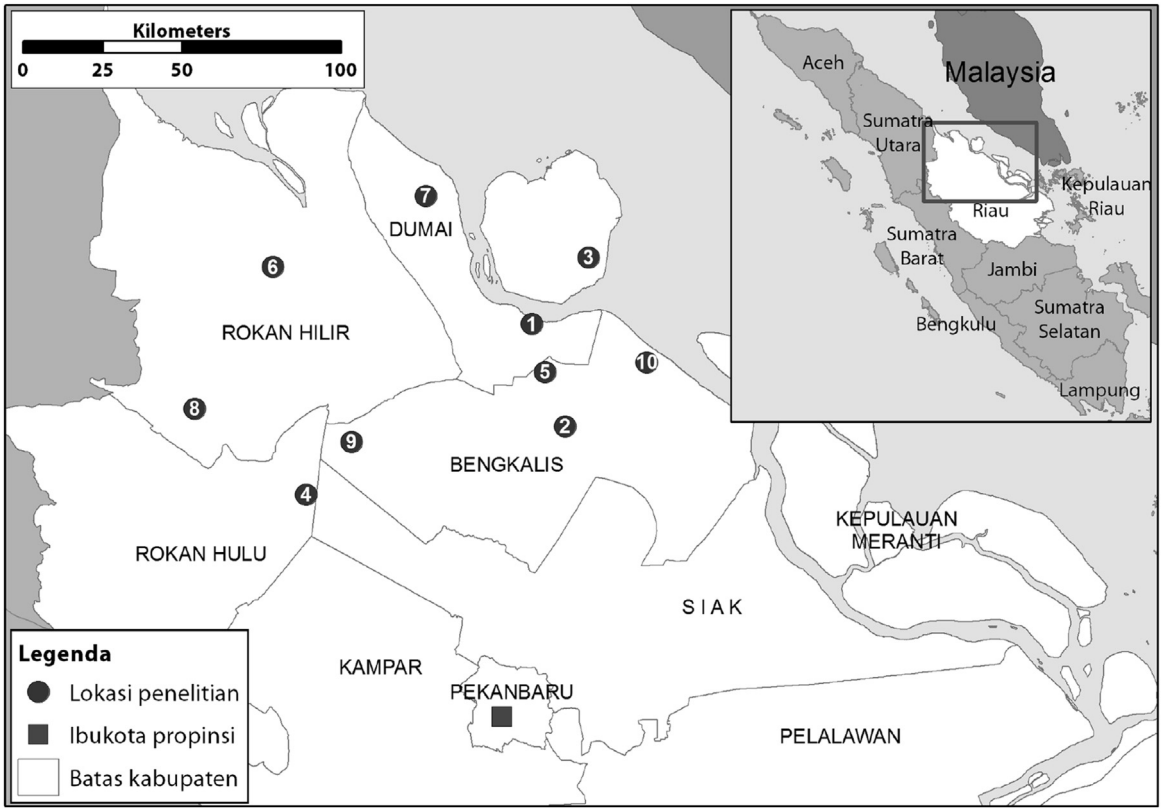

Fig. 1. Research locations in Riau Province.

they are connected to other key actors were analyzed using SNA. The SNA was carried out by producing square binary matrices of paired actors. These matrices covered information exchange between actors; with '1' used to indicate significant information exchange and '0' if there was no significant information exchange. SNAs were conducted using UCINET 6.559 and NetDraw 2.148 software.

4. Results

4.1. The stakeholders' perspective on reducing fires

Fires occurred in concession areas managed by companies, and community land and conservation areas managed by the government.

Table 1
Survey research locations (Sitorus et al., 2015).

