



Communication networks for rubber marketing in Riau province, Indonesia

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ABSTRACT

The Riau province is one of the largest rubber manufacturers in Indonesia. Ten percent of Indonesia's rubber comes from Riau, and of this, 82.64% comes from community rubber plantations. The main problems experienced by rubber farmers are low-quality rubber, stiff competition for rubber products, and its low price. There are several models used by farmers for marketing: the conventional system, auctions and auctions via associations. The right communication channel/network is important because it provides information to farmers about rubber price and quality for efficient marketing. To analyse the communication network used in the auction system, this study interviewed 127 respondents from two districts in Riau: Kuantan Singingi and Kampar. Findings show that 95% of the farmers come from the productive age group, are high-school leavers and have 1–32 years' farming experience. The cosmopolite level is medium with an average score of 1.81 while 72% farmers have access to 1-2 media, used 4-7 times a month for 0-60 minutes on average in a week. Auctions via associations take the form of a radial personal network, where information flow is open and widespread. Whereas the conventional system and auctions via farmer groups form an interlocking personal network model, where information is often centralized and only reaches a limited number of people in the network.

Keywords: **communication network, rubber farmers, rubber farmer association, auction marketing system, conventional marketing system**

INTRODUCTION

Rubber has a long economic lifespan that can last more than 30 years, if managed properly (Qi, Zhou, Xie, & Wu, 2014). People in Riau have a long tradition with rubber planting, and the commodity has been long developed by the Riau provincial government since 1975. However, with the decline of rubber price, many rubber farmers started converting their rubber plantations to other commodities such as oil palm. Beginning 2009 however, the Riau provincial government started providing seedlings and production facilities to revive an old rubber replanting program and motivate farmers to plant rubber again.

The Riau province is the third largest rubber manufacturer in Indonesia, after South Sumatra and the Jambi province. About 82.64% of rubber (307, 901 tons in 2017) in Riau comes from community plantations (310, 121 ha) (BPS Statistics Indonesia, 2018). However, the main problems experienced by farmers are the low quality of rubber, stiff competition for rubber products, the weak position of farmers in marketing and its low price. Therefore, it is imperative that the government continues to improve the rubber marketing system and make it more efficient.

In developing countries, such as Indonesia, the problems of small farmers are low market and financial access, low-quality human resources, and weak information flow (Food and Agriculture Organization (FAO), 2017) and the limited information obtained by farmers from extension agents (Ali, Man, Abd Latif, Muharam, & Zobidah Omar, 2018). The use of communication technology (Lwoga, Stilwell, & Ngulube, 2012) can address these issues. The information received must also be complete so that it can be of use to farmers (Mbagwu, Benson, & Onuoha, 2018).

There are currently three marketing models for rubber marketing in Riau. The first is a conventional system whereby farmers sell directly to the collector/buyer. The second and third are both auction systems but the former is through farmer groups while latter is via farmer associations. Both the conventional system and auction through farmer groups are common in some districts in Riau while auctions via the farmer association (formed in 2018) only exist in the Kuantan Singingi district. This marketing model improves the bargaining position of farmers to get an equal price as the auction determines one auction winner and one price at the same time and place. Therefore, the initial auction at the sub-district level was moved to the district level under the facilitation of the Kuantan Singingi Rubber Farmers Association.

The implementation of the auction system can help solve the issue of low prices. A well-managed auction system should involve the farmers, helping them secure higher prices. In conventional systems, the average selling price of Rp 6,000–8,000 per kg can rise up to Rp 9,000–10,000 per kg with the auction system for quality rubber. Therefore, relevant institutions such as the Plantation Service need to arrange counselling sessions with farmers to improve the quality of their rubber before being included in auctions. Auction is a form of market where products are sold through the bargaining process in order to get more competitive prices. To achieve the goal of institutional auctions, clear rules are very important. In auctions, it is not only mathematics and rules that come into play but also social science and experimentation. An ideal auction system features at least three characteristics : i) an efficient mechanism to determine the winner, ii) an incentive-compatible mechanism so that participants bid truthfully, and iii) the prices of the items should be set (Iglesias, Lavios & Poza, 2014). Further, Chakravati, Greenleaf and Sinha (2002) highlighted that the psychology of sales is one of the keys to successful auctions. Thus, associations can be the answer to the implementation of more transparent and efficient auctions.

However today, the auction system still has weaknesses, whereby auctions carried out in groups at the sub-district level creates unequal prices. In contrast, auctions carried out by an association results in standardised prices in the district. This type of auction is managed by local

plantation offices together with farmer associations whose members are rubber farmers such as the one found in Kuantan Singingi. This association has a WhatsApp group so that all the farmers get the same information, especially about rubber prices and relevant regulations such as rubber processing methods suitable for producing high-quality rubber, rubber cultivation, and others. This allows accessibility of information for all farmers.

