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## Article

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## Article

# A Probe into the Status of the Oil Palm Sector in the Malaysian Value Chain

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**Abstract:** A ban on palm oil imports by the European Union has become a problematic issue, especially for palm oil producers' countries. Oil palm has been widely used in many sub-sectors, and any changes in the production side may affect many sectors that use oil palm as an input factor in their productions. This study explores the chain of the oil palm sector on the other sub-sectors in Malaysia by using a value-added multiplier method and network modeling. The study focuses on the specific oil palm sub-sector and oils and fats sub-sector in the Malaysian economic structure based on the Malaysian Input-Output 2015 Table. Network visualization and all the analyses involving network methods were developed and performed using UCINET and Gephi software. The value-added multiplier results explained that the net value between output multiplier and import multiplier is vital to depict the real impact of net resources used as an input factor in the oils and fats and oil palm sub-sectors. The high-density value level shows that the Malaysian oil palm sector has high connectivity in the economic system. From the network visualization analysis, the oils and fats sub-sector has a high level of integration with other sectors within the network. Meanwhile, the oil palm sub-sector categorized in the periphery structure group has a low level of integration in the input-output network. This is due to the high value-added demand for oil palm in the oils and fats sub-sector in the manufacturing sector. Overall, most of the sub-sectors in Malaysia are highly interconnected due to the high clustering ratio. Therefore, ensuring sufficient oil palm production is vital for sustainable production of other sub-sectors.



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**Keywords:** network analysis; input-output model; oil palm sector

## 1. Introduction

World palm oil production is growing rapidly, especially in Southeast Asia where Indonesia and Malaysia are the primary producers. In the context of Malaysia, the forecast of a decrease in global demand of palm oil due to the ban on imports of palm oil by the European Union is expected to have a significant impact on all stakeholders. The oil palm sector is one of the significant contributors to the income of exporting countries. Many would think that the ban would affect mainly the smallholders as they totally depend on the production of oil palm. In reality, there are significant other parties which would be greatly affected as the oil palm products are widely used in other economic sectors.

Generally, to produce a product, various other materials are needed to produce it, leading to interdependency among production industries (Utiti et al. 2015a), and there is no exception in the production within the oil palm sector itself. The oil palm sector is one of the 124 sectors listed in the Malaysian Input-Output Table in Malaysia. In 2018, the oil palm sector contributed around 2.8% (RM37.71 billion) to the composition of Malaysia's GDP (Department of Statistic Malaysia 2019). Besides that, the oil palm sector opened job

opportunities up to 400 thousand in 2019, and this number is estimated to increase every year (Bernama 2019).

Based on supply and demand theory, the interactions for supply, demand, and price are interrelated. When demand is low, and collection is high, it will lead to low prices (Whelan and Msefer 1996). Assuming that palm oil production is the same and unchanged and the total demand for palm oil by other countries remains the same, the import ban by the European Union will result in a large inventory of palm oil in the producing countries. Whelan and Msefer (1996) argue that the only direct action by manufacturers to bring inventory to the desired level is to change prices. While the producers do not want to let the price of oil palm products continue to fall and suffer losses, the producing countries can reduce production to maintain prices. By lowering oil palm production, it will indirectly affect this sector input use. Therefore, an analysis is needed to look more closely at other parties involved in reducing oil palm production to frame initial preparation and planning.

For viewing and analyzing the structure of the Malaysian economy, the input-output table is seen as one of the most widely used mediums. This is because the input-output table provides the flow of goods and services purchased and sold by the sector in the economy. Therefore, this study employs the input-output table to extract information about the relationship between the oil palm sector and other sectors in the Malaysian economy.

Even though the input-output method can provide information about the relationship between sectors, the input-output analysis does not indicate the oil palm sector's position in the economic structure and the role of the sub-sector in helping each other in the Malaysian economy structure. From the point of view of production in the oil palm sector in Malaysia, assessing the roles and implications of the oil palm sector in Malaysia's domestic production network on the demand of other sub-sectors would provide valuable information and a clear picture of the importance of the oil palm sector to the Malaysian economy. Thus, a study on the domestic production network of the oil palm sector in Malaysia is essential. The proposed policies can benefit all parties directly involved with this sector to prevent persecution and drop out of aid.

This study will integrate the use of input-output models with network modeling. Therefore, this study contributes in identifying the agents or sectors affected by changes in the production of the oil palm sector in Malaysia using input-output network modelling. Network modeling can provide a clear link for each sub-sector and provide a clear picture of who is connected to who and how each sector reflects in the economy. Network modeling has long been widely used because of its potential to provide new insights into the understanding of complex phenomena in many fields, including science, economics, social interaction, and others (Albert 2005; Barabási and Oltvai 2004; Kitsak et al. 2010; Markose et al. 2012; Pammolli and Riccaboni 2002; Said 2016; Yu and Ma 2020).

Given today's domestic and global economic uncertainty, it is difficult for Malaysia to face an import ban from the European Union. The European Union is one of the biggest markets in the world, while the oil palm sector contributes hugely to Malaysian GDP. Such an incident will affect the Malaysian economy. Nonetheless, the Malaysian economy needs to continue to implement policy initiatives that will contribute to the well-being and sustainability of the current economy. This study provides policymakers with a different perspective on understanding the oil palm sector's relationship with the economy. By clearly understanding the oil palm sector's role and importance in the economic sectors of Malaysia and the interlinkages between the oil palm sector with other sectors, more policy objectives can be implemented accordingly. Therefore, this study aims to analyze the implications of changes in the production of the oil palm sector in Malaysia on the demand of other sub-sectors in Malaysia using the input-output network.

## 2. Literature Review

Understanding the impact of international oil palm trade on the continuity of various industrial sectors in a country is of great importance. As of now, very little is known about the interaction between domestic production and trade of oil palm due to a lack of relevant

data and analysis. Generally, to produce a product offered in the international market, various other materials are needed to produce it. In the context of Malaysia, the forecast of a decrease in global demand due to the ban on imports of palm oil by the European Union is expected to have a significant impact, especially for the oil palm industry itself. Due to this concern, this study will discover the implications of changes in the production of the oil palm sector in Malaysia on the demand of other sub-sectors in Malaysia. To study the flow between various sectors in the domestic economic system and realize the joint transformation of economic data into sectors closely related to the oil palm sector in Malaysia, the methodology proposed by Leontief will be adopted. The Leontief approach (Leontief 1936, 1951, 1975) through input-output has been widely used to analyze various related cases for the country's economic structure. For this study, the matrix model for input-output is chosen because it gives an overview of the relationship between industries in the economy by showing how the output from one industrial sector can be one of the inputs to another industrial sector and vice versa.

Input-output modeling is a linear modeling approach that involves the economic cycle flow for production by analyzing the relative relationship between production input flow and output flow generated in economics (Grealis et al. 2017). The advantages of using input-output modeling allow researchers to capture the relative importance of the different production factors used by each sector and the trade balance that can be generated (Utiti et al. 2015b). In the real world, the behaviors of each agent in the economy are interconnected. It is no exception for the economic sectors available in Malaysia. Based on input-output data, there are many methods to measure the level of connectivity; as in development and economic planning, the economic drivers are identified based on two frequently used measurements: linkages and multiplier (Saari et al. 2018). The linkages are used to measure how the growth of one sector can benefit other sectors. Meanwhile, multipliers measure the overall economic impact of certain economic variables due to output growth for a sector.

For the measurement of linkages, there are two measures used, namely forward linkages and backward linkages. Backward linkages are used to measure the relationship between input providers for the economic sector. For example, if one sector increases its output, there will be increasing demand from other industries (as suppliers), whose goods and production factors are used as input for that sector's production (Saari et al. 2018). Meanwhile, forward linkages measure the relationship between buyers for the output produced by the economic sector. In other words, the additional product output available is to be used as input by different sectors for their production and use (Saari et al. 2018).

Sectors with a high value of linkages indicate a significant spillover effect on other economic sectors (Jaafar et al. 2015). One of the primary uses of the input-output model is to assess the impact of economic change on the exogenous elements in the economy. Techniques to evaluate the effects of these changes were first introduced by Wassily Leontief and later developed into many measurement branches such as multipliers and others (Miller and Blair 2009). For multipliers, based on the Leontief inverse matrix function form, this function allows estimates for individual sector multipliers to capture both macroeconomic effects, either directly or indirectly, to increase or decrease exogenous demand (Leontief 1975). Multiplier analysis of the input-output matrix has been widely used in the study of various sectors of the economy, such as studying the waste contained in the economy in Malaysia (Utiti et al. 2015b), aquaculture (Grealis et al. 2017), energy, and manufacturing (Bekhet et al. 2016).

Based on previous studies, multiplier measurement was chosen over linkages in this study to achieve the objective. The multiplier can see the changes in a sector by directly impacting the inputs involved in that sector. The multiplier calculation based on the input-output matrix is carried out to see the implications of changes in oil palm on other economic sub-sectors in Malaysia. A literature review conducted on the use of input-output analysis to identify multipliers of each sector found that the most used measurement to analyze multipliers is the output multipliers (Bekhet et al. 2016; Grealis et al. 2017; Utiti et al. 2015b).

However, in identifying growth drivers, it was found that the measure of ‘value-added’ is more relevant to be evaluated by policymakers than the output multiplier because the output multiplier also includes the value of imports, which is the holding of foreign input (Saari et al. 2018). Baldwin and Lopez-Gonzalez (2014), Koopman et al. (2008), and Said and Fang (2019), in their study, stressed the importance of assessing the extent to which the content of domestic value (value-added) is original compared to the total production. Therefore, the contribution of this study applies value-added multiplier measures so that the study results are more realistic and the policy to be proposed will be more effective than the overall calculation.