No.	Site name	District	Site characteristic			Respondent	
			Fire occurrence	Land ownership	Forest area	Total number	Type
1	Ayu Junaidi	Dumai	2012 and 2014	Private land	No	6	2 government officials, 2 local communities, 2 farmworkers
2	Giam Siak	Bengkalis	2008, 2010, 2013 and 2014	Mixed acacia company and community land	Yes	15	1 head of village parliament, 1 head of sub-village, 4 community members, 3 shop owners, 4 farmers, 1 community organization, 1 company manager
3	Pulau Rupat	Bengkalis	2013 and 2014	Mixed acacia company and community land	Yes	4	4 community members, 1 village government official
4	Rokan Adi Karya	Rokan Hulu	2013	Mixed palm oil company and community land	No	18	2 polices, 3 village government officials, 4 different company staff, 2 shop owners, 7 different plantation workers and owners
5	Satria Perkasa Agung	Dumai	2014	Mixed acacia company and community land	Yes	4	1 company manager, 3 community members
6	Sumatra Lestari	Rokan Hilir	2013	Mixed acacia company and community land	Yes	4	1 Village government head, 4 community members
7	Suntara Gaja Pati	Dumai	2013 and 2014	Mixed acacia company and community land	Yes	10	1 company worker, 4 company staff, 2 community members, 2 plantation workers, 1 local organization
8	Torganda	Rokan Hilir		Mixed acacia company and community land	Yes	12	3 customary leaders, 2 company manager and staff, 5 community members, 2 small shop owners.
9	Tumpuan	Bengkalis	2010	Mixed forest concession and community land	Yes	8	2 village government officials, 3 plantation workers, 3 community members
10	Buruk Bakul	Bengkalis	2014 and 2015	Cooperative areas	Yes	7	2 village government officials, 1 community member, 2 cooperative staff, 2 member of fire concerned community
Total number of respondents						131 people	

Actors often blame each other for causing fires. The government claims that local communities and companies start the fires. Companies blame communities for allowing fires to spread from their land. Communities blame companies' greed in monopolizing the forest and its resources. The government is blamed for unclear spatial planning and a lack of will and ability to enforce laws against land encroachers.

Fire stakeholders included governments, who develop and implement fire policies; business communities that are experienced in using fires; NGOs, who actively engage on fire issues; local communities, who engage with fire suppression issues; and academics, who are actively researching fires. The stakeholders shared the concern that effective measures for reducing fires are needed. The discussions covered the spectrum from fire prevention to suppression with different measures being suggested by the participants. There were three clusters of fire measures proposed: biophysical, socioeconomic and legal.

Remote sensing and satellite technology must be used to detect and monitor fires. More importantly, technology should be used to improve coordination, prevent, monitor and mitigate fire spread; for example, using social media such as BlackBerry Messenger and WhatsApp. On the ground, the drainage of peatland by digging canals is not properly managed by forest concessionaires; this has contributed to the occurrence and spread of fire in the past. Canal blocking to improve water management in the peatland as will prevent further degradation and reduce the fire risk. In line with this, the acting Governor of Riau, proposed blocking 1000 canals to reduce fire.

From a socioeconomic perspective, there was concern that unclear spatial planning incentivizes forest land claims by people who will use fires to develop agriculture. The palm oil industry provides a good income for communities, as well as economic growth for the district. Alternative livelihoods are needed to support local economies. Land tenure conflict between plantation companies and local communities can escalate and result in incidences of arson. However, the government allocates few resources to local communities for fire suppression.

From a legal perspective, weak law enforcement provides little incentive to big companies to comply with government regulation. The private sector does take action to reduce fire on their concessions, but neglects fire in neighbouring areas. Although it is experienced in monitoring, preventing and fighting fires, fires still occur in both palm oil and acacia plantations.

All stakeholders agreed that fire suppression would not be effective in combating fire, since fires are usually extensive and produce a toxic haze. A shift from fire suppression to fire prevention is required. Stakeholders realized that the lack of technical land management and satellite monitoring of fire are not the only causes of fire. A better understanding of the underlying political, social and economic causes of fire is needed for effective fire prevention.

4.2. Land transactions, fires and added value

Fires occurred on various land types: community land, forest estate and industrial concessions. In some places, they were located far from settlements (locations 5 and 7 in Fig. 1). Areas impacted by fires were inhabited by local communities of various ethnicities: Malay, Sakai, and immigrants from North Sumatra, West Sumatra and Java. The age of a settlement was a determining factor for fires, with new settlements tending to contribute to extensive burnt areas, some of which resulted from settlement expansion (locations 3 and 4).

In addition to demographic factors, most of the locations observed had links to previous illegal logging. Fires had started as a result of land claims, slashing, burning, and the establishment of palm oil and acacia plantations. Land claims in the observed locations have occurred since, at least, 2004. Initially, land claims were sporadic, but became widespread between 2005 and 2008, and have continued to date. Land claims have involved local communities or groups posing as local communities. Actors involved in illegal logging knew which locations were not subject to claims or, in the case of former logging concessions, had been abandoned by their proprietors. Such places, categorized as open access areas, have become the objects of land disputes and conflicts.