Marketing is the process of selling and buying, which requires farmers to communicate with each other and share information regarding transactions and other matters. Information can be shared through interpersonal communication, that is, a communication network between farmers and market participants. In this regard, the auction forms an important communication network for rubber marketing because it provides information to farmers about the rubber price, rubber quality and more profitable marketing methods.

The purpose of this research was to analyse the communication network used for rubber marketing in Riau. The findings provide an overview of the marketing communication models and individuals involved in rubber marketing, so that it can become a source of reference especially for policymakers in strengthening the bargaining position and income of rubber farmers.

LITERATURE REVIEW

Human beings are social beings who interact with others to fulfill their needs (Mowlana, 2019). Communication network refers to the relationship between communicators which shapes patterns and flows of information (Rogers & Everett, 2003; Lunenburg, 2011; Bohn, Feinerer, Hornik, & Mair, 2019; Ebadi & Utterback, 2008). Further, Castells (2011) added that such communication networks may be a potential force with certain sections of the society in light of its significant role in the adoption and distribution of innovation (Ravi Kumar, Nain, Singh, Chahal, & Bana, 2015) (Ramirez, 2013).

Rogers (2013) defined communication network as the relationship formed between individuals whereby the flow of information and communication is characterised by a certain structure, determined by the cliques and their interconnections. Interpersonal relationship is the unit of analysis used in communication network research. The closeness of individuals who interact with one another and are linked forms a communication network that binds inward (personal interlocking). Conversely, the closeness of linked individuals that spreads outward (radial personal network) represents a low level of integration and is more open to the flow of information and communication from the outside. Such communication networks are important for the process of innovation diffusion (Rogers & Everett, 2003).

Social networks describe the bonds formed between nodes, which represent the type of relationship. The structure of social relations and patterns of relationships that are formed determine the level of importance and behaviour of nodes. There are five characteristics that determine the type of relationship between an individual and a group: equality, social relations, mental relationships, information flow, and transaction flow. To measure the position of nodes in a network with regard to the level of centrality, two approaches are used to collect data in social network studies. The whole network approach measures all existing relationships while the egocentric approach works with a sample selected from the population, and collects the characteristic data in social networks (McGee & Warms, 2013). The individual who creates the network is called a node and the relationship created with others is called a bond (Popp et al., 2018).

In general, there are two types of nodes, namely i) the core role that binds the nodes together in groups, has a major effect on other nodes and occupies a central position in the network. This role is also referred to as a leader in the network; ii) the role of a bridge that

connects the nodes and shows the importance of exchanging information and resources between nodes (Huang et al., 2014).

Concerning the positions of actors in the network, actors who play a decisive role occupy the position of a star, e.g. a broker who can connect two or more groups, a gatekeeper who is able to control the flow of information between a network and its parts; while actors who do not carry any bonding role in the network occupy positions as isolates (Sözen, Basım, & Hazır, 2009).

RESEARCH METHODOLOGY

The research was conducted at Riau's top two rubber producers: Kuantan Singingi district (24%) and Kampar district (15%) (Riau in Figures, 2018). Kuantan Singingi is the only district that markets its rubber using the auction system via its farmer association. Whereas in Kampar, rubber marketing is carried out using the conventional system and auctions are one via farmer groups. Research respondents were selected using the purposive sampling and snowball sampling methods and comprised 79 respondents from the Kuantan Singingi district and 48 from the Kampar district.

Data were collected through questionnaires and field surveys. The respondents were classified into three levels based on certain criteria using descriptive analysis. The communication networks were analysed using a matrix of communication links based on the results of sociometry questions called sociogram analysis with the help of the Ucinet VI software. Sociograms can describe the patterns of communication between networks and actors (Katz, Lazer, Arrow, & Contractor, 2004). The pattern of relationship between farmers can vary, depending on the understanding and perception of farmers on innovation (Oreszczyń, Lane, & Carr, 2010).

RESULTS AND DISCUSSION

Characteristics of respondents

The attitude of an individual as a consumer is influenced by many factors, for example, personal factors, psychological factors, family, culture, social class, and group membership (Ramya & Mohamed Ali, 2016). In the same way, communication behavior and social relations that are intertwined from the results of interactions between respondents are influenced by their personal characteristics.

Table 1. Distribution of respondents based on age

No.	Age (years old)	Percentage (%)
1.	Not Productive yet (<15)	0
2.	Productive (>15–64)	96.64
3.	Not Productive (>64)	3.36
Total		100

In accordance to Indonesia's Labor Law No. 13 (2003), productive age refers to the age range between 15 and 64, while age ranges that are classified as unproductive are under 15 and over 64. Table 1 shows that the majority of the respondents are in the productive age group (96%).