As it has been said earlier, even though the input-output method can provide information about the relationship between sector using either linkages or multiplier approach, however, the input-output analysis does not indicate the oil palm sector’s position in the economic structure and the role of the oil palm sector and others sub-sector plays in helping each other’s in the Malaysian economy structure. Therefore, the contribution of this study integrates the use of input-output models with network modeling. Network analysis is one of the tools used to analyze complex systems for relational data. In recent times, network analysis has been seen to have emerged and is widely used in the economic field, especially for analyzing international trade networks as well as financial networks. Although international trade and financial networks are the most popular fields, these network analysis methods have also been used to create input-output networks. There are several studies, such as the study by Alatraste-Contreras (2015), Blochl et al. (2011), Cerina et al. (2015), Grazzini and Spelta (2015), Giammetti et al. (2020), and Prell (2016), on input-output analysis using network approaches found in the existing literature. A study by Cerina et al. (2015) focused on global input output. Her research analyzes network properties based on the three level group, global, regional, and local network properties. Based on her finding, at the global level, industries seem to connect highly. This study also highlights that to identify the key sectors in economic structure, network-based measures such as PageRank centrality and community coreness measure have given valuable insights. Besides Cerina et al. (2015), several other studies have used global input-output as the focus of their study (Liang et al. 2016; Soyuyigit and Boz 2017). For example, the Alatraste-Contreras (2015) study uses input-output data with network methodology and found that the most important sectors in each country are also the most important sectors in the European Union. Besides, the most significant sectors have a high shock spreading and a high aggregate impact on the economy.

With a borderless world and a more open economy, the global economy has been integrated over time. Several other studies (Kali and Reyes 2007; Kim and Shin 2002; Liang et al. 2016; Prell 2016; Su 1995) have used the network methodology to describe the entire network structure to look at how well the economy had integrated and growth. Viewing network patterns can help understand the characteristics of a structure, understand the relationship, and see the role of each unit in the whole network.

The input-output model allows researchers to identify and measure the use of resources directly and indirectly through the entire supply chain, either forward or backward processes. The use of input-outputs enables the calculation of the overall needs of the resource to be done more systematically and can identify the geographical origin of the source. In addition, the existence of a network model allows for more systematic structured studies and network evolution to be made. Such studies can help uncover potential weaknesses in exploiting and allocating resources and provide new insights that can assist in preparing and improving a policy.

### 3. Methodology

Data from the Malaysian Input-Output Table provided by the Statistics Department of Malaysia are required. This study uses the latest data from Malaysia Input-Output Table 2015 since it has been published every five years. However, for the current study, the available data are up to only year 2015. The table comprises 124 economic sub-sectors.

Therefore, this study focuses on a specific analysis of oil palm sub-sectors and oil and fat sub-sectors in the Malaysian economic structure in 2015 based on the Malaysian Input-Output Table 2015. The reason for choosing oil palm with oil and fat sub-sectors is the high demand, especially from other sectors in the economy. In the Malaysian Input-Output Table, the oils and fats sub-sector is also considered palm oil processing sub-sector as other oils and fats are very limited (less than 1%). (Jaafar et al. 2015). Besides that, network visualization and all analyses involving network methods were developed and performed using UCINET software (Borgatti et al. 2002) and GEPHI software (Bastian and Heymann 2009).

The flow for analysis begins by obtaining the Malaysian Input-Output Table for 2015. Next, multiplier calculations based on the input-output matrix are carried out to see the implications of the oil palm sector on other economic sub-sectors in Malaysia. Multiplier data are used to capture macroeconomic effects, directly and indirectly, to increase or decrease exogenous demand (Leontief 1975). Through the input-output multiplier, changes in one sector will directly impact the inputs involved in that sector. Then, the visual of the input-output network for the value-added multiplier is developed to view the network structure. Next, several tests such as density, average path length, core/periphery, degree, betweenness, and clustering were conducted to obtain more detailed information.

### 3.1. Input-Output Multiplier

The multiplier calculation based on the input-output matrix is carried out to see the implications of the oil palm sector on other economic sub-sectors in Malaysia. Based on the input-output modeling, the matrix algebra forms the basis of input-output analysis (Grealis et al. 2017; Miller and Blair 2009).

### 3.2. Network Methodology

Input-output network analysis methods adapted from social network analysis emerge as a set of social structure analysis methods. These methods depend only on the existence of relationships or contact data (Scott 2000). The data are organized in a matrix before network visualization and other network tests (density, distance, core/periphery, degree, betweenness, and clustering). The arrangement of this study in a network matrix form shows the actual relationship of the input/output of one sub-sector to another.

The  $N \times N$  matrix (124 Malaysian sub-sectors  $\times$  124 Malaysian sub-sectors) represented the Malaysian input-output network matrix for this study.  $N$  was the sub-sectors found in the Malaysian domestic input-output table of 2015. For this matrix below,  $X_{ij}$  represents the actual value (RM) of input from sector  $i$  to sector  $j$ , with rows representing input values and columns representing output values as in the following matrix:

$$X = \begin{bmatrix} 0 & X_{12} & X_{13} & X_{14} & \dots & \dots & \dots & X_{1j} & X_{1n} \\ X_{ij} & 0 & \dots & \dots & \dots & \dots & \dots & \dots & X_{2n} \\ X_{31} & \dots & 0 & \dots & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & 0 & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & 0 & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots & 0 & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & 0 & \dots & \dots \\ X_{n1} & \dots & \dots & \dots & \dots & \dots & \dots & \dots & 0 \end{bmatrix}$$

For the next step, the matrix X above will be converted to the VA matrix, where the VA matrix is the value-added multiplier input-output matrix. Calculations for value-added multipliers can be referred into the sub-section before. The VA matrix is as follows:

$$VA = \begin{bmatrix} 0 & VA_{12} & VA_{13} & VA_{14} & \dots & \dots & \dots & VA_{1j} & VA_{1n} \\ VA_{ij} & 0 & \dots & \dots & \dots & \dots & \dots & \dots & VA_{2n} \\ VA_{31} & \dots & 0 & \dots & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & 0 & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & 0 & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots & 0 & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & 0 & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & 0 & \dots \\ VA_{n1} & \dots & \dots & \dots & \dots & \dots & \dots & \dots & 0 \end{bmatrix}$$

In this study, input-output networks based on value-added multiplier data are summarized into models as interconnected networks  $R = (N, M)$ . R is the whole network structure, N is the number of nodes, and M is the edges. In this study, nodes will represent 124 economic sub-sectors listed in the Malaysian Input-Output Table, and the edges represent relationships between each sub-sector. The edges direction is also known as input-output flows. The goal of visualization as a starting point for this study is to get a complete picture of the entire network, focusing on key studied sectors: the oil palm sub-sector and oils and fats sub-sector.

Density in a network procedure measures how many edges are in a network compared to the maximum number of advantages between nodes. Density is used to know the compactness of connection among all nodes in the network. The greater the density value, the closer the relationships between nodes within the network. The definition of network density can be seen through the following equations (Kitamura and Managi 2017):

$$Density = m/n(n - 1) \tag{1}$$

where  $n$  is the number of nodes and  $m$  is the number of actual edges within the network.

The next test is the core/periphery structure, in-network terminology (Prell 2016); the network composition is divided into two types: core and periphery. The core structure consists of nodes or sub-sectors interconnected and are the center point of the whole network. In comparison, a periphery structure refers to a more or less isolated type of nodes. It is associated with the rest of the network mainly through its relationship to the core structure.

The average path length represents the average number of steps for each node pair. Based on Watts and Strogatz (1998), the average path length can be defined as the following equation:

$$l = 1/n(n - 1) \sum_{ij} d_{ij} \tag{2}$$

where  $d_{i,j}$  represents the shortest distance between nodes  $i$  and  $j$ , if nodes  $i$  and  $j$  cannot link or reach each other or  $i = j$ , then the shortest distance  $d_{i,j}$  equals 0.

The degree of the node is the number of edges per node in a network showing the basic network features. The direct networks consist of two types of degrees, which are in-degree and out-degree. Out-degree represents the value of the output/edges exit, while in-degree represents the value of input/edges enters into nodes. Therefore, analyzing the degrees of a node can help further explore the node that is important in the network structure. The degree of the nodes can be defined as follows (Kitamura and Managi 2017):

$$k_{in}i = \sum_{j=1}^n a_{ji} \tag{3}$$

$$k_{out}^i = \sum_{j=1}^n a_{ij} \quad (4)$$

where  $a_{ji}$  is the value of input edges and  $a_{ij}$  is the value of output edges, while  $k_{in}$  is the degree of entry and  $k_{out}$  is the degree of exit.

Betweenness for a node is the number of the shortest path between two nodes that pass through  $i$ .  $n_{st}^i$  is equal to 1 if node  $i$  is located on the shortest path from node  $s$  to node  $t$  and equal to 0 if there is no shortest path available between node  $s$  and node  $t$ . Therefore, we can determine the intermediate value for node  $i$  as in the following equation:

$$x_i \sum_{st} n_{st}^i \quad (5)$$

The clustering ratio of a network is known as the level of interconnectedness of each node's neighbors. It measures the relation between a network in which two neighbors of a node are also neighbors. This process is also called the measurement of the level of transitivity. For simplicity, it is the fraction of the total number of triangles to the possible number of triangles (Saïd 2016). The clustering ratio of a network ( $C$ ) can be between 0 and 1. If  $C = 1$ , it is said that the network is perfectly transitive, and, on the other hand,  $C = 0$  implies that the network is intransitive.

## 4. Result & Discussion

### 4.1. Input-Output Multiplier

The multiplier value is significant because the multiplier can measure the economic impact on certain economic variables as an effect on the growth results in the production of a sector (Saari et al. 2018).

Table 1 shows the ten sub-sectors of the main inputs for the oils and fats sub-sector based on the value-added multiplier. Based on the multiplier value, the sub-sector, the primary input, will receive the most significant implications in any change, either an increase in production or a decrease in production for the palm oil industry in Malaysia. Based on multiplier results, 93%, out of 124 sub-sectors, is an input for the oil palm sector in Malaysia. Although in Table 1, the output multiplier for oils and fats against itself is 1.33, which is higher, while oil palm against itself is only 1, 1.25 out of 1.33 output multiplier come from import input. This is because the oils and fats sub-sector in Malaysia concentrated more on exporting refined palm oil. At the same time, Indonesia dominated the crude palm oil (CPO) export market (Salleh et al. 2016). Through sole investments and joint ventures with local companies in Indonesia, the investors in Indonesia are primarily from Malaysian and Singaporean groups of companies. These investors control more than two-thirds of total palm oil production in Indonesia (Pacheco et al. 2017). Most of this crude palm oil brought back to Malaysia to be processed into refined palm oil. For the oil palm sub-sector, 0.77 out of 1 output multiplier is originated from value-added because input supply for oil palm replanting is from the domestic plantation. The primary input for this sub-sector is palm oil sapling, and the primary output is palm kernel and crude palm oil.