Land claims include the following processes: communities scrambling to claim and sell land (location 2); working together to clear land (locations 1, 7 and 10); new settlements (location 4); overlapping land claims in concession areas (location 6); and overlapping claims between local communities and land mafias (location 5, 7 and 9). The driving actors include *oknum*[1] of village heads, former forest concession employees and public figures. Once claimed, land was commonly sold for cash income with small parcels kept for offspring (locations 1, 2 and 8). Land transactions involved small- and large-scale buyers. For small-scale transactions (<25 ha), buyers were able to meet with sellers directly, whereas large-scale transactions involved other actors. In large-scale transactions, land was divided into blocks (100–1000 ha) and sub-blocks (50–100 ha), then divided further to the relevant scale for individual ownership, i.e. 2 ha. To certify these 2-ha plots, the actors involved needed to fabricate farming groups made up of fictitious individual farmers with 2-ha plots. The establishment of farmer groups was an important characteristic of land acquisitions and land claims in the locations observed.

Many actors have interests in land and forest fires, either in preventing, overcoming or seeking benefits from them. These actors are listed in Table 2.

The condition of land being traded was adjusted to buyers' demands; some buyers demanded ready-to- plant land (cleared, slashed and burnt), some buyers demanded land that had only been cleared and slashed; while others demanded ready-to-harvest land (already planted with oil palm). Buyers came from various levels: colleagues and family members, resident immigrants, company staff, village officials, business people and residents from nearby district towns. Networking also involved buyers from other islands, for example, medium-scale investors from Jakarta, Bogor or Surabaya. Using word-of-mouth marketing strategies, they sent marketing teams to areas with more potential buyers and land brokers.

Traded lands were supported with deeds issued by village officials to assert their legality. Village officials issued SKTs during the land claim phase, and SKGRs in the transaction phase (see Table 2). Sub-district officials were also involved in administrative processes surrounding land transactions, particularly in issuing SKGRs, which hold more sway with a sub-district head's signature. The costs involved in making SKT and SKGR documents for 2-ha plots of land were around USD 75 and 150, respectively.

Cleared land (cut and slashed) was worth USD 665/ha and sold in the form of 2-ha blocks. Added value for land consisted of the following: 26% for farmer groups in the land clearing phase; 4% gained by claimers for their efforts in claiming the land; 6% of the total value of the land for marketing, including travel, communications and other costs; and 13% of the total value of the land gained by village officials for land administration documents; with the organizers of farmers groups gaining the highest value at 51%. Based on information on the ground, there were no clear patterns for benefit sharing between farmer group organizers and other organizers. However, the organizers of farmer groups usually gained more benefits than any others (see Fig. 2).

When buyers bought only cleared (slashed) land, they would be responsible for land preparation. They might burn it or use mechanized tools for this. The marginal cost of land preparation would thus benefit the buyers.

Higher values were obtained from 'ready-to-plant' land, which had already been slashed and burnt. Local people call this mode of trading '*terima abu*' (receiving the ashes). The distribution of benefits for actors

[1] *Oknum* is a common term in Indonesian and is generally used to describe rogue individuals in organizations, including those categorized in institutional economics as free riders and rent seekers.

Table 2
Actors (stakeholders) with various interests in land and forest fires.

