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Assessment of Social Sustainability of Nutmeg Based-Agroindustry Supply Chain in South Aceh Regency Trisna Trisna#1, Muhammad Zakaria#2, Mochamad Ari Saptari*3 #Industrial Engineering Department, Faculty of Engineering, Universitas Malikussaleh Jl. Batam Kampus Bukit Indah, Blang Pulo, Muara Satu, Lhokseumawe, Aceh, Indonesia 1trisna@unimal.ac.id 2muh_za@yahoo.com *Information System Department, Faculty of Engineering, Universitas Malikussaleh Jl.

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Abstract— Currently, nutmeg supply chain actors face various problems such as many damaged plants, the price of nutmeg seeds and oil which continues to decline, the processing industry has difficulty in the procurement of raw materials, and social impacts for the local community.

Observing the current nutmeg commodity conditions, it need to assessment of sustainability, especially for the social dimension as a basis for improvement. This study aimed to identify social sustainability indicators, to assessment for each social sustainability indicators, and to measure the overall social sustainability index.

The identification results were 19 indicators of social sustainability consisting of 7 main indicators, namely: employment, health and safety, nuisance, local community, infrastructure and resources, partnerships with stakeholders, and macro social performance. The measurement of importance weights showed that the most influential social indicator was the improvement of community welfare, then followed by the local employment.

The assessment results showed that the nutmeg oil and food and beverage agroindustry, each had very poor and bad social sustainability. That is the basis for the policymakers to improve and enhance social impacts for the communities around the nutmeg supply chain. Keywords— Nutmeg, Agroindustry, Sustainability, Social Indicator, Supply chain Introduction Aceh is the second largest producer of nutmeg (Myristica fragrant Houtt) in Indonesia after Maluku which is widely cultivated in South Aceh and Southwest Aceh Regencies.

Based on data, the total area of nutmeg plantations in Aceh in 2015 was 22,043 ha, production was 8,410 tons and involved 28,048 farmers[1]. The importance of nutmeg commodity in the economy of the people of South Aceh Regency because in addition to being able to increase the country's foreign exchange, it can also absorb labor and increase the income of farmers and the community.

In addition to dried nutmegs and mace which are sold to traders for export, they also impact the development of downstream industries including nutmeg oil, food, and beverage agroindustry. Nutmeg-based agroindustry is needed to increase value-added, absorb labor, reduce price fluctuations, and increase farmers' incomes. Nutmeg agroindustry involves many actors which include farmers and collectors as raw materials suppliers, processing industries, and traders or exporters.

Although nutmeg is a superior commodity, nutmeg cultivation is almost entirely managed by the society, so there are still many obstacles developing nutmeg

agroindustry caused by: 1) not yet applying cultivation technology properly, 2) some old/ damaged and unproductive plants; 3) not using superior seeds; 4) pest and disease disturbance, 5) low yield quality, and 6) product hygiene / health is not guaranteed [2].

In addition, based on observations and interviews with nutmeg actors, the price of dried-nutmeg seeds and nutmeg oil decreased significantly compared to the previous year. Problems faced by commodity and agroindustry supply chains must be considered basic aspects of sustainability which include economic, social and environmental dimensions [3]. Likewise with nutmeg, wherewith the various problems faced currently, its sustainability needs to be measured.

Good sustainability performance is an indicator of an organization economically profitable, able to reduce negative impacts on the environment, and provide social impacts for the surrounding community. In general, previous studies focused on measuring economic and environmental sustainability and those are still the lack of researches focused on measuring social sustainability.

Considering that many actors involved in the supply chain, especially farmers and the dependence of the community on nutmeg, it is necessary to measure social sustainability. Social sustainability is related to the employment and stability of the livelihoods of surrounding communities [4]. Activities along the supply chain are not only to obtain economic benefits for the actors, but also require community acceptance by reducing disturbances, and contributing to improving welfare.

Organizations or supply chains that have social sustainability produce justice in distribution and opportunities, the fulfillment of social services such as health and education, gender equality, as well as accountability and political participation [5]. Several previous studies on the assessment of social sustainability of supply chains or industry include conducted on process industries [6], energy technologies [5], automotive component manufacture [7], shale gas in the UK [8], manufacturing firms in Portuguese [9], rubber industry [10], the national municipality of the Republic of Tatarstan [11], [12], and others.