**Table 1.** The results of the multiplier analysis for the top 10 sub-sectors as input to the oils and fats sub-sector and the oil palm sub-sector based on the Malaysian Input-Output Table 2015.

| No. | Oils and Fats Sub-Sector |                   |                        |                   |
|-----|--------------------------|-------------------|------------------------|-------------------|
|     | Sub-Sector               | Output Multiplier | Value Added Multiplier | Import Multiplier |
| 1   | Oil Palm                 | 0.38 <sup>1</sup> | 0.29                   | 0.08              |
| 2   | S-93                     | 0.22              | 0.13                   | 0.09              |
| 3   | Oils and Fat             | 1.33              | 0.08                   | 1.25              |
| 4   | S-115                    | 0.06              | 0.04                   | 0.03              |
| 5   | S-86                     | 0.06              | 0.03                   | 0.03              |
| 6   | S-13                     | 0.03              | 0.03                   | 0.01              |
| 7   | S-44                     | 0.07              | 0.02                   | 0.05              |
| 8   | S-107                    | 0.02              | 0.01                   | 0.01              |
| 9   | S-45                     | 0.03              | 0.01                   | 0.02              |
| 10  | S-8                      | 0.01              | 0.01                   | 0.00              |
| Ni  | -                        | -                 | -                      | -                 |
|     | Total                    | 2.49              | 0.74                   | 1.75              |
| No. | Oil Palm Sub-Sector      |                   |                        |                   |
|     | Sub-Sector               | Output Multiplier | Value Added Multiplier | Import Multiplier |
| 1   | Oil Palm                 | 1.00              | 0.77                   | 0.23              |
| 2   | S-8                      | 0.03              | 0.02                   | 0.01              |
| 3   | S-93                     | 0.04              | 0.02                   | 0.01              |
| 4   | S-46                     | 0.04              | 0.01                   | 0.03              |
| 5   | S-13                     | 0.01              | 0.01                   | 0.00              |
| 6   | S-115                    | 0.01              | 0.01                   | 0.00              |
| 7   | S-44                     | 0.02              | 0.01                   | 0.02              |
| 8   | S-107                    | 0.01              | 0.01                   | 0.00              |
| 9   | S-11                     | 0.01              | 0.00                   | 0.01              |
| 10  | S-45                     | 0.01              | 0.00                   | 0.01              |
| Ni  | -                        | -                 | -                      | -                 |
|     | Total                    | 1.25              | 0.89                   | 0.36              |

#### 4.2. Network Analyses

Table 2 shows a descriptive analysis of the overall pattern of value-added multiplier data for the Malaysia Input-Output Table 2015. The total number of links, also known as edges for the value-added multiplier network, is 15,252 for the 124 nodes involved. One hundred twenty-four nodes consist of 124 economic sub-sectors found in the Malaysian Input-Output Table 2015. For this study, edges represent the value of multiplier input flow or multiplier output flow from one sub-sector to another sub-sector. The minimum score value of the edges is 0, and the maximum is 0.377. Besides that, based on Table 2, the average value of route length is 1.1 sub-sectors. The low average length of the route reflects the level of strong contact with each other. Thus, it will immediately affect the sub-sectors involved as input or output in the event of a shock to one of the sub-sectors.

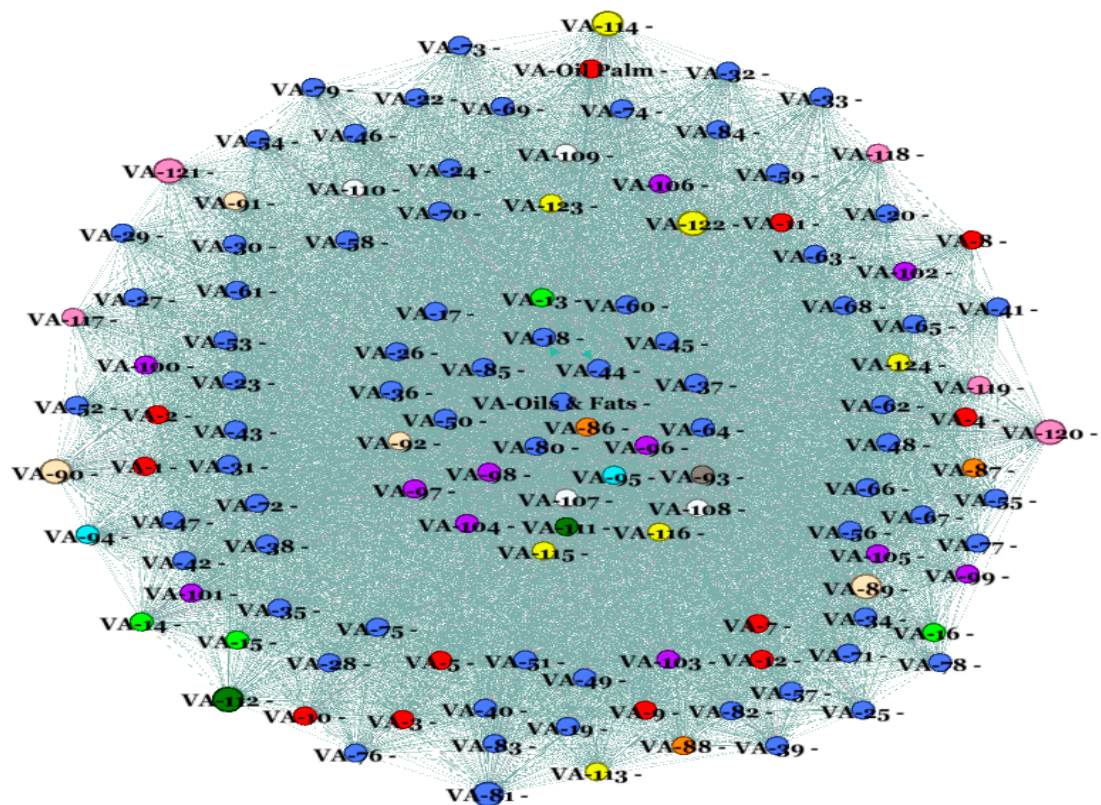
**Table 2.** The results of the descriptive analysis for the value-added multiplier network based on the Malaysian Input-Output Table 2015.

|                        | Value Added (VA) Multiplier |
|------------------------|-----------------------------|
| Edges                  | 15252                       |
| Clustering coefficient | 0.885                       |
| Mean                   | 0.002                       |
| Standard deviation     | 0.010                       |
| Sum                    | 37.867                      |
| Variance               | 0                           |
| Minimum                | 0                           |
| Maximum                | 0.377                       |
| Density                | 0.874                       |
| Average path length    | 1.066                       |
| Eigenvalue             | 0.467                       |

Based on the total number of nodes and the number of actual links, the density obtained is 0.874. Density in the network procedure used to measure the closeness or compactness among all sectors in the Malaysian economic network. The density value also shows the degree of network efficiency (Hou et al. 2018), where the closer the relationship between all nodes is represented by the more significant density value. Three basic levels can be used to rank the density values, where 40% and below represents the low values, between 40% to 70% is for median values, and 70% and above is for high values (Alatrliste-Contreras 2015). From Alatrliste-Contreras (2015), high-density value connectivity in which sectors are highly dependent on almost all other sectors is shown by high-density value, whereas low-density values show otherwise. By referring to this ranking level, it can be said that Malaysia, with the high-density value level, has high connectivity in the economic system based on value-added multiplier where sectors are highly dependent among them in the Malaysian economic structure. Based on the input-output data, France, United Kingdom, and Hungary (Alatrliste-Contreras 2015) are among other countries with high-density value levels in the European region. While the value of Eigen is 0.467, which located between the value of zero to one, it shows that this network is stable (May 1972).

#### 4.3. Network Visual

Figure 1 shows the network visualization of the Malaysian economic structure based on the value-added multiplier data from the Malaysian Input-Output Table 2015. The purpose of visualization as a starting point is to obtain an overview of the network (Lovrić et al. 2018), focusing on oil palm sub-sectors and the oils and fats sub-sector found in the Malaysian economic structure. Based on Figure 1, 27 sub-sectors were the primary “core” sub-sector in the Malaysian economic structure in 2015 based on a network of value-added multipliers. The remaining 97 sub-sectors are side or also known as “periphery” sub-sector. Based on the diagram above, the oil palm sub-sector has a periphery structure as a whole network while the oils and fats sub-sector has a core structure. In the diagram above, the oils and fats sub-sector has many edges in the middle of the network and surrounded by dense edges.



Source: The data are derived from the calculation of value-added multipliers from Input-Output Malaysia 2015 and visualized by the author using Gephi.

Diagram indicator

|    | Sector   |
|----|--|
| 1  | Agriculture, forestry, and fisheries                   |
| 2  | Mining and quarrying                                   |
| 3  | Manufacturing  |
| 4  | Utility  |
| 5  | Construction   |
| 6  | Wholesale and retail trade                             |
| 7  | Accommodation, food and beverage                       |
| 8  | Transportation, storage, and communication information |
| 9  | Finance and insurance                                  |
| 10 | Real estate and homeownership                          |
| 11 | Business and private services                          |
| 12 | Government service                                     |

Figure 1. Malaysia’s 2015 economic structure based on value-added (VA) multipliers.<sup>2</sup>

The main structure in network analysis for this objective is a sub-sector or node with many edges and can be described as having a high degree of integration to other sub-sectors of nodes in the same network (Lovrić et al. 2018). Whereas sub-sector or nodes categorized in a group of periphery structures are composed of sub-sectors or nodes with few edges and low levels of integration within the network (Lovrić et al. 2018). It can be concluded that the oils and fats sub-sector has a high level of integration with other sectors within this network. Meanwhile, the oil palm sub-sector categorized in the periphery structure group has a low level of integration in this input-output network. It is located outside the central network and has few edges compared to the oil and fat sub-sector. Vandermarliere et al.

(2016) stated if core/periphery structure theory holds, network structure divided into core structure for highly integrated nodes and periphery structure, which is a highly integrated structure with central structured nodes through the visualization in Figure 1.