No.	Actors	Descriptions	Roles
1	Land claimers	Individuals including village officials; youth and customary leaders; former illegal loggers	Individually or collectively identify neglected (open access) state-owned areas, i.e. ex-HPH or non-operational concession areas; mark the boundaries of claimed land; organize block certification and ownership documents
2	Farmer group organizers	Land claimants; members of political parties; public figures	Assemble and organize farmers and villagers to be listed as group members; together with village and sub-district officials organize land administration and documentation; delegate tasks to group members
3	Farmer group members	Farmers; local people; family members of farmer group organizers	Secure or safeguard claimed land from other claimants; participate in land clearing; secure free/inexpensive land
4	Land marketing teams	Members of farmer groups who act as land marketers	Identify potential buyers and supply them with information on the land; negotiate land transaction processes
5	Village officials	Village heads (*Kades*); village secretaries (*Sekdes*); administrative coordinators (*Kaur*); neighborhood heads (RT/RW)	Facilitate administration management relating to land documentation, i.e. SKTs[a] and SKGRs[b]
6	Sub-district government officials	Sub-district heads (*Camat*); sub-district secretaries (*Sekcam*); divisional heads	Facilitate administration management relating to land documentation (SKTs, SKGRs)
7	District governments	–	Manage land administration at the district level
8	Provincial government	–	Manage land administration at the provincial level
9	Ministry of Environment and Forestry (KLHK)	–	Issue permits for forest areas; manage and conserve forest areas
10	Brokers	Public figures; members of political parties; village officials	Act as sources of information for land sellers and buyers; connect land sellers and buyers; buy land at a low price and sell it for a higher price
11	Small-scale land buyers (<25 ha)	Company staff; families of farmer group members and organizers; local traders, heads of political parties; government officials	Buy land for cultivation or as an asset or property
12	Large-scale land buyers (≥25 ha)	Large companies; district/provincial officials; traders from other islands	Buy land for industrial cultivation purposes as a plantation area, mostly for oil palm
13	Small-scale palm oil businesses	Company staff; colleagues or families of farmer group organizers; local traders; heads of political parties; government officials	Develop oil palm plantations on claimed land of <25 ha
14	Large-scale palm oil businesses	Large companies; district/provincial officials; traders from other islands; company managers	Develop oil palm plantations on claimed land of >25 ha
15	Advocacy organizations	Local and national advocacy NGOs; universities, the media	Provide information and awareness to communities on social and environmental problems; encourage relevant stakeholders to seek solutions to resolve these problems
16	Civil society organizations	Community organizations; universities; NGOs	Conduct studies into social problems; build social awareness
17	Donor institutions	DFID, JICA, EU	Support civil society strengthening; support programs relating to natural resource governance
18	Land corporations	Palm oil companies, industrial plantation forest companies	Create and manage land investments that provide benefits to investors
19	Research institutions	Universities, research organizations (CIFOR, ICRAF, BPPT, FORDA, etc.)	Conduct studies into social and natural resource problems; provide alternative solutions from scientific and academic viewpoints
20	Regional disaster management agencies (BPBD)	District-level government institutions related to provincial and national disaster management agencies (BPBN)	Manage all forms of natural disasters in the district

[a] *Surat Keterangan Tanah* (SKTs) are letters issued by village governments explaining the details of the land.
[b] *Surat Keterangan Ganti Rugi* (SKGRs) are letters from village governments explaining land compensation.

involved in *terima abu* is shown in Fig. 3. The trading value was USD 856/ha. Farmer group organizers promised their members would gain parts of the land for free or at a reduced price. This cost about 0.2% of the total value. The distribution of added value was nearly the same as in Fig. 2. Farmer group organizers gained 57% of the total value or around USD 486/ha.

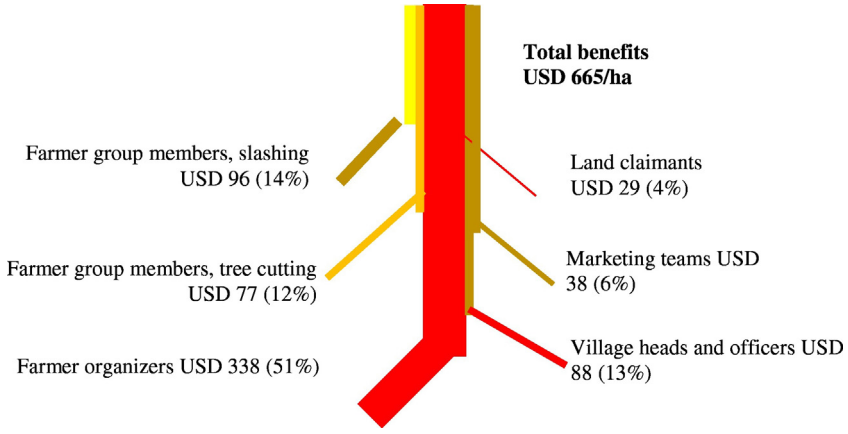

Fig. 2. Added value of cleared land per hectare.