Table 2. Distribution of respondents based on education level

No.	Education Level	Percentage (%)
1.	Low (Elementary school)	17.65
2.	Medium (Junior high school – Senior high school)	66.39
3.	High (Diploma – Bachelor)	15.96
Total		100

Table 2 shows that the majority of respondents are junior or senior high school leavers (66.39%). Those with diploma or bachelor degrees correspond with respondents who hold important positions in the Kuantan Singingi Rubber Farmers Association.

Table 3. Distribution of respondents based on farming experience

No.	Farming Experience	Percentage (%)
1.	Low (1–16 years)	57.14
2.	Medium (>16–32 years)	36.98
3.	High (>32–48 years)	5.88
Total		100

Table 3 illustrates that the majority (57.14%) of the respondents' farming experience are classified as low (1-16 years). In general, those in this category are farmers who have recently only started planting rubber with the assistance of the government. Farmers with moderate (36.98%) and high (5.88%) farming experience are farmers who have long planted rubber, and continue to maintain their rubber plantations.

In this study, *cosmopolite* refers to the farmer's ability in obtaining information about rubber farming and auctions, by networking with extension agents or other sources of information, even sources outside their villages. Based on this, farmers are categorised into three levels: i) low (score 1.00 – 1.65): never read information, mingle with counselors or other sources of information and never travel out of their villages to obtain information about farming and auctions; ii) medium (score 1.66 – 2.31): read information (at least once a week), mingle with counselors or other sources of information (at least once a month) and have traveled out of their villages (at least once or twice a month); iii) high (score 2.32 – 3.00): often read information (at least 3 times a week), mingle with counselors or other sources of information (at least 2 times a month) and have traveled out of the village to obtain information about farming and auctions (every month).

Table 4. Distribution of respondents based on cosmopolite level

No.	Description	Score	Category
1.	Farmers use mass media for information about auctions to market rubber.	1.99	Medium
2.	Farmers network with counselor/ other sources for information about auctions to market rubber	2.49	Medium
3.	Farmers travel to other places (outside their own area) for information about auctions to market rubber	1.22	Low
Average Score		1.81	Medium

Based on the results shown in Table 4, the majority of the respondents' cosmopolite level is classified as medium with an average score of 1.81. This implies that only a small number of respondents make the effort to read, communicate and travel to obtain information

about auctions to market their rubber. Respondents who read information through media is in medium category with a total of 2.17. This means that respondents rarely read information about rubber marketing using auction systems. Not surprising, since on average, the respondents only read information about rubber marketing using auctions through WhatsApp groups, SICOM (Singapore Commodity Exchange—the global pricing centre for rubber trade) or rubber once a week. The results show that the respondents rarely mingled with extension agents or other sources obtain information about marketing rubber with the auction system. It shows that the auction takes place once a week and the association's management meet once a month to evaluate the activities that have been carried out. The number of respondents who traveled to other places to understand better about marketing using the auction system was also low. A possible reason for this is that the average respondent considers exchanges with colleagues from farmer groups as sufficient without the need to travel far outside his region.

Table 5. Distribution of respondents according to media ownership

No.	Media ownership	Percentage (%)
1.	Low (1–2 media)	82.35
2.	Medium (3–4 media)	17.65
3.	High (>4 media)	0
Total		100

Table 5 shows that the majority of respondents (82.35%) have only 2 communication tools, usually smartphone and television; the smartphone is most frequently used by respondents to communicate and obtain information about rubber marketing. Most respondents do not use the television as a source of information because this medium lacks information on rubber marketing.

Table 6. The frequency of media usage

No.	Frequency of media usage	Percentage (%)
1.	Low (0–3 times monthly)	0
2.	Medium (4–7 times monthly)	89.92
3.	High (>7 times monthly)	10.08
Total		100

Table 6 shows that the majority of respondents (89.92%) using their media only 4–7 times a month. Further, respondents used smartphones more often than the television. Television is hardly used as it does not provide any information on rubber marketing and respondents would rather spend their time in their farm rather than home.

Table 7. The duration of media usage

No.	Duration (minutes)	Percentage (%)
1.	Low (0–60 weekly)	72.73
2.	Medium (61–120 weekly)	22.08
3.	High (>120 weekly)	4.19
Total		100

Based on Table 7, the average duration of media usage is classified as low, which is about 0–60 minutes a week. This can be attributed to the lack of media ownership.