This study aimed to identify indicators and measure social sustainability in the nutmeg supply chain, which includes the nutmeg oil agro-industry, as well as food and beverages agro-industry. The first step of this research is to identify social indicators that influence the sustainability of the nutmeg supply chain. Identification is carried out based on literature studies and structured and in-depth interviews with supply chain actors and experts in the field of nutmeg.

The experts were asked to assess the importance of these indicators. The assessment results in weight each of the social indicators. In the second step of the study was to evaluate indicators of social sustainability. Some formulas used to calculate social sustainability indicators are based on [8].

The third step of research is to measure the overall supply chain social sustainability index. The index obtained as a basis for policymakers to improve the social sustainability of the nutmeg supply chain. Literature Review There are no standard social indicators used for measuring sustainability.

The previous studies generally used key indicators and sub-indicators based on organizational conditions, product type, company type, and the surrounding environment. The main indicators may include internal human resources, external population, stakeholder participation, and macro social performance, then each indicator consisting of several sub-indicators [13],[7].

Some literature using social indicators consist of 1) labor, 2) healthy and safety, 3) nuisance, 4) local communities, 5) infrastructure and resources, 5) partnership with stakeholders, and 6) macro social performance [8], [14], and [15]. In summary, some of the main social indicators frameworks used in assessment social sustainability can be seen in Table 1.

Based on literature studies and in-depth interviews with experts, in general indicators of social supply chain nutmeg broad outline include: 1) labor, 2) health and safety, 3) nuisance, 4) local communities, 5) Infrastructure and resources, 6) partnership with stakeholders, 7) macro social performance. Each indicator is divided into several sub-indicators. The stipulation of this sub-indicator is not yet standard.

Each literature has a sub-indicator coverage that varies depending on the needs and conditions of the supply chain. The literature study results can be summarized in social sub-indicators that are generally used can be seen in Table 2. To more easily understand and assess social indicators, it is necessary to clearly define the definitions and units used to measure these indicators can be seen in Table 3.

Methods In this study, the first step was to identify the social indicators that influential to the sustainability of the nutmeg-based agroindustry supply chain. Identification is carried out based on literature studies and discussion of experts in the fields of nutmeg and supply chain. The experts consisted of 10 people, including academics, nutmeg practitioners, researchers, and local governments.

After the indicators of social sustainability are obtained, then the experts judged them based on their importance levels 1 to 5. Value 1 means very unimportant, 2 (two) means not important, 3 (three) means quite important, 4 (four) means important, and 5 (five) means very important. After evaluating each indicator, then weighting was conducted using the ranking method to obtain the weight of each indicator and the main indicators that must be improved to improve social sustainability.

The indicators used for measuring social sustainability were then measured their value based on data obtained through direct observation, interviews, and government statistical data. The next, we compared the social indicator value of the nutmeg-producing area with a target to be achieved and the value of the national indicator, the further from the target value, the lower the sustainability of the nutmeg agro-industry supply chain, and vice versa.

The total social sustainability index is obtained by summing the weight multiplication of each indicator with the comparison value. Results and Discussion 4.1. Determination of the weight of social indicators We identified nineteen (19) social indicators from various literature, then judged by experts based on the importance level of 1 to 5.

For example, if an expert thought that the absorption of the local employment is so insignificant to the sustainability of the nutmeg supply chain, then he can give a value of 2. In this study, there were ten experts gave ratings consisting of academics, researchers, practitioners, and government. The results of weighting social indicators from experts can be seen in Table 4.

According to the experts' assessment in Table 4, we can see that the most important social indicator is community welfare, with a weight of 0.062. The second important social indicator is local employment with a weight of 0.060. The next important indicator is respect for policy, work accident, trading opportunity, and poverty alleviation.

The lower the weight value, the less important the indicator is to the sustainability of the supply chain, and vice versa. 4.2 Measuring each social sustainability indicator 4.2.1 Local Employment This indicator shows the workforce sourced from the environment around supply chain activities or is still within the territory of one village, sub-district, or district.