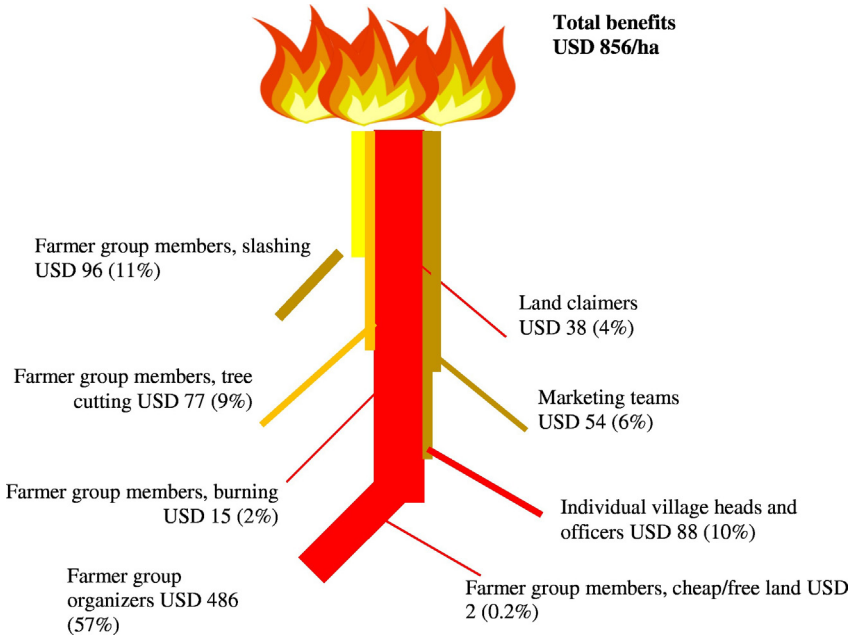

Fig. 3. Added value for 'ready-to-plant' land per hectare.

'Ready-to-plant' land was not only sought by palm oil investors but also by small-scale investors for horticultural purposes. It was easier for small to medium investors to buy 'ready-to-plant' land due to its lower price and the flexibility of managing growing costs. Other investors, preferring more practical means and quicker profits, were willing to pay USD 3077/ha for ready-to-harvest oil palm plantation land (see Fig. 4).

Around USD 992 or 32% of the total value was allocated for planting and growing costs for 3–4 years. Laborers received around 7% and 5% of the total value, respectively, for land clearing and planting. Benefits gained by individual village heads and sub-district officials amounted to 3% of the total value. Land-block letter or 'certificate' holders would only gain 1% of the total value, an extremely small amount for those not involved in group management. Farmer group organizers carried out management, administration and marketing processes and gained the largest share at 51% of the total value.

4.3. Social network of forest and land transaction and fire stakeholders

Stakeholders in forest fires are related to one another in various contexts: information exchange, economic transactions, kinship, political affiliation, ethnicity or religion. Each of these relations can be independent or mutually reinforcing. Centrality determines the importance of actors in the network, which is measured by degrees of connectivity and betweenness. The degree of centrality measures the quantity of relations, such as information received or sent out from each node or

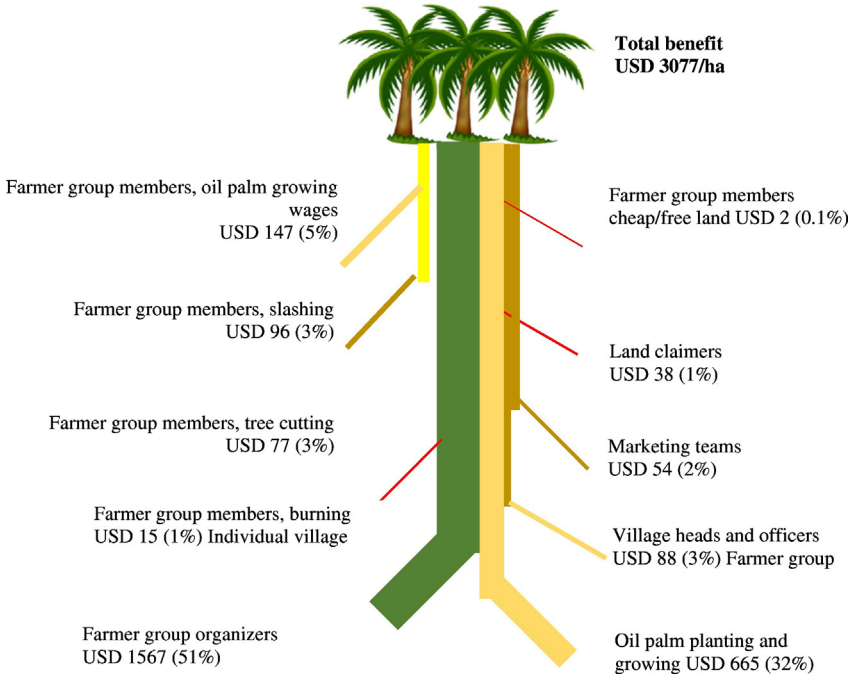

Fig. 4. Added value added of oil palm land per hectare.

actor, while betweenness measures an actor's role as the shortest path (geodesic link) between two other actors.