The communication network in Kuantan Singingi (rubber marketing using auctions via association)

Rubber marketing is carried out through auctions at the same time and place involving members of the Kuantan Singingi Rubber Farmers Association, that is, all the rubber production groups in the district. Rubber is first collected by each group every Sunday afternoon, whereby the name and address of the group, amount of production, and photos of rubber samples are shared through the WhatsApp group. Collaboration between farmers and relevant organizations, with the help of information and communication technology can be a vital source of information for farmers (Lwoga, 2010). Mobile phone is a popular communication tool that is preferred by farmers to get information on prices, communicate with others and negotiate (Churi, Mlozi, Tumbo, & Casmir, 2012; Timothy, Kilima, Sife, & Sanga, 2016; Chhachhar, Qureshi, Khushk, & Ahmed, 2014).

The auction is then held at 8 pm at the Rubber Farmers Association Secretariat building. It is attended by the management of the Kuantan Singingi Regency Association, representatives from each group and company representatives (buyers). After all the companies (buyers) have bid their price, the highest bidder wins the auction. Communication networks and farmer organizations are two important sources of information (Crawford, Warren, Grossman, & Cabbage, 2015). For farmers in developing countries, the need for information continues to increase because farmers must increasingly make complex decisions (Food and Agriculture Organization (FAO), 2017).

The purchased rubber is weighed by the winning company representative (buyer) on Monday by 2 pm latest. For consistency of quality, the following standards are agreed to:

- The rubber is dried and not soaked;
- The rubber is clean and should not contain impurities of any kind; and
- The recommended coagulants are *semur* acid, vinegar and deorub. Fertilizers and other coagulants are not allowed or recommended.

The communication network analysis conducted on the respondents from Kuantan Singingi who market rubber using auctions via its association yielded an overview of the communication structure that exists between respondents in the form of a sociogram (Figure 1). In the sociogram, the arrows that connect respondents represent the interactions that occur between them. The sociogram also illustrates the direction and intensity of communication that occurs as indicated by the direction of the reciprocal arrows.

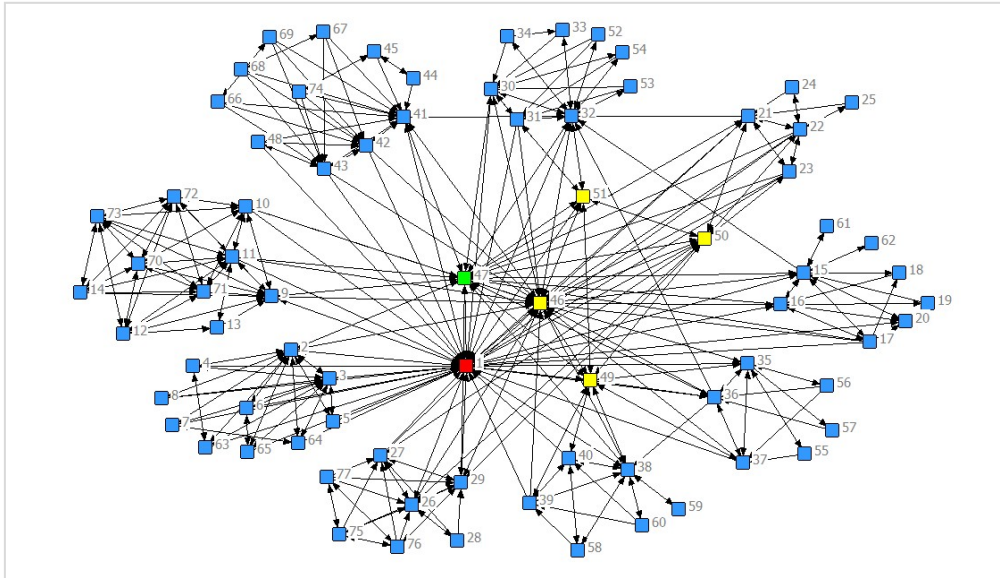


Figure 1. Sociogram of communication network used in auctions via association in the Kuantan Singingi district

<i>Legend:</i>	
■ : Extension Workers	■ : Chair of the Kuantan Singingi Rubber Farmers Association
■ : Head of Kuantan Singingi Plantation	■ : Rubber farmers

The sociogram shown in Figure 1 is in the form of a radial personal network. This is because the communication network that is formed is large (spread), has little integration, displays high diversity and is open to outside information sources such as extension workers and Plantation Services. Radial personal networks are important for the diffusion of innovation because relationships can spread outside the system (Rogers & Everett, 2003) and improving communication (Saleh, 2010).

The sociogram also identifies respondents who have the greatest number of ties: Mr. Sepriadi, Ms. Tuty and Mr. Syaffinal. These respondents are recognised as stars in the communication network model based on their positions and roles. The stars refer to those who first receives or obtains information regarding auctions and then conveys them to all other members.