This indicator measures the percentage of new jobs that can be filled by the community around nutmeg supply chain activities, ranging from processing at the farmer level, agents, processing industries, and exporters. At the farmer level, labor is used for the cultivation of nutmeg involve planting, maintenance, and harvesting. After harvesting,

workers are needed to peel the nutmeg for the seeds.

In the processing industry, like essential oil as well as food and beverage agroindustries, workers are needed as machine operators. The formulation used to measure this indicator is as follows: In this study, local employment indicators can be determined as follows [16]: _ (1) Where, PL = New job presentations for local workforce LE = Number of local workers needed (person/year) TE = Total workforce needed (person/year) From the observation, the workforce needed throughout the supply chain activities does not require expertise and high education, so that it is easily available to the local community.

For this indicator, the local workforce needed is 100%. Gender equality This indicator shows the ratio of male to female workers. Based on [8], the formulation of gender equality index can be determined by the following formulation: _ (2) Where, GE = gender equality index (-) FW = percentage of female workforce (%) The gender equality index scale is between -1 and 1.

A value of -1 means there are no female workers, 1 means 100%, female workers, while 0 means the percentage of women and men is balanced. In this study, the work is divided according to the supply chain points. The determination of the gender equality index in each activity along the nutmeg supply chain can be seen in Table 5.

The overall GE calculation result in the nutmeg supply chain is -0.33, which means that the percentage of male labor is more than that of women. In the separation of meat and seeds in meat and nutmeg seeds dominated by women because housewives generally do it. Likewise, the nutmeg based food and beverage agroindustry is dominated by women because it is usually a home industry.

Training Education This indicator shows the opportunity for workers to receive training/guidance to develop abilities and expertise. Agro-industry and activities along the nutmeg supply chain are generally micro, small, and medium enterprises (MSMEs) and still use simple equipment and technology. Besides, MSMEs did not allocate funds to provide training to workers.

Respect for policy This indicator shows that there is an awareness of every worker to obey prevailing regulations. Activities along the supply chain are generally flexible, i.e., the results of their work are measured from the outputs produced. The more output produced, the worker has a good performance. However, workers still comply with regulations that apply in the work environment.

Employment Rights This indicator is the wage of workers received in accordance with the workload and minimum wages determined by local governments. The minimum wage stipulation in Aceh province as a nutmeg producer in 2019 is Rp 2,916,810 / month for 40 hours per week. Based on observations, the worker's payment system along supply chain activities is based on the output produced.

Wage data obtained by workers along the nutmeg supply chain can be seen in Table 6. The average wage received by workers along the nutmeg supply chain varies depending on the output produced. The greater the output produced, the higher the payments received.

Based on wage data received by workers per month, it can be seen that it is still below the provincial minimum wage in 2019. That suggests that labor in the nutmeg agroindustry sector has not received a decent income. 4.2.2 Health and safety Work accidents This indicator shows the number of accidents that occurred in the work environment at certain periods.

Indicators for measuring work accident rates include frequency rate, severity rate, average time lost rate (ATLR), incidence rate, frequency severity indicator (FSI), and others. The indexing measurement is based on lost work hours due to injured workers or the number of accidents compared to available work hours during a certain period [17].

The nutmeg supply chain activities are micro, small, and medium businesses, so they do not have work accident documentation. Therefore in this study, it was difficult to determine the occupational accident index. Based on observations and interviews with supply chain actors, the vulnerable activities to workplace accidents are the separation of nutmeg seeds from its flesh.

That activity is carried out manually using a knife. However, based on interviews with workers, the accident occurred in the form of cutting a knife in which the worker was still able to carry out activities. To facilitate the determination of this indicator, we assumed that the severity of the accident is in the light category because it does not cause loss of worker's work time. Work operational standards This indicator shows the existence of effective, efficient, and ergonomic work procedures in every nutmeg supply chain activity.