The oil palm sub-sector is more structured as periphery rather than core due to the characteristics of this sub-sector for the agricultural sector. The agricultural sector only needs a little basic input (fertilizer, soil, capital, etc.) to produce its output than the oils and fats sub-sector located in the manufacturing sector, requiring various inputs to produce each output. Additionally, the agricultural sector's output less likely used as input for other sub-sectors than the manufacturing sector's output. This is also why the oil palm sub-sector does not have a core structure or is a focal node in this network. Based on Appendix B, the total production multiplier for the output of the oil palm sub-sector is RM1.77 for every RM1.00 production of other sub-sectors. Meanwhile, the total production multiplier for oil and fat sub-sector output is RM2.33 for every RM1.00 production of other sub-sectors.

The oil palm sub-sector contributes almost 40% of input requirements based on the value-added multiplier to produce each oil and fat sub-sector production. Here, we can see the strong interconnectedness between these two sub-sectors. Thus, based on the analysis of core/periphery structures, we conclude that these two sub-sectors play an important role in the chain of relations of the Malaysian economic sector. In addition, the oils and fats sub-sector having many interactions with other sub-sectors in the network. In contrast, the oil palm sub-sector is the most extensive input in generating oils and fats sub-sector output.

Due to the key or core structure that highly integrated or connected nodes, if one of the most core sectors of a country hit by a shock, the shock can cause a vast impact on the whole economic structure and vice versa (Alatraste-Contreras 2015). High connectivity or integration of core sub-sector also can cause the economy to be fragile because it allows targeted shocks to spread from one sub-sector to another. If the core sub-sector are intentionally picked out or accidentally touched, the effects will spread rapidly throughout the network. Therefore, it can be inferred that key or core sub-sectors are a good sub-sector for selective promotion and are weak if the economy suffers adverse shocks.

#### 4.4. Degree

Table 3 results from in-degrees and out-degrees for the top 10 sub-sectors and the lowest ten sub-sectors based on input-output value-added multipliers. Degrees for nodes are the link or edges values of each node in a network, showing the network's basic features. As mentioned earlier, this study's edges represent the flow value of the value-added input multiplier or the value-added output multiplier from one sub-sector to another sub-sector. As already described, direct networks have two types of degrees, namely the in-degree and the out-degree. Analyzing the in-degree value can help explore further sub-sectors that use high input in the Malaysian economy based on a value-added multiplier. In any growth contraction for a sub-sector, the sub-sector uses a lot of input to produce one unit of output exposed to affect the input sub-sector significantly.

Based on Table 3, the oils and fats sub-sector is ranked first in the in-degree value for value-added multipliers. This is because the oils and fats sub-sector inputs are primarily derived from Malaysian domestic inputs and do not rely heavily on imported inputs. Meanwhile, the in-degree value for the oil palm sub-sector is ranked 115th for the value-added multiplier with a 0.114 value of inbound links. The high degree of input for value-added multipliers demonstrates the importance of the oils and fats sub-sector in helping to generate the pure Malaysian economy income for each production.

**Table 3.** Results of in-degrees and out-degrees for the top 10 sub-sectors and the lowest ten sub-sectors based on value-added (VA) multipliers<sup>3</sup>.

| No.   | Sub-Sector        | In-Degree | No.   | Sub-Sector | Out-Degree |
|-------|-------------------|-----------|-------|------------|------------|
| 1     | VA- Oils and Fats | 0.661     | 1     | VA-93      | 7.487      |
| 2     | VA-18             | 0.632     | 2     | VA-13      | 3.976      |
| 3     | VA-26             | 0.611     | 3     | VA-115     | 3.316      |
| 4     | VA-17             | 0.602     | 4     | VA-44      | 2.229      |
| 5     | VA-44             | 0.522     | 5     | VA-86      | 1.519      |
| 6     | VA-37             | 0.483     | 6     | VA-107     | 1.278      |
| 7     | VA-98             | 0.48      | 7     | VA-45      | 0.976      |
| 8     | VA-36             | 0.479     | 8     | VA-11      | 0.779      |
| 9     | VA-38             | 0.466     | 9     | VA-108     | 0.769      |
| 10    | VA-122            | 0.458     | 10    | VA-80      | 0.667      |
| $N_i$ | -                 | -         | $N_i$ | -          | -          |
| 115   | VA-Oil Palm       | 0.114     | 115   | VA-42      | 0          |
| 116   | VA-3              | 0.113     | 116   | VA-81      | 0          |
| 117   | VA-8              | 0.113     | 117   | VA-89      | 0          |
| 118   | VA-12             | 0.111     | 118   | VA-90      | 0          |
| 119   | VA-11             | 0.103     | 119   | VA-112     | 0          |
| 120   | VA-2              | 0.09      | 120   | VA-114     | 0          |
| 121   | VA-101            | 0.09      | 121   | VA-119     | 0          |
| 122   | VA-112            | 0.088     | 122   | VA-120     | 0          |
| 123   | VA-1              | 0.073     | 123   | VA-121     | 0          |
| 124   | VA-13             | 0.056     | 124   | VA-122     | 0          |

Sub-sectors with high in-degrees and high out-degrees can be the key to creating demand and spreading growth indirectly throughout the economic system. Therefore, identifying sub-sectors that contain high in or out-degree is very useful as each sub-sector will influence other sub-sectors differently based on the links and values of degrees. For example, the implications of demand shocks, whether positive or negative for one sub-sector, vary based on the value of inputs or outputs received or supplied from the demand shock sub-sectors.

So, conducting an analysis of the in-degree and the out-degree will give a clearer picture of the changes to other sectors in the Malaysian economy. In addition, based on Appendix C, the findings also prove that these two sub-sectors supply output to other sub-sectors that contain a high content of imports (goods/services).

#### 4.5. Node Results

The table in Appendix C shows the overall results of the node analysis conducted on the value-added multiplier for the Malaysian Input-Output Table 2015. Column 4 shows the betweenness results for the network. Almost all sub-sectors are intermediaries with the highest value of 59.814 located at node VA-115 (Professional). It indicates that the professional sub-sector in the input-output network, based on the value-added multiplier, has the highest value-added flow connection to other sub-sectors. From the 124 nodes, it found that only 7 per cent of nodes were not intermediaries.

Columns 6 and 7 show in-clustering and out-clustering value. Clustering within the network is also known as the number of neighbors (Said 2016). The highest values for in-clustering are 0.005 at nodes VA-17 (Processing and Preserving of Meat), VA-18 (Processing and Preserving of Seafood), VA-26 (Prepared Animal Feeds), VA-(Oils and Fats). The out-clustering is at node VA-93 (Wholesale and Retail Trade, Repair of Motor Vehicles and Motorcycles) with a value of 0.06. The last column shows the clustering ratio (C). The clustering ratio for a network is between the values of 0 to 1. If  $C = 1$ , it is said that the network is perfectly transitive, whereas if  $C = 0$  indicates that the network is not transitive. For networks, C essentially shows the extent to which the presence of three nodes forms an interconnected triangle in a network (Said 2016).

The results show that the VA-122 sub-sector (Non-Profit Institutions Serving Households) has the highest cluster coefficient of 0.998, close to 1. In contrast, the VA-111 (Real Estate) sub-sector has the lowest clustering coefficient value at only 0.872. Thus, the overall value of the clustering coefficient value concludes that all sub-sectors in the input-output network based on the value-added multiplier have high transitive properties.

## 5. Conclusions

The value-added multiplier method is used for the input factor's net value in the oils and fats and oil palm sub-sectors analyzed in this paper. The advantage of using a value-added multiplier is to avoid double counting of both domestic and import factors. Thus, it is vital for using the value-added multiplier method to explain the net impact of the flow of input factor of the oil palm industry. Besides, the high-density level shows that the Malaysian oil palm sector has high connectivity in the economic system where sectors are highly dependent on the Malaysian economic structure. In addition, from network visualization analysis, the oils and fats sub-sector has a high level of integration with other sectors within the network. Meanwhile, the oil palm sub-sector categorized in the periphery structure group has a low level of integration in the input-output network. This is due to the high value-added demand for oil palm in the oils and fats sub-sector in the manufacturing sector. Overall, most of the sub-sectors are interconnected due to the high clustering ratio that closed to 1. Therefore, if there is deteriorating or expanding production of oil palm, it will directly affect the value of the other sub-sectors that used oil palm and oils and fats as an input factor. The interdependence of oil palm sector with other sub-sectors in the Malaysian economic structure has proved the importance of the oil palm industry. Therefore, policymakers need to be more sensitive to the chain effect of the change in the production of the oil palm sector. Sufficient oil palm production is vital to ensure the stability of the oil palm sector chain to other sub-sectors.

However, most past studies rarely look at the relationship between the production and demand for oil palm. In the context of Malaysia, the forecast of a decrease in global demand due to the ban on imports of palm oil by the European Union has a significant impact on the Malaysian economy. In conclusion, the importance of the oil palm industry in the Malaysian production chain to other sectors shows the high dependence of different sectors on the oil palm industry. Policymakers need to be more sensitive to these chain relationships. A policy needs to be made to protect this oil palm industry in ensuring the survival of this industry in Malaysia. Based on the pressures faced, producing countries need to seek further development potential. In urgent circumstances, countries that receive pressure or negative demand shock can find early solution measures to reduce the risks faced against future sanctions.

Meanwhile, this study has shown the importance of the oil palm industry in Malaysia to the other sub-sectors. It is exciting to know the position and the role of the oil palm industry in other countries. To achieve this goal, a study based on the input-output table is needed. In addition, by integrating the input-output tables of various countries, an analysis of the global value chain (GVC), which refers to international production sharing, can be implemented to see the interconnectedness between the integrated oil palm sectors. The current study's limitations are more detailed data for palm oil product fractions in the Malaysian Input-Output Table. Here, Malaysia as a producing country can conduct further studies of palm oil products more in line with the needs and wants of a domestic and international market. Meeting the needs and wants of each country more precisely is one way to increase the consumption and demand for palm oil products.

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**Data Availability Statement:** Data available in a publicly accessible repository that does not issue DOIs Publicly available datasets were analyzed in this study. This data can be found here: [<https://newss.statistics.gov.my/newss-portalx/ep/epFreeDownloadContentSearch.seam?cid=810771>].