The results confirm that group leaders act as main actors in the communication and marketing networks of production (Wahyuni, Lubis, & Sadono, 2016). Further, extension workers are needed to communicate the needs and problems of farmers (Mwangi, 2013) and are very instrumental in disseminating agricultural technology to farmers (Altalb, Filipek & Skowron, 2015; Borrelli & Roesch-, 2018). Government institutions also serve as a bridge between formal and informal communication networks (Isaac, Erickson, Quashie-Sam, & Timmer, 2007). The star's role is to be the first person to receive or obtain information on rubber marketing through the auction system to be shared with all other members. Involving rural stakeholders can improve the bargaining role of farmers (Gultom, Sumardjo, Sarwoprasodjo, & Muljono, 2016).

Further, 22 respondents act as bridges in this communication network: Mr. Sepriadi, Mr. Azir, Ms. Zulhenim, Mr. Sarmidi, Mr. Setiyadi, Ms. Nurhayati, Mr. Abdul, Mr. Deni, Mr. Anwar, Mr. Robi, Mrs. Robi, Jeni, Mr Masri, Mr Alpisandri, Mr Zukri, Mr Sukriansi, Mr Afrizal, Mr Muskeni, Mr Mashuri, Mr Sapriwal Mr Tafwira, Mr Oktafian and Mr Sukiman.

The bridges are those who connect one group with another group, while being a member of one of the linked groups.

Communication network at the individual level

In this research, the measurement of communication networks at the individual level includes local centrality, global centrality and similarity of information on rubber marketing. According to Lockie (2006), communication networks and interactions between farmers form the proximity of personality between individuals and groups.

Local centrality

Local centrality shows the number of relationships that individuals can create with others. Local centrality are obtained through "normalised degree centrality" or "centrality degree" in Ucinet VI. Local centrality values are obtained through `network> centrality> degree`. The data obtained is ratio scale data. For example, an actor who obtains the highest local centrality value is the actor with the maximum number of relationships with other individuals in his setting. He can also be called a star in the sociogram concept and is the most popular actor. The higher the centrality score, the stronger the communication that takes place (Bohn et al., 2011). The maximum and minimum values of the local centrality of actors in the communication network for auctions can be seen in Table 8.

Table 8. The maximum and minimum values of local centrality

Local centrality	<i>Outdegree</i>	<i>Indegree</i>
Maximum	19.000	41.000
Minimum	1.000	1.000

Outdegree refers to an actor who acts as a subject and contacts other actors to provide, seek and share information while indegree refers to an actor who acts as an object and is contacted by other actors to receive information and instructions. The degree of local centrality is obtained through "normalised degree centrality" or "centrality degree" and the data is ratio scale data. Meanwhile, the global centrality value is obtained through "centrality closeness". The data is in ratio scale as well. From Table 8, it can be seen that the highest outdegree is Mr. Sepriadi (19.000), who contacted 19 other actors. While the highest indegree actor is Mr. Sepriadi (41.000), which means he was contacted by 41 other actors. The higher the value of centrality obtained by an actor, the bigger the star he/she becomes in the network.

The lowest outdegree with a value of 1.000 means the actor has only contacted 1 other actor. Whereas the lowest indegree value is 1.000, which means that the actor has only been contacted by one other actor.

Global centrality

The value of global centrality shows the number of bonds that a person needs to contact with all other individuals in the network. Global centrality is obtained through "centrality closeness" that is obtained through `network> centrality> closeness`. The data obtained is also ratio scale data. The global centrality value shows the number of steps an individual must take to contact other individuals in the system. In other words, the smaller the global centrality value obtained by an individual, the greater the individual's ability to contact all other members in the network. The global centrality values of actors in the communication network for auctions is shown in Table 9.

Table 9. The maximum and minimum values of global centrality of actors

Global centrality	<i>InFarness</i>
Maximum	5576.000
Minimum	111.000

Table 9 shows that the actor who has the lowest global centrality value is still the same actor who has the highest local centrality value, that is node 1 with a value of 111.000. In other words, the low global centrality value indicates that node 1 (Chair of the Kuantan Singingi Rubber Farmers Association) must travel to contact all other actors in the system. The smaller the global centrality value obtained by the actor, the greater the actor's ability to contact all other members in the network.

Togetherness

Togetherness is a measure of centrality that reflects the position of an actor amongst others in a network. Actors who have a high togetherness value have the potential for communication control as a broker or gatekeeper in a network. The other actors become dependent on him/her if the path that connects him/her with others must pass through this particular actor. The value for togetherness in the communication network for auctions is presented in Table 10.

Table 10. The maximum and minimum values of togetherness

Global Centrality	<i>Betweenness</i>
Maximum	2425.281
Minimum	0.000

Based on Table 10, the maximum value of togetherness among actors in the network is 2425.281 and the minimum value is 0.000. This means that node 1 with the maximum togetherness value has various types of information related to rubber marketing using the auction system due to his association with key information sources such as extension agents and the Plantation Office. Thus, he is contacted by many other actors.