Degrees of centrality in land transaction and fire information networks are shown in Fig. 5. Higher degrees are indicated by larger circles. There are four actors with high degrees of connectivity, namely village governments, sub-district governments, district governments and advocacy groups. Connectivity is the amount of received information (in-degree) or outgoing information (out-degree). The lowest degree belongs to farmer group members, which indicates they are the most isolated actors in forest fire information traffic. Appendix 1 provides the detail of centrality degree results.

The crucial roles of actors in linking information to other actors are shown in Fig. 6. Larger circles indicate a greater role as an information hub between actors in land transactions and fires. Farmer group organizers and advocacy groups are the two most important actors in linking with other actors. Farmer group organizers are central hubs for other actors in land transactions connected to fires. Appendix 2 provides the detail of the betweenness results.

5. Discussion

Efforts to tackle forest and land fires have been, and still are, initiated by various stakeholders (Jalil et al., 2014). This research aimed to determine the actors with interests, added value and information networks surrounding fires at the local level, based on value chain and social network analyses. This research found 20 types of actors associated with fires. Per-hectare added values were USD 856/ha for 'ready-to-plant' land and USD 3077/ha for ready-to-harvest land for palm oil plantations. Local governments and advocacy groups play important roles in receiving and sending out land transaction and fire information, while farmer group organizers play an important role in linking information flows in a social network surrounding forest and land fires (Purnomo et al., 2003a).

The large amounts of economic rent involved bring negative impacts for natural resource development. There are illegal aspects to the accumulation and pursuit of economic rent. The burnt areas are land and state forest areas, the use of which is regulated by laws. Fire brings losses for society and the majority of people. The economic rent surrounding fires is legal only when they occur on privately owned land and are supported by law. A zero-burning policy is advocated by many stakeholders, while others doubt it is possible (Tacconi et al., 2008). In some parts of Indonesia, traditional, limited and controlled burning remains an integral part of land-clearing law. Land claims occurring in the lead up to forest fires are often carried out illegally. However, illegal economic rent provides a livelihood for some sections of communities as well as people at the local and national levels.

The magnitude of economic rent involved indicates that fires generate huge income for certain people, particularly for elites governing farmer groups, for their contributions to land clearing, and for oil palm investors developing areas in the aftermath of fires. Putting a stop to forest and land fires will mean ending the economic rent for such people. Legal, economic and social approaches are crucial in order for this to happen.

The economic approach argues that it is necessary to unravel the livelihood dependency problems of people, i.e. farmers and farmer group members, on land resources. Unlike ruling elites, farmers do not gain enormous benefits from forest and land fires compared to the other actors. Farmers obtain the burnt land free or at a very low price. Obtaining free land would be very significant capital for their farming.

Farmers' involvement in fire networks also indicates they have yet to realize the benefits of forests as environmental services. The effectiveness of REDD+, PES (Payment for Environmental Services) and other sustainable development mechanisms is key to guaranteeing forests are able to compensate their livelihoods (Purnomo et al., 2012b). The failure to understand the political economy (Dauvergne, 1998), actors and their patronage network has often resulted in the failure of attempts to resolve the problem of forest and land fires (Varkkey, 2013). Key facilitators of the fires include businesses and political ruling elites at local, national and regional levels (Varkkey, 2016). These actors form a patronage network to obtain power, support and protection from the government and political elites allowing them to access available resources including forest and land (Varkkey, 2016).

The legal approach means terminating illegal fires. The claiming and burning of land occurs in areas that are not properly managed, either intentionally or unintentionally, or are open-access areas, such as former forest concessions, and disputed and abandoned areas. Clear spatial planning is a necessary precondition to law enforcement (Purnomo et al., 2003b). Clear and secure spatial plans would guarantee every hectare of land is owned and managed by specific actors. This enforcement should be applied at each level of government, i.e. village, sub-district, district and province. If there are no legal guidelines at the provincial level, then governance innovations at lower levels are essential.

The legal approach alone is not enough to tackle forest and land fires. The distribution of economic rent also shows actors interested in policy development and the implementation of fires (Purnomo and Mendoza, 2011). Actors who benefit from fires will have an incentive to continue.