**Conflicts of Interest:** The authors declare that they have no known competing interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Appendix A. 124 Sub-Sector in Malaysia Input-Output Table 2015

| Code (S/VA)   | Sub-Sector   |
|---------------|--|
| 1             | Paddy  |
| 2             | Food Crops   |
| 3             | Vegetables   |
| 4             | Fruits   |
| 5             | Rubber   |
| Oil Palm      | Oil Palm   |
| 7             | Flower Plants  |
| 8             | Other Agriculture                                    |
| 9             | Poultry Farming                                      |
| 10            | Other Livestock                                      |
| 11            | Forestry and Logging                                 |
| 12            | Fishing and Aquaculture                              |
| 13            | Crude Oil and Natural Gas                            |
| 14            | Mining of Metal Ores                                 |
| 15            | Quarrying of Stone, Sand, and Clay                   |
| 16            | Other Mining and Quarrying                           |
| 17            | Processing and Preserving of Meat                    |
| 18            | Processing and Preserving of Seafood                 |
| 19            | Processing and Preserving of Fruits and Vegetables   |
| 20            | Dairy Products                                       |
| Oils and Fats | Vegetable and Animal Oils and Fats                   |
| 22            | Grain Mill Products, Starches, and Starch Products   |
| 23            | Bakery Products                                      |
| 24            | Confectionery  |
| 25            | Other Food Processing                                |
| 26            | Prepared Animal Feeds                                |
| 27            | Spirits, Wines, and Liquors                          |
| 28            | Soft Drinks, Mineral Waters and Other Bottled Waters |
| 29            | Tobacco Products                                     |
| 30            | Preparation, Spinning, and Weaving of Textiles       |
| 31            | Finishing of Textiles                                |
| 32            | Other Textiles                                       |
| 33            | Wearing Apparel                                      |
| 34            | Leather Products                                     |
| 35            | Footwear   |
| 36            | Sawmilling and Planning of Wood                      |
| 37            | Veneer Sheets and Wood-based Panels                  |
| 38            | Builders' Carpentry and Joinery                      |
| 39            | Wooden Containers and Other Wood Products            |
| 40            | Paper and Paper Products                             |

| Code (S/VA) | Sub-Sector  |
|-------------|---|
| 41          | Furniture   |
| 42          | Reproduction of Recorded Media  |
| 43          | Printing  |
| 44          | Coke and Refined Petroleum Products   |
| 45          | Basic Chemicals   |
| 46          | Fertilizers and Nitrogen Compounds  |
| 47          | Paints and Varnishes  |
| 48          | Pharmaceuticals, Medicinal Chemical, and Botanical Products                 |
| 49          | Soaps and Detergents, Cleaning and Polishing, Perfumes, Toilet Preparations |
| 50          | Other Chemicals Products  |
| 51          | Rubber Tyres and Tubes  |
| 52          | Rubber Processing   |
| 53          | Rubber Gloves   |
| 54          | Other Rubber Products   |
| 55          | Plastic Products  |
| 56          | Glass and Glass Products  |
| 57          | Refractory, Clay, Porcelain, and Ceramic Products                           |
| 58          | Cement, Lime, and Plaster   |
| 59          | Non-Metallic Mineral Products   |
| 60          | Basic Iron and Steel  |
| 61          | Basic Precious and Other Non-Ferrous Metals                                 |
| 62          | Casting of Metals   |
| 63          | Structural Metal Products, Tanks, Reservoirs, and Steam Generators          |
| 64          | Other Fabricated Metal Products   |
| 65          | Engines and Turbines, Fluid Power Equipment, Other Pumps and others         |
| 66          | Other General Purpose Machinery   |
| 67          | Weapons, Ammunition, and Special Purpose Machinery                          |
| 68          | Domestic Appliances   |
| 69          | Computers, Peripheral, Office Equipment, and Machinery                      |
| 70          | Electric Motors, Generators, and Transformers                               |
| 71          | Electricity Distribution and Control Apparatus, Batteries, and Accumulators |
| 72          | Fibre Optic, Electronic, and Other Electric Cables                          |
| 73          | Wiring Devices, Electric Lighting Equipment, and Other Electrical           |
| 74          | Electronic Components and Boards  |
| 75          | Communication Equipment and Consumer Electronics                            |
| 76          | Irradiation Equipment, Electro Medical, and Electrotherapeutic"             |
| 77          | Measuring Equipment, Testing, Navigating, and Control                       |
| 78          | Optical Instruments, Photographic Equipment, Magnetic, and Optical Media    |
| 79          | Watches and Clocks  |
| 80          | Motor Vehicles, Trailers, and Semi Trailers                                 |
| 81          | Motorcycles   |
| 82          | Ships, Boats, Bicycles, and Invalid Carriages                               |
| 83          | Other Transport Equipment   |
| 84          | Other Manufacturing   |
| 85          | Repair and Installation of Machinery and Equipment                          |
| 86          | Electricity and Gas   |
| 87          | Water   |
| 88          | Sewerage, Waste Management and Remediation Activities                       |
| 89          | Residential Buildings   |
| 90          | Non-Residential Buildings   |
| 91          | Civil Engineering   |
| 92          | Specialized Construction Activities   |
| 93          | Wholesale and Retail Trade, Repair of Motor Vehicles and Motorcycles        |
| 94          | Accommodation   |



| Code (S/VA) | Sub-Sector  |
|-------------|---|
| 95          | Food and Beverage   |
| 96          | Land Transport  |
| 97          | Water Transport   |
| 98          | Air Transport   |
| 99          | Warehousing and Support Activities for Transportation           |
| 100         | Services Incidental to Water and Air Transportation             |
| 101         | Highway Operation Services, Bridge and Tunnel                   |
| 102         | Postal and Courier Activities                                   |
| 103         | Publishing Activities   |
| 104         | Telecommunications  |
| 105         | Motion Picture, Programming, and Broadcasting Activities        |
| 106         | Computer and Information Services                               |
| 107         | Monetary Intermediation   |
| 108         | Other Financial Service   |
| 109         | Insurance/ Takaful and Pension Funding                          |
| 110         | Activities Auxiliary to Financial Service and Insurance/Takaful |
| 111         | Real Estate   |
| 112         | Ownership of Dwellings  |
| 113         | Rental and Leasing  |
| 114         | Scientific Research and Development                             |
| 115         | Professional  |
| 116         | Business Services   |
| 117         | Public Administration   |
| 118         | Education   |
| 119         | Health  |
| 120         | Public Order and Safety   |
| 121         | Other Public Administration                                     |
| 122         | Non-Profit Institutions Serving Households                      |
| 123         | Arts, Entertainment and Recreation                              |
| 124         | Other Private Services  |

#### Appendix B. Results of Multiplier Analysis for the Output of Oil Palm Sub-Sector and Oils and Fats Sub-Sector Based on Malaysia Input-Output Table 2015

| No. | Sub-Sector | Oil Palm Sub-Sector |                        |                   | Oils and Fats Sub-Sector |                        |                   |
|-----|------------|---------------------|------------------------|-------------------|--------------------------|------------------------|-------------------|
|     |            | Output Multiplier   | Value Added Multiplier | Import Multiplier | Output Multiplier        | Value Added Multiplier | Import Multiplier |
| 1   | S-1        | 0.000351            | 0.000271               | 0.000079          | 0.000730                 | 0.000043               | 0.000687          |
| 2   | S-2        | 0.000427            | 0.000330               | 0.000097          | 0.000868                 | 0.000051               | 0.000816          |
| 3   | S-3        | 0.000560            | 0.000434               | 0.000127          | 0.001164                 | 0.000069               | 0.001096          |
| 4   | S-4        | 0.000741            | 0.000573               | 0.000168          | 0.001624                 | 0.000096               | 0.001528          |
| 5   | S-5        | 0.000533            | 0.000412               | 0.000121          | 0.001037                 | 0.000061               | 0.000976          |
| 6   | S-Oil palm | 1.000547            | 0.774124               | 0.226423          | 0.001148                 | 0.000068               | 0.001081          |
| 7   | S-7        | 0.000818            | 0.000633               | 0.000185          | 0.001718                 | 0.000101               | 0.001616          |
| 8   | S-8        | 0.001047            | 0.000810               | 0.000237          | 0.002843                 | 0.000168               | 0.002675          |
| 9   | S-9        | 0.003444            | 0.002665               | 0.000779          | 0.010303                 | 0.000609               | 0.009694          |
| 10  | S-10       | 0.004419            | 0.003419               | 0.001000          | 0.013263                 | 0.000784               | 0.012480          |