The communication network in conventional marketing and auction marketing

Rubber marketing in the Kampar district is carried out using the conventional marketing, which is marketing rubber to buyers (*tauke*) and auctions through farmer groups. Both of these communication network models are interrelated and generally involve the same individuals. Therefore, the marketing communication network analysis yielded an integrated sociogram.

This communication network is formed from the interactions of farmers from various groups who gather and share information about marketing. The communication relationship between farmers and individuals is illustrated by the sociogram in Figure 2.

In the Kampar district, the individuals involved in the communication network include 42 farmers and 7 external individuals consisting of 4 *taukses*, 1 person from a rubber auction agency and 2 porters. Based on Figure 2, it can be seen that most of the patterns formed are wheels with individuals numbered 7, 43, 44, 45, 46, and 47 forming the centre points. This is related to the roles of nodes who occupy a central position in the communication network. For example, node 47 leads the the rubber auction, node 7 is the village head as well as the *tauke*, while nodes 43, 44, 45 and 46 are *taukses*. Actors in communication networks tend to have leadership positions in their communities. These actors can be important channels of information and intermediaries in carrying out updates on farmers (Freeman & Aidoo, 2016).

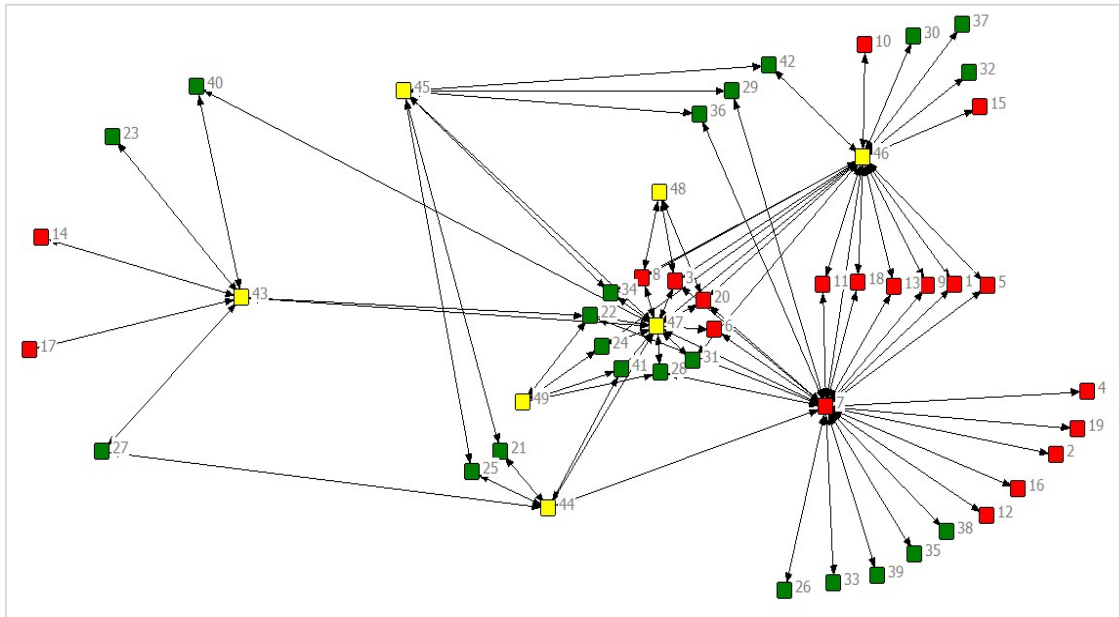


Figure 2. Sociogram of communication network in the Kampar district

Legend:	
49, 50	: Porters
47	: Chairman of the rubber auctions
7, 43, 44, 45, 46	: Tauke

- : Sungai Kulim Farmer Group
- : Gulamo River Farmer Group
- : External Individuals

The sociogram of the communication network forms a big network group and an interlocking personal network model. In other words, the network is homophilic consisting of individuals who are less open to their environment. The information exchange is centralised and only reaches a few people in the network. Thus, farmers on average only contact and rely on information from the *tauke* for marketing activities.

The nodes are differentiated using three different colors to see the distribution of farmers between farmer groups and external individuals. On sociograms, individuals in core networks can be identified; individuals in the core are those who have more ties/relationships and special roles. The number of individuals who are in the core network are farmer and *tauke* (node 7), *tauques* (nodes 43, 44, 45, and 46), chairman of the auction (node 47), and porters (nodes 48 and 49). Individuals in the core network mostly consists of external individuals whereas internal individuals include node 7. It should be noted that the five individuals who are in the core network are *tauques*.