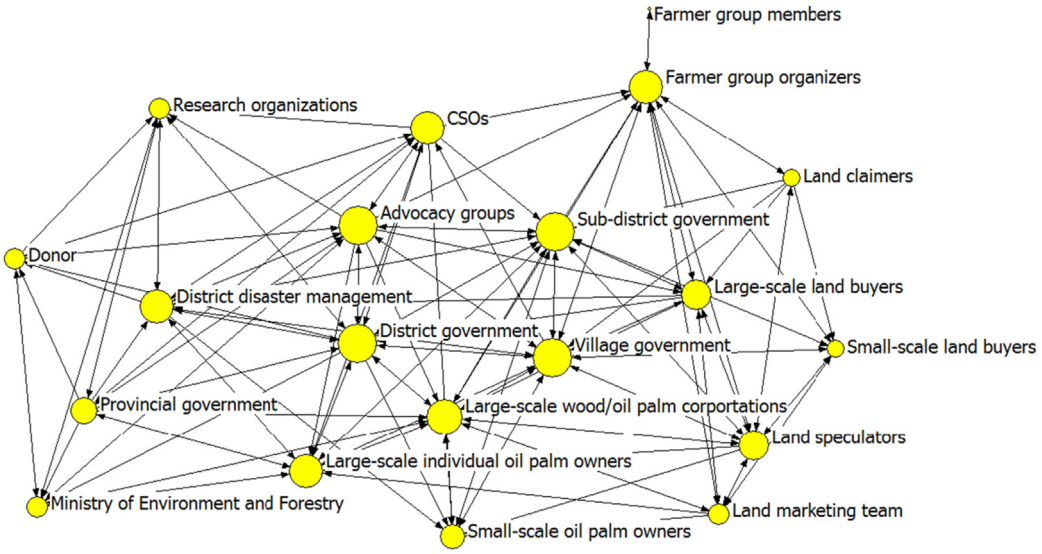

Fig. 5. Centrality information network for land transaction and fire stakeholders.

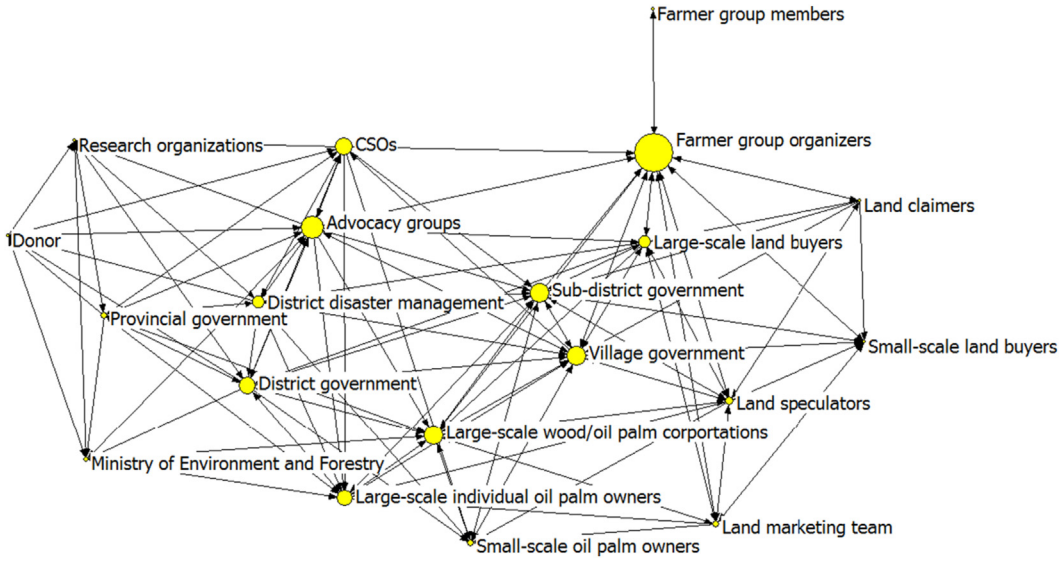

Fig. 6. Betweenness information network for land transaction and fire stakeholders.

As long as fires create more economic value than REDD + or PES, then those actors will not feel incentivized to overcome or tackle fires.