| No. | Oil Palm Sub-Sector |                   |                        | Oils and Fats Sub-Sector |                   |                        |                   |
|-----|---------------------|-------------------|------------------------|--------------------------|-------------------|------------------------|-------------------|
|     | Sub-Sector          | Output Multiplier | Value Added Multiplier | Import Multiplier        | Output Multiplier | Value Added Multiplier | Import Multiplier |
| 11  | S-11                | 0.000578          | 0.000447               | 0.000131                 | 0.001108          | 0.000065               | 0.001043          |
| 12  | S-12                | 0.000860          | 0.000665               | 0.000195                 | 0.002240          | 0.000132               | 0.002108          |
| 13  | S-13                | 0.000416          | 0.000322               | 0.000094                 | 0.000894          | 0.000053               | 0.000841          |
| 14  | S-14                | 0.001264          | 0.000978               | 0.000286                 | 0.002470          | 0.000146               | 0.002324          |
| 15  | S-15                | 0.001406          | 0.001088               | 0.000318                 | 0.002488          | 0.000147               | 0.002341          |
| 16  | S-16                | 0.001589          | 0.001230               | 0.000360                 | 0.003034          | 0.000179               | 0.002855          |
| 17  | S-17                | 0.008744          | 0.006765               | 0.001979                 | 0.024058          | 0.001421               | 0.022636          |
| 18  | S-18                | 0.002367          | 0.001831               | 0.000536                 | 0.005741          | 0.000339               | 0.005402          |
| 19  | S-19                | 0.003630          | 0.002809               | 0.000822                 | 0.010597          | 0.000626               | 0.009971          |
| 20  | S-20                | 0.009505          | 0.007354               | 0.002151                 | 0.030635          | 0.001810               | 0.028825          |
| 21  | S-Oils and Fats     | 0.375037          | 0.290166               | 0.084870                 | 1.331213          | 0.078652               | 1.252561          |
| 22  | S-22                | 0.002949          | 0.002282               | 0.000667                 | 0.008205          | 0.000485               | 0.007721          |
| 23  | S-23                | 0.023067          | 0.017847               | 0.005220                 | 0.079108          | 0.004674               | 0.074434          |
| 24  | S-24                | 0.013851          | 0.010717               | 0.003135                 | 0.042533          | 0.002513               | 0.040020          |
| 25  | S-25                | 0.020192          | 0.015622               | 0.004569                 | 0.069035          | 0.004079               | 0.064956          |
| 26  | S-26                | 0.011641          | 0.009007               | 0.002634                 | 0.037902          | 0.002239               | 0.035662          |
| 27  | S-27                | 0.005000          | 0.003868               | 0.001131                 | 0.014976          | 0.000885               | 0.014091          |
| 28  | S-28                | 0.011271          | 0.008720               | 0.002551                 | 0.025473          | 0.001505               | 0.023968          |
| 29  | S-29                | 0.001043          | 0.000807               | 0.000236                 | 0.002617          | 0.000155               | 0.002462          |
| 30  | S-30                | 0.000709          | 0.000548               | 0.000160                 | 0.001056          | 0.000062               | 0.000993          |
| 31  | S-31                | 0.001144          | 0.000885               | 0.000259                 | 0.001576          | 0.000093               | 0.001483          |
| 32  | S-32                | 0.001493          | 0.001155               | 0.000338                 | 0.002098          | 0.000124               | 0.001974          |
| 33  | S-33                | 0.001179          | 0.000912               | 0.000267                 | 0.001776          | 0.000105               | 0.001671          |
| 34  | S-34                | 0.003103          | 0.002401               | 0.000702                 | 0.005799          | 0.000343               | 0.005456          |
| 35  | S-35                | 0.001282          | 0.000992               | 0.000290                 | 0.002015          | 0.000119               | 0.001896          |
| 36  | S-36                | 0.001376          | 0.001065               | 0.000311                 | 0.001902          | 0.000112               | 0.001789          |
| 37  | S-37                | 0.001675          | 0.001296               | 0.000379                 | 0.002106          | 0.000124               | 0.001982          |
| 38  | S-38                | 0.001573          | 0.001217               | 0.000356                 | 0.002262          | 0.000134               | 0.002128          |
| 39  | S-39                | 0.001551          | 0.001200               | 0.000351                 | 0.002295          | 0.000136               | 0.002159          |
| 40  | S-40                | 0.001495          | 0.001157               | 0.000338                 | 0.002110          | 0.000125               | 0.001986          |
| 41  | S-41                | 0.001477          | 0.001143               | 0.000334                 | 0.002173          | 0.000128               | 0.002045          |
| 42  | S-42                | 0.001565          | 0.001211               | 0.000354                 | 0.002249          | 0.000133               | 0.002116          |
| 43  | S-43                | 0.001346          | 0.001041               | 0.000305                 | 0.002159          | 0.000128               | 0.002031          |
| 44  | S-44                | 0.001757          | 0.001359               | 0.000398                 | 0.002001          | 0.000118               | 0.001883          |
| 45  | S-45                | 0.001858          | 0.001438               | 0.000421                 | 0.002431          | 0.000144               | 0.002287          |
| 46  | S-46                | 0.001310          | 0.001014               | 0.000297                 | 0.001821          | 0.000108               | 0.001713          |

| No. | Oil Palm Sub-Sector |                   |                        | Oils and Fats Sub-Sector |                   |                        |                   |
|-----|---------------------|-------------------|------------------------|--------------------------|-------------------|------------------------|-------------------|
|     | Sub-Sector          | Output Multiplier | Value Added Multiplier | Import Multiplier        | Output Multiplier | Value Added Multiplier | Import Multiplier |
| 47  | S-47                | 0.001712          | 0.001325               | 0.000387                 | 0.002460          | 0.000145               | 0.002315          |
| 48  | S-48                | 0.003327          | 0.002574               | 0.000753                 | 0.005394          | 0.000319               | 0.005076          |
| 49  | S-49                | 0.025042          | 0.019375               | 0.005667                 | 0.027717          | 0.001638               | 0.026079          |
| 50  | S-50                | 0.005838          | 0.004517               | 0.001321                 | 0.005826          | 0.000344               | 0.005482          |
| 51  | S-51                | 0.001869          | 0.001446               | 0.000423                 | 0.002252          | 0.000133               | 0.002119          |
| 52  | S-52                | 0.001508          | 0.001167               | 0.000341                 | 0.001761          | 0.000104               | 0.001657          |
| 53  | S-53                | 0.002379          | 0.001841               | 0.000538                 | 0.004490          | 0.000265               | 0.004225          |
| 54  | S-54                | 0.001778          | 0.001376               | 0.000402                 | 0.002822          | 0.000167               | 0.002655          |
| 55  | S-55                | 0.002556          | 0.001978               | 0.000578                 | 0.004452          | 0.000263               | 0.004189          |
| 56  | S-56                | 0.001415          | 0.001095               | 0.000320                 | 0.001874          | 0.000111               | 0.001763          |
| 57  | S-57                | 0.001672          | 0.001293               | 0.000378                 | 0.003002          | 0.000177               | 0.002824          |
| 58  | S-58                | 0.001498          | 0.001159               | 0.000339                 | 0.001987          | 0.000117               | 0.001869          |
| 59  | S-59                | 0.001690          | 0.001307               | 0.000382                 | 0.002516          | 0.000149               | 0.002367          |
| 60  | S-60                | 0.001599          | 0.001237               | 0.000362                 | 0.002834          | 0.000167               | 0.002666          |
| 61  | S-61                | 0.001431          | 0.001107               | 0.000324                 | 0.002073          | 0.000122               | 0.001950          |
| 62  | S-62                | 0.001411          | 0.001092               | 0.000319                 | 0.002501          | 0.000148               | 0.002353          |
| 63  | S-63                | 0.001260          | 0.000975               | 0.000285                 | 0.002045          | 0.000121               | 0.001924          |
| 64  | S-64                | 0.001194          | 0.000924               | 0.000270                 | 0.001955          | 0.000115               | 0.001839          |
| 65  | S-65                | 0.000933          | 0.000722               | 0.000211                 | 0.001358          | 0.000080               | 0.001278          |
| 66  | S-66                | 0.001287          | 0.000996               | 0.000291                 | 0.001971          | 0.000116               | 0.001855          |
| 67  | S-67                | 0.001207          | 0.000934               | 0.000273                 | 0.001958          | 0.000116               | 0.001843          |
| 68  | S-68                | 0.001153          | 0.000892               | 0.000261                 | 0.001536          | 0.000091               | 0.001445          |
| 69  | S-69                | 0.001029          | 0.000796               | 0.000233                 | 0.001268          | 0.000075               | 0.001193          |
| 70  | S-70                | 0.001031          | 0.000797               | 0.000233                 | 0.001441          | 0.000085               | 0.001356          |
| 71  | S-71                | 0.001194          | 0.000923               | 0.000270                 | 0.001641          | 0.000097               | 0.001544          |
| 72  | S-72                | 0.001339          | 0.001036               | 0.000303                 | 0.001917          | 0.000113               | 0.001804          |
| 73  | S-73                | 0.001227          | 0.000949               | 0.000278                 | 0.001922          | 0.000114               | 0.001808          |
| 74  | S-74                | 0.001098          | 0.000850               | 0.000248                 | 0.001447          | 0.000086               | 0.001362          |
| 75  | S-75                | 0.001042          | 0.000806               | 0.000236                 | 0.001366          | 0.000081               | 0.001285          |
| 76  | S-76                | 0.001130          | 0.000874               | 0.000256                 | 0.001628          | 0.000096               | 0.001532          |
| 77  | S-77                | 0.001061          | 0.000821               | 0.000240                 | 0.001475          | 0.000087               | 0.001388          |
| 78  | S-78                | 0.001163          | 0.000900               | 0.000263                 | 0.001564          | 0.000092               | 0.001472          |
| 79  | S-79                | 0.000986          | 0.000763               | 0.000223                 | 0.001469          | 0.000087               | 0.001382          |
| 80  | S-80                | 0.001034          | 0.000800               | 0.000234                 | 0.001559          | 0.000092               | 0.001467          |
| 81  | S-81                | 0.000935          | 0.000723               | 0.000212                 | 0.001559          | 0.000092               | 0.001467          |
| 82  | S-82                | 0.001035          | 0.000801               | 0.000234                 | 0.001648          | 0.000097               | 0.001551          |
| 83  | S-83                | 0.001106          | 0.000856               | 0.000250                 | 0.001664          | 0.000098               | 0.001566          |
| 84  | S-84                | 0.007430          | 0.005749               | 0.001681                 | 0.007368          | 0.000435               | 0.006933          |