The star is represented by node 7. In this community, node 7 is also one of the farmers in the Kulim River group. His position as a *tauke* proves that stars in networks are not always people with a formal authority in the system, but instead can be anyone who understands the attitude of the members and can influence their decisions. Node 7 has the greatest number of relationships due to the actor's position as a farmer and *tauke*, as well as an employee of the government. Node 7 is also active in various organizations and is the chairman of the hamlet number 02 of Kampar, which makes him widely known in the local community. Further, node 7 owns and has access to a number of media such as television, radio, and smartphones. Therefore, node 7 is an established source on rubber marketing. This corroborates with Schut,

Rodenburg, Klerkx, van Ast, & Bastiaans (2014) who attested that farmers who play a role in farmer groups can also be an obstacle in the transfer of knowledge to others.

The next individual who has the greatest number of bonds is node 47. He is active with village administration as the Head of Village Affairs in Binamang. Further, he is one of the people who initiated the establishment of the rubber auction market. Based on the interview transcripts, the auction market was established in 2017 due to declining rubber prices. The auction market helps to stabilise rubber prices and hinders *taukes* from unilaterally reducing prices.

Communication network at the individual level

The relationship of the communication network in the group structure may differ from the individual level (Nyantakyi-Frimpong, Matouš, & Isaac, 2019) and depend on the benefits of the communication (Magnan, Spielman, Lybbert & Gulati, 2015). In their work, Kondylis, Mueller, & Zhu (2017) have shown that the diffusion of innovation at the farm level has indeed played a role in the adoption of innovations. The intensity and diversity of communication as well as individual roles have a positive impact on technological innovation (Lunenborg, 2011).

Local centrality

According to Scoot (2009), local centrality shows the number of relationships that individuals can make with other individuals in a system. A person who displays a high local centrality value is generally an active person in a communication network. He often becomes a major link in the network and does not depend on others. In addition, he obtains a number of advantages from his position in a network. The maximum value of local centrality indicates the maximum number of individuals one can interact with in a system.

Table 11. Local centrality of the communication network in self-help patterns

Communication Network Index	Value
Local centrality	
Maximum	26.000
Minimum	1.000
Mean	3.306

The local centrality of the actors in the communication network in Kampar has a maximum value of 26.00 and a minimum value of 1.00. This implies that in seeking information about marketing, most individuals are able to contact at most 26 persons and at the least 1 person. The individual who has the highest local centrality value is node 7 who is a *tauke*.

Taukes such as node 7 has a central role in marketing rubber. As node 7 is a member of the Sungai Kulim farmer group and chairman of hamlet no. 02, farmers sell their rubber products to him. Thus, node 7 maintains strong ties with farmers and has a formal authority in the system.

The other *taukes* that display high local centrality values are nodes 46, 45, 43, and 44. These four *taukes* buy a lot of rubber products from farmers, but the bonds are fewer than node 7 because they come from outside. *Taukes* are also recognised by farmers as one of the sources for marketing.

The next high locality value (15.000) is displayed by node 47. Node 47 is the chairman of the rubber auction market and is often contacted by farmers. Based on the interviews with the farmers, node 47 is the most influential individual in the auction, as the chairman of the rubber auction and also as Chief of Affairs for Binamang. This is evident from the number of interactions, not only from farmers, but also from external individuals such as *taukes*.

Those with the lowest local centrality values are farmers who have minimal contact with other individuals in their environment. The farmer with a local centrality value of 1 means he only interacts with one individual in the system. There are 19 farmers who play a minimal role as shown by nodes 2, 4, 10, 10, 12, 14, 15, 17, 19, 23, 26, 30, 33, 35, 37, 38, 39, and 40. These farmers only sell to one *tauke* due to the patron-client relationship between them. There are various reasons for the patron-client relationships: i) family relationship between farmers and *tauke*, ii) farmers are attracted because the *tauke* can afford to pay early, and iii) the *tauke* is willing to lend large amounts of money when there is a financial emergency.

Global centrality

Global centrality refers to the distance between various individuals and reflects an individual's accessibility of the whole network. The global centrality value indicates the number of bonds a person needs to contact with all other individuals in the network.

Individuals who have a low global centrality value are able to contact others better than individuals who have a high global centrality value, because they need fewer intermediaries. In the context of information dissemination, individuals with a low global centrality value will receive more information than those with a high global centrality value (Zulkarnain, 2015). Thus, global centrality is often used as a consideration for choosing the right person as a key information disseminator.

Table 12. Global centrality of the communication network in self-help patterns

Communication Network Index	Value
Global centrality	
Maximum	163.000
Minimum	74.000
Mean	119.592

The actors in the communication network in Kampar has a maximum global centrality value of 163.000 and a minimum value of 74.000. The individual with the lowest global centrality value is node 7. This is attributed to his position and role as a *tauke* in Batu Bersurat Village which enables him to reach all other individuals in his communication network system. Therefore, node 7 acts as the key disseminator on new rubber market prices to all the farmers in the system.