Policy interventions should focus on central actors in land transaction and fire information networks, namely local governments (village, sub-district and district) and advocacy groups. The information networks position them as the most important actors playing roles in preventing and overcoming fires. Elites ruling farmer groups are the most important actors in linking whole networks. At the same time, these ruling elites are also the biggest recipients of economic rent from land clearing for oil palm plantations. In other words, in order to create effective efforts to prevent and overcome forest and land fires we must start from the network core that involves these ruling elites.

This research helps make a difference in the policy approach to forest and land fires by prioritizing a strategy of prevention rather than firefighting. Institutional reinforcement at the local and national levels will also be necessary in order to implement policies that comprehend economic rent distribution and the actors involved in land transaction and fire information networks.

6. Conclusion

Fire actors – large and small – are involved in burning land and forest. These actors benefit directly and indirectly from the business of fire, enjoying profits and economic rents at the expense of environmental quality. Our findings show that the value of land cleared by fire is USD 665 per hectare, which increases to USD 856 per hectare when it is burnt, and USD 3800 per hectare for land planted with oil palm. Money from land cleared by fire is mostly distributed to local elites at the district level, who manage land transactions and organize farmers, and local community members, who engage in burning. Local elites receive 68% of the revenue while individuals who burn land get 22%. Village elites who administer land documents obtain 10%. These actors exchange information and form complex social networks that can influence decision-making processes at district, national and regional levels. These elites form protective patronage networks, which hinder the government's capacity to allocate economic resources efficiently, enforce the rule of law and maintain justice for all citizens. Patronage networks, profits and high market demand for oil palm incentivize the use of fire and will result in fires and haze continuing to occur every year. Reducing the incentives for large and small-scale actors to burn land is crucial. Market demand for illegal land for plantations must be reduced and eliminated. Transparency, civil society engagement, anti-corruption measures and an efficient government bureaucracy will reduce the effectiveness of patronage networks.

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Appendix 1. Centrality degree measures

No	Actor	Degree	Normalized degree
1	Land claimers	6.000	0.316
2	Local elites	11.000	0.579
3	Farmer group members	1.000	0.053
4	Land marketing team	7.000	0.368
5	Village government	13.000	0.684
6	Sub-district government	13.000	0.684
7	District government	13.000	0.684
8	Provincial government	9.000	0.474
9	Ministry of Environment and Forestry	7.000	0.368
10	Land speculators	10.000	0.526
11	Small-scale land buyers	6.000	0.316
12	Large-scale land buyers	10.000	0.526
13	Small-scale oil palm owner	8.000	0.421
14	Large-scale individual oi	11.000	0.579
15	Advocacy groups	13.000	0.684
16	CSOs	11.000	0.579
17	Donor	7.000	0.368
18	Large-scale wood/oil palm	12.000	0.632
19	Research organizations	7.000	0.368
20	District disaster management	11.000	0.579

Appendix 2. Betweenness measure

No	Actor	Betweenness	Normalized_Betweenness
2	Farmer group organizers (local elites)	23.255	13.599
15	Advocacy groups	12.428	7.268
6	Sub-district government	10.589	6.192
5	Village government	10.589	6.192

(continued on next page)

(*continued*)

No	Actor	Betweenness	Normalized_Betweenness
18	Large-scale wood/oil palm corporations	10.408	6.087
7	District government	9.001	5.264
16	CSOs	8.974	5.248
14	Large-scale individual oil palm owners	7.570	4.427
20	District disaster management	6.054	3.540
12	Large-scale land buyers	5.293	3.096
10	Land speculators	3.758	2.197
13	Small-scale oil palm owners	2.583	1.511
4	Land marketing team	2.127	1.244
8	Provincial government	1.793	1.048
9	Ministry of Environment and Forestry	1.209	0.707
11	Small-scale land buyers	0.536	0.313
17	Donor	0.333	0.195
19	Research organizations	0.333	0.195
1	Land claimers	0.167	0.097
3	Farmer group members	0.000	0.000

Descriptive statistics for each measure

		Betweenness	Normalized_Betweenness
1	Mean	5.850	3.421
2	Std dev	5.733	3.353
3	Sum	117.000	68.421
4	Variance	32.871	11.242
5	SSQ	1341.879	458.903
6	MCSSQ	657.429	224.831
7	Euc norm	36.632	21.422
8	Minimum	0.000	0.000
9	Maximum	23.255	13.599
10	N of obs.	20.000	20.000

Network Centralization Index = 10.71%.

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