| No. | Oil Palm Sub-Sector |                   |                        | Oils and Fats Sub-Sector |                   |                        |                   |
|-----|---------------------|-------------------|------------------------|--------------------------|-------------------|------------------------|-------------------|
|     | Sub-Sector          | Output Multiplier | Value Added Multiplier | Import Multiplier        | Output Multiplier | Value Added Multiplier | Import Multiplier |
| 85  | S-85                | 0.001644          | 0.001272               | 0.000372                 | 0.002752          | 0.000163               | 0.002590          |
| 86  | S-86                | 0.000764          | 0.000591               | 0.000173                 | 0.001008          | 0.000060               | 0.000948          |
| 87  | S-87                | 0.000731          | 0.000566               | 0.000165                 | 0.001164          | 0.000069               | 0.001095          |
| 88  | S-88                | 0.001156          | 0.000894               | 0.000262                 | 0.001906          | 0.000113               | 0.001794          |
| 89  | S-89                | 0.001333          | 0.001031               | 0.000302                 | 0.001898          | 0.000112               | 0.001786          |
| 90  | S-90                | 0.001312          | 0.001015               | 0.000297                 | 0.001868          | 0.000110               | 0.001757          |
| 91  | S-91                | 0.001331          | 0.001030               | 0.000301                 | 0.001983          | 0.000117               | 0.001866          |
| 92  | S-92                | 0.001402          | 0.001084               | 0.000317                 | 0.002323          | 0.000137               | 0.002185          |
| 93  | S-93                | 0.006864          | 0.005310               | 0.001553                 | 0.006785          | 0.000401               | 0.006384          |
| 94  | S-94                | 0.001185          | 0.000917               | 0.000268                 | 0.002711          | 0.000160               | 0.002551          |
| 95  | S-95                | 0.074454          | 0.057605               | 0.016849                 | 0.262275          | 0.015496               | 0.246779          |
| 96  | S-96                | 0.001290          | 0.000998               | 0.000292                 | 0.001998          | 0.000118               | 0.001879          |
| 97  | S-97                | 0.002918          | 0.002258               | 0.000660                 | 0.008373          | 0.000495               | 0.007878          |
| 98  | S-98                | 0.006362          | 0.004922               | 0.001440                 | 0.020693          | 0.001223               | 0.019470          |
| 99  | S-99                | 0.002320          | 0.001795               | 0.000525                 | 0.005673          | 0.000335               | 0.005337          |
| 100 | S-100               | 0.002562          | 0.001982               | 0.000580                 | 0.007957          | 0.000470               | 0.007487          |
| 101 | S-101               | 0.000363          | 0.000280               | 0.000082                 | 0.000771          | 0.000046               | 0.000726          |
| 102 | S-102               | 0.001042          | 0.000807               | 0.000236                 | 0.001677          | 0.000099               | 0.001578          |
| 103 | S-103               | 0.001090          | 0.000844               | 0.000247                 | 0.002459          | 0.000145               | 0.002314          |
| 104 | S-104               | 0.001170          | 0.000906               | 0.000265                 | 0.003352          | 0.000198               | 0.003154          |
| 105 | S-105               | 0.001342          | 0.001039               | 0.000304                 | 0.003701          | 0.000219               | 0.003482          |
| 106 | S-106               | 0.001950          | 0.001508               | 0.000441                 | 0.005718          | 0.000338               | 0.005380          |
| 107 | S-107               | 0.000453          | 0.000350               | 0.000103                 | 0.000982          | 0.000058               | 0.000924          |
| 108 | S-108               | 0.000651          | 0.000503               | 0.000147                 | 0.001512          | 0.000089               | 0.001423          |
| 109 | S-109               | 0.001312          | 0.001015               | 0.000297                 | 0.003812          | 0.000225               | 0.003587          |
| 110 | S-110               | 0.001052          | 0.000814               | 0.000238                 | 0.002691          | 0.000159               | 0.002532          |
| 111 | S-111               | 0.002503          | 0.001937               | 0.000567                 | 0.003687          | 0.000218               | 0.003469          |
| 112 | S-112               | 0.000206          | 0.000159               | 0.000047                 | 0.000331          | 0.000020               | 0.000311          |
| 113 | S-113               | 0.003619          | 0.002800               | 0.000819                 | 0.007811          | 0.000462               | 0.007350          |
| 114 | S-114               | 0.001269          | 0.000982               | 0.000287                 | 0.003420          | 0.000202               | 0.003218          |
| 115 | S-115               | 0.002451          | 0.001896               | 0.000555                 | 0.005018          | 0.000297               | 0.004722          |
| 116 | S-116               | 0.002658          | 0.002056               | 0.000601                 | 0.007652          | 0.000452               | 0.007200          |
| 117 | S-117               | 0.002881          | 0.002229               | 0.000652                 | 0.008911          | 0.000527               | 0.008385          |
| 118 | S-118               | 0.001689          | 0.001307               | 0.000382                 | 0.004883          | 0.000289               | 0.004595          |
| 119 | S-119               | 0.002796          | 0.002163               | 0.000633                 | 0.007974          | 0.000471               | 0.007503          |
| 120 | S-120               | 0.003726          | 0.002883               | 0.000843                 | 0.011837          | 0.000699               | 0.011138          |

| No. | Oil Palm Sub-Sector |                   |                        | Oils and Fats Sub-Sector |                   |                        |                   |
|-----|---------------------|-------------------|------------------------|--------------------------|-------------------|------------------------|-------------------|
|     | Sub-Sector          | Output Multiplier | Value Added Multiplier | Import Multiplier        | Output Multiplier | Value Added Multiplier | Import Multiplier |
| 121 | S-121               | 0.002084          | 0.001612               | 0.000472                 | 0.006165          | 0.000364               | 0.005800          |
| 122 | S-122               | 0.002244          | 0.001736               | 0.000508                 | 0.005442          | 0.000322               | 0.005120          |
| 123 | S-123               | 0.003624          | 0.002804               | 0.000820                 | 0.010984          | 0.000649               | 0.010335          |
| 124 | S-124               | 0.000766          | 0.000593               | 0.000173                 | 0.001982          | 0.000117               | 0.001865          |
|     | <b>Total</b>        | <b>1.771354</b>   | <b>1.370498</b>        | <b>0.400855</b>          | <b>2.326711</b>   | <b>0.137470</b>        | <b>2.189242</b>   |

### Appendix C. Nodes Results

| No. | Sub-Sector       | In-Degree | Out-Degree | Betweenness | In-Clustering | Out-Clustering | Cluster Ratio |
|-----|------------------|-----------|------------|-------------|---------------|----------------|---------------|
| 1   | VA-1             | 0.073     | 0.378      | 0.072       | 0.001         | 0.003          | 0.874         |
| 2   | VA-2             | 0.09      | 0.005      | 0           | 0.001         | 0.000          | 0.943         |
| 3   | VA-3             | 0.113     | 0.051      | 0.124       | 0.001         | 0.000          | 0.873         |
| 4   | VA-4             | 0.165     | 0.152      | 0.515       | 0.001         | 0.001          | 0.873         |
| 5   | VA-5             | 0.135     | 0.032      | 0.031       | 0.001         | 0.000          | 0.887         |
| 6   | VA-Oil Palm      | 0.114     | 0.596      | 0.124       | 0.001         | 0.005          | 0.873         |
| 7   | VA-7             | 0.153     | 0.012      | 0.624       | 0.001         | 0.000          | 0.873         |
| 8   | VA-8             | 0.113     | 0.279      | 0.124       | 0.001         | 0.002          | 0.873         |
| 9   | VA-9             | 0.261     | 0.414      | 1.209       | 0.002         | 0.003          | 0.873         |
| 10  | VA-10            | 0.338     | 0.178      | 7.287       | 0.003         | 0.001          | 0.873         |
| 11  | VA-11            | 0.103     | 0.779      | 0.732       | 0.001         | 0.006          | 0.873         |
| 12  | VA-12            | 0.111     | 0.593      | 0.124       | 0.001         | 0.005          | 0.873         |
| 13  | VA-13            | 0.056     | 3.976      | 0.501       | 0.000         | 0.032          | 0.873         |
| 14  | VA-14            | 0.346     | 0.04       | 5.327       | 0.003         | 0.000          | 0.873         |
| 15  | VA-15            | 0.348     | 0.131      | 5.327       | 0.003         | 0.001          | 0.873         |
| 16  | VA-16            | 0.393     | 0.021      | 6.201       | 0.003         | 0.000          | 0.873         |
| 17  | VA-17            | 0.602     | 0.046      | 11.102      | 0.005         | 0.000          | 0.873         |
| 18  | VA-18            | 0.632     | 0.058      | 6.413       | 0.005         | 0.000          | 0.873         |
| 19  | VA-19            | 0.376     | 0.04       | 7.287       | 0.003         | 0.000          | 0.873         |
| 20  | VA-20            | 0.391     | 0.003      | 1.763       | 0.003         | 0.000          | 0.927         |
| 21  | VA-Oils and Fats | 0.661     | 0.059      | 11.102      | 0.005         | 0.000          | 0.873         |
| 22  | VA-22            | 0.366     | 0.073      | 6.97        | 0.003         | 0.001          | 0.873         |
| 23  | VA-23            | 0.378     | 0.007      | 9.267       | 0.003         | 0.000          | 0.873         |
| 24  | VA-24            | 0.288     | 0.074      | 6.984       | 0.002         | 0.001          | 0.873         |
| 25  | VA-25            | 0.342     | 0.068      | 9.123       | 0.003         | 0.001          | 0.873         |
| 26  | VA-26            | 0.611     | 0.129      | 7.287       | 0.005         | 0.001          | 0.873         |
| 27  | VA-27            | 0.332     | 0.004      | 8.596       | 0.003         | 0.000          | 0.881         |
| 28  | VA-28            | 0.369     | 0.033      | 9.267       | 0.003         | 0.000          | 0.873         |
| 29  | VA-29            | 0.141     | 0.003      | 6.338       | 0.001         | 0.000          | 0.881         |
| 30  | VA-30            | 0.202     | 0.122      | 1.606       | 0.002         | 0.001          | 0.873         |
| 31  | VA-31            | 0.311     | 0.035      | 2.257       | 0.003         | 0.000          | 0.881         |
| 32  | VA-32            | 0.3       | 0.002      | 0.061       | 0.002         | 0.000          | 0.948         |
| 33  | VA-33            | 0.292     | 0.014      | 29.678      | 0.002         | 0.000          | 0.873         |
| 34  | VA-34            | 0.345     | 0.01       | 4.308       | 0.003         | 0.000          | 0.89          |
| 35  | VA-35            | 0.283     | 0.02       | 2.083       | 0.002         | 0.000          | 0.873         |
| 36  | VA-36            | 0.479     | 0.287      | 4.193       | 0.004         | 0.002          | 0.873         |
| 37  | VA-37            | 0.483     | 0.14       | 4.193       | 0.004         | 0.001          | 0.873         |
| 38  | VA-38            | 0.466     | 0.016      | 3.085       | 0.004         | 0.000          | 0.879         |
| 39  | VA-39            | 0.451     | 0.023      | 4.193       | 0.004         | 0.000          | 0.873         |
| 40  | VA-40            | 0.393     | 0.043      | 20.461      | 0.003         | 0.000          | 0.873         |