Another individual who has a low global centrality value is the head of the rubber auction indicated by node 47. Node 47 is able to communicate with farmers directly without the need for any intermediate agents. Furthermore, node 47 accesses the market by dealing directly with *taukses* and shares information about market prices with the farmers.

Togetherness

According to Prell (2011), the level of togetherness reflects the potential for control in information flow. The level of togetherness in this study is interpreted as the frequency at which a node/individual connects with other nodes. In regard to that, Scott, Carrington, Marin and Wellman (2015) suggested that the level of togetherness can be interpreted as the level of individual dependence on other individuals. In other words, a high level of togetherness indicates a high level of individual dependence. Individuals with a high togetherness value have the potential for communication control and can act as a broker or gatekeeper in a network.

Table 13. Togetherness in the communication network of self-help rubber farmers

Communication Network Index	Value
Togetherness	
Maximum	1.216.318
Minimum	0.000
Mean	71.592

For this communication network, the maximum togetherness value is 1.216.318 while the minimum value is 0.000. The maximum value is displayed by node 7 who acts as the *tauke*. The *tauke* is a key information disseminator, especially on rubber market prices, which can be conveyed to all farmers to help them sell their rubber products. The interview transcripts show that the dependence of farmers on node 7 who acts as a *tauke* as very high.

High togetherness values are also shown by nodes 43, 44, 45, 46, and 47. These five individuals are *taukses* who buy rubber from farmers. The *taukses* have a lot of information regarding the marketing of rubber, especially market prices, because they deal directly with buyers such as rubber factories or wholesalers.

The togetherness value of node 27 is 0 which means the actor depends on certain individuals to contact each other. The data also shows that togetherness value of farmers is mostly low. This can be attributed to the lack of activity amongst farmers, whereby communication is only established between the farmers and the *tauke*.

The establishment of the farmers' association to market rubber via auctions in the Kuantan Singingi district created a communication network that spreads outwards in all directions. Farmers who join the association are connected to a WhatsApp group that enables them to access information and communicate with one another. Although there are several main actors who act as information providers, all the farmers get the same information so that they are able to follow the development of the auction market and participate to get the same or better price. The establishment of the Kuantan Singingi Farmers Association was fostered by Kuantan Singingi' Plantation Office extension officers and has tremendously improved the quality of processed rubber, which is then sold at higher prices.

In contrast, rubber marketing in the Kampar district uses the conventional and auction systems in the absence of an association. In the conventional system, rubber is directly sold to *taukses* while, in the auction system, auctions take place in farmer groups in their respective districts. Based on the study observations, even the auction system is not good enough because rubber prices are still controlled by certain actors and differ between districts. Further, the farmers' communication is limited to certain actors only, resulting in farmers not being able to monitor rubber prices, and instead adhere to the prices set by the *tauke*. This is evident from the centralised and locked communication network (interlocking network) found in the Kampar district. The control of communication and information flow by certain actors, leads to the exploitation of ignorant or ill-informed farmers.

The use of information and communication technology (such as a WhatsApp group) can play a major role in forming a multi-directional and open communication network for rubber farmers. Access to vital and relevant information as well as the ability to communicate with others such as buyers is important for improving and strengthening farmers' knowledge, attitude and skills in rubber farming. Farmers can then cultivate and process higher-quality rubber, and sell them at a higher price, thus increasing their income and quality of life.

CONCLUSION

In brief, the majority of the respondents are in the productive age group and are high school leavers. For the majority of them, their farming experience ranges from 1-32 years, and their cosmopolite level medium. Meanwhile, the average media ownership is around 1-2 media, with frequency of use about 4-7 times a month, for 0-60 minutes a week.

Auctions through an association creates a more open and widespread communication network in the form of a radial personal network. The main actors who act as the stars in the communication network is the Chairman of the Kuantan Singingi Rubber Farmers Association as well as the Coordinator of the Human Resources Development and Institutional Development Section. They are responsible for the overall administration of the Kuantan Singingi Rubber Farmers Association. An additional 22 actors (29%) act as the bridges in this communication network.

The communication network found in the conventional system and auctions through farmer groups is an interlocking personal network model, where the network consists of individuals who are less open to their environment. The flow of information is centralised and only reaches several people in the network. The main actors who act as stars in the communication network are the farmer who acts as the chairman of the auction, the farmer who acts as a *tauke* and external *taukes*.

Government agencies (plantation agencies called *dinas perkebunan*) through extension workers can help farmers form farmer associations in each district, so that rubber marketing can be done in a more transparent way which allows open communication and access to information leading to improved knowledge base and livelihood of rubber farmers.

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