| No. | Sub-Sector | In-Degree | Out-Degree | Betweenness | In-Clustering | Out-Clustering | Cluster Ratio |
|-----|------------|-----------|------------|-------------|---------------|----------------|---------------|
| 41  | VA-41      | 0.41      | 0.026      | 4.193       | 0.003         | 0.000          | 0.873         |
| 42  | VA-42      | 0.325     | 0          | 0.519       | 0.003         | 0.000          | 0.969         |
| 43  | VA-43      | 0.29      | 0.132      | 18.958      | 0.002         | 0.001          | 0.873         |
| 44  | VA-44      | 0.522     | 2.229      | 1.195       | 0.004         | 0.018          | 0.873         |
| 45  | VA-45      | 0.406     | 0.976      | 6.413       | 0.003         | 0.008          | 0.873         |
| 46  | VA-46      | 0.337     | 0.127      | 6.096       | 0.003         | 0.001          | 0.873         |
| 47  | VA-47      | 0.333     | 0.113      | 4.193       | 0.003         | 0.001          | 0.873         |
| 48  | VA-48      | 0.268     | 0.092      | 7.287       | 0.002         | 0.001          | 0.873         |
| 49  | VA-49      | 0.301     | 0.014      | 7.1         | 0.002         | 0.000          | 0.873         |
| 50  | VA-50      | 0.364     | 0.347      | 4.193       | 0.003         | 0.003          | 0.873         |
| 51  | VA-51      | 0.375     | 0.028      | 6.172       | 0.003         | 0.000          | 0.873         |
| 52  | VA-52      | 0.265     | 0.156      | 4.193       | 0.002         | 0.001          | 0.873         |
| 53  | VA-53      | 0.293     | 0.011      | 1.966       | 0.002         | 0.000          | 0.881         |
| 54  | VA-54      | 0.301     | 0.08       | 3.889       | 0.002         | 0.001          | 0.873         |
| 55  | VA-55      | 0.271     | 0.181      | 3.918       | 0.002         | 0.001          | 0.873         |
| 56  | VA-56      | 0.329     | 0.042      | 2.386       | 0.003         | 0.000          | 0.873         |
| 57  | VA-57      | 0.363     | 0.039      | 2.386       | 0.003         | 0.000          | 0.873         |
| 58  | VA-58      | 0.397     | 0.137      | 4.193       | 0.003         | 0.001          | 0.873         |
| 59  | VA-59      | 0.411     | 0.174      | 8.007       | 0.003         | 0.001          | 0.873         |
| 60  | VA-60      | 0.375     | 0.311      | 6.028       | 0.003         | 0.003          | 0.873         |
| 61  | VA-61      | 0.385     | 0.073      | 4.193       | 0.003         | 0.001          | 0.873         |
| 62  | VA-62      | 0.316     | 0.035      | 6.201       | 0.003         | 0.000          | 0.873         |
| 63  | VA-63      | 0.312     | 0.257      | 4.222       | 0.003         | 0.002          | 0.873         |
| 64  | VA-64      | 0.274     | 0.659      | 4.222       | 0.002         | 0.005          | 0.873         |
| 65  | VA-65      | 0.256     | 0.022      | 4.222       | 0.002         | 0.000          | 0.873         |
| 66  | VA-66      | 0.316     | 0.081      | 4.222       | 0.003         | 0.001          | 0.873         |
| 67  | VA-67      | 0.296     | 0.035      | 4.222       | 0.002         | 0.000          | 0.873         |
| 68  | VA-68      | 0.284     | 0.002      | 0.463       | 0.002         | 0.000          | 0.91          |
| 69  | VA-69      | 0.25      | 0.099      | 1.209       | 0.002         | 0.001          | 0.873         |
| 70  | VA-70      | 0.262     | 0.018      | 1.512       | 0.002         | 0.000          | 0.873         |
| 71  | VA-71      | 0.28      | 0.009      | 3.359       | 0.002         | 0.000          | 0.879         |
| 72  | VA-72      | 0.347     | 0.031      | 6.028       | 0.003         | 0.000          | 0.873         |
| 73  | VA-73      | 0.281     | 0.005      | 3.101       | 0.002         | 0.000          | 0.879         |
| 74  | VA-74      | 0.235     | 0.502      | 1.512       | 0.002         | 0.004          | 0.873         |
| 75  | VA-75      | 0.23      | 0.403      | 0.891       | 0.002         | 0.003          | 0.873         |
| 76  | VA-76      | 0.265     | 0.009      | 1.401       | 0.002         | 0.000          | 0.881         |
| 77  | VA-77      | 0.261     | 0.021      | 1.512       | 0.002         | 0.000          | 0.873         |
| 78  | VA-78      | 0.283     | 0.018      | 4.222       | 0.002         | 0.000          | 0.873         |
| 79  | VA-79      | 0.248     | 0.001      | 0.516       | 0.002         | 0.000          | 0.945         |
| 80  | VA-80      | 0.241     | 0.667      | 4.222       | 0.002         | 0.005          | 0.873         |
| 81  | VA-81      | 0.259     | 0          | 0           | 0.002         | 0.000          | 0.988         |
| 82  | VA-82      | 0.332     | 0.09       | 12.751      | 0.003         | 0.001          | 0.873         |
| 83  | VA-83      | 0.297     | 0.01       | 4.072       | 0.002         | 0.000          | 0.873         |
| 84  | VA-84      | 0.316     | 0.1        | 33.32       | 0.003         | 0.001          | 0.873         |
| 85  | VA-85      | 0.344     | 0.443      | 20.793      | 0.003         | 0.004          | 0.873         |
| 86  | VA-86      | 0.252     | 1.519      | 0.718       | 0.002         | 0.012          | 0.873         |
| 87  | VA-87      | 0.262     | 0.172      | 4.532       | 0.002         | 0.001          | 0.873         |
| 88  | VA-88      | 0.298     | 0.179      | 11.56       | 0.002         | 0.001          | 0.873         |
| 89  | VA-89      | 0.398     | 0          | 0           | 0.003         | 0.000          | 0.977         |
| 90  | VA-90      | 0.394     | 0          | 0           | 0.003         | 0.000          | 0.977         |
| 91  | VA-91      | 0.396     | 0.023      | 3.027       | 0.003         | 0.000          | 0.891         |
| 92  | VA-92      | 0.385     | 0.518      | 6.201       | 0.003         | 0.004          | 0.873         |
| 93  | VA-93      | 0.207     | 7.487      | 11.102      | 0.002         | 0.060          | 0.873         |
| 94  | VA-94      | 0.283     | 0.072      | 19.586      | 0.002         | 0.001          | 0.873         |
| 95  | VA-95      | 0.377     | 0.36       | 11.102      | 0.003         | 0.003          | 0.873         |

| No. | Sub-Sector | In-Degree | Out-Degree | Betweenness | In-Clustering | Out-Clustering | Cluster Ratio |
|-----|------------|-----------|------------|-------------|---------------|----------------|---------------|
| 96  | VA-96      | 0.368     | 0.486      | 3.492       | 0.003         | 0.004          | 0.873         |
| 97  | VA-97      | 0.408     | 0.235      | 51.179      | 0.003         | 0.002          | 0.873         |
| 98  | VA-98      | 0.48      | 0.22       | 16.778      | 0.004         | 0.002          | 0.873         |
| 99  | VA-99      | 0.391     | 0.163      | 8.421       | 0.003         | 0.001          | 0.873         |
| 100 | VA-100     | 0.21      | 0.19       | 7.627       | 0.002         | 0.002          | 0.873         |
| 101 | VA-101     | 0.09      | 0.21       | 0.624       | 0.001         | 0.002          | 0.873         |
| 102 | VA-102     | 0.321     | 0.038      | 3.015       | 0.003         | 0.000          | 0.873         |
| 103 | VA-103     | 0.289     | 0.086      | 44.581      | 0.002         | 0.001          | 0.873         |
| 104 | VA-104     | 0.219     | 0.604      | 2.697       | 0.002         | 0.005          | 0.873         |
| 105 | VA-105     | 0.247     | 0.052      | 2.388       | 0.002         | 0.000          | 0.887         |
| 106 | VA-106     | 0.243     | 0.246      | 4.532       | 0.002         | 0.002          | 0.873         |
| 107 | VA-107     | 0.151     | 1.278      | 9.248       | 0.001         | 0.010          | 0.873         |
| 108 | VA-108     | 0.2       | 0.769      | 9.565       | 0.002         | 0.006          | 0.873         |
| 109 | VA-109     | 0.249     | 0.481      | 9.248       | 0.002         | 0.004          | 0.873         |
| 110 | VA-110     | 0.331     | 0.139      | 32.648      | 0.003         | 0.001          | 0.873         |
| 111 | VA-111     | 0.245     | 0.379      | 59.814      | 0.002         | 0.003          | 0.872         |
| 112 | VA-112     | 0.088     | 0          | 0           | 0.001         | 0.000          | 0.998         |
| 113 | VA-113     | 0.266     | 0.206      | 57.624      | 0.002         | 0.002          | 0.872         |
| 114 | VA-114     | 0.268     | 0          | 0           | 0.002         | 0.000          | 0.965         |
| 115 | VA-115     | 0.198     | 3.316      | 59.814      | 0.002         | 0.027          | 0.872         |
| 116 | VA-116     | 0.369     | 0.397      | 38.372      | 0.003         | 0.003          | 0.873         |
| 117 | VA-117     | 0.248     | 0.13       | 1.006       | 0.002         | 0.001          | 0.914         |
| 118 | VA-118     | 0.221     | 0.026      | 0.222       | 0.002         | 0.000          | 0.935         |
| 119 | VA-119     | 0.292     | 0          | 0.68        | 0.002         | 0.000          | 0.943         |
| 120 | VA-120     | 0.385     | 0          | 0           | 0.003         | 0.000          | 0.955         |
| 121 | VA-121     | 0.206     | 0          | 0           | 0.002         | 0.000          | 0.96          |
| 122 | VA-122     | 0.458     | 0          | 0           | 0.004         | 0.000          | 0.972         |
| 123 | VA-123     | 0.353     | 0.02       | 2.976       | 0.003         | 0.000          | 0.913         |
| 124 | VA-124     | 0.312     | 0.111      | 3.015       | 0.003         | 0.001          | 0.873         |

## Notes

- <sup>1</sup> Based on the value of the output multiplier, value added multiplier, and import multiplier, every RM1.00 increase in output for the Oils and Fats sub-sector will further increase the production of the Oil Palm sub-sector by RM0.38. However, from the increase of RM0.38 from the Oil Palm sub-sector, only RM0.29 is owned by Malaysia while the remaining RM0.08 is through import input.
- <sup>2</sup> Each color represents different sector.
- <sup>3</sup> For the full results of in-degrees and out-degrees based on value-added multipliers please refer to Appendix B.

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