Based on these definitions, it can be determined whether the nutmeg supply chain activities have carried out work operational standards (WOS). Activities along the nutmeg supply chain are generally still carried out manually, making them inefficient

and ineffective. That is because businesses in the nutmeg supply chain are micro, small, and medium businesses. The WOS on each activity can be seen in Table 7. 4.2.3

Nuisance Noise This indicator is the noise generated from the supply chain activity from upstream to downstream. Noise data was obtained through direct measurements using a sound level meter on each activity at the node supply chain. According to WHO (2015), the highest safe sound level for workers with 8 hours of work per day is 85 dB.

Table 8 shows sound levels of activity along the nutmeg supply chain. Based on measurements of noise levels in activities along the nutmeg supply chain shows that it is still below the highest level recommended by WHO. It indicates that the supply chain activity does not endanger the hearing of workers.

Traffic jam This indicator shows the number of vehicles passing along the road due to the production process activities per unit time. The level of congestion is measured based on the Tom Tom Traffic Index, which is the additional travel time for the driver throughout the year compared to regular traffic. If the congestion level is 35%, it means 35% extra time is needed compared to the smooth road conditions [19].

Traffic activities are transportation for 1) nutmeg raw materials to refine nutmeg oil, 2) nutmeg shells to the nutmeg-based food industry, 3) nutmeg oil to exporters, and 4) nutmeg-based food products to traders. Nutmeg is generally harvested twice a year so that the traffic from farmers to the processing industry does not disrupt daily traffic.

Likewise, in the nutmeg oil processing industry, where production is conducted once a week, so it does not have an impact on traffic congestion in the surrounding environment. Considering the current road conditions, we assumed that the level of congestion along the supply chain is below 15% or means it is not severe. In other words, it's normal. Environmental conditions This indicator shows the comfort and cleanliness of the environment from pollution and waste.

The comfort level of the living environment can be measured from the pollution level of water, air, and soil and noise levels. Nutmeg is a plant that is tolerant of other plants. They need protection, so farmers usually plant their farms with other plants such as coconuts, cloves, forest plants, etc.

That way, the clearing of nutmeg plantations without the need to clear the forest so that it remains sustainable and does not interfere with water reserves [20]. The nutmeg processing industry is still a micro, small, and medium businesses that produce organic solid waste which is left to be used as fertilizer. In general, the waste produced by the

nutmeg processing industry does not endanger the environment compared to the mining, chemical, and palm oil industries. 4.2.4

Local Communities Use of local suppliers This indicator shows the percentage of suppliers or local raw materials used by the nutmeg based-agroindustry. The existing nutmeg based-agroindustry include essential oils, sweets, and nutmeg syrup. All of those use local suppliers and raw materials to make their products. Investments or donations to the local community This indicator is the percentage of investment or donations issued by the company or nutmeg agroindustry to the local community as a result of damage from activities along the supply chain.

This indicator based on the percentage of donations given to local communities compared to the company's total income per year or can be expressed using a formula [8], as follows: _ (3) Where, PLI= percentage of donations directly to the local community (%) LI = annual donations to the local community (Rp./year) RT= agroindustry annual revenue (Rp./year) Based on Indonesian government regulations, companies in the form of limited liability companies must allocate annual revenue as a responsibility to the community and the surrounding environment or refer to as Corporate Social Responsibility (CSR).

In general, nutmeg based agroindustry in Indonesia, either essential oil or food and beverage, is a micro, small, and medium enterprise. This causes the agroindustry not to have an obligation to donate part of the annual income to the local community. Public welfare This indicator shows the quality of life of the surrounding community, such as public facilities (roads, hospitals, education, etc.).

In this study, we measured public welfare indicators in South Aceh District, which is the third-largest nutmeg producer in Indonesia. Based on data BPS (2018), the number of actors involved included farmers as many as 18,656 households, 43 nutmeg based food industries, and 14 nutmeg processing industries. Several criteria that indicate the welfare of the community in nutmeg producing regions can be seen in Table 9.

The data of the welfare indicators on the people of South Aceh as a nutmeg producer are then compared with the national data, as shown in Table 10. In Table 10 can be seen that the welfare of nutmeg-producing regions is still below the national average. The data identifies that activities along the nutmeg supply chain have not been able to prosper the local community. 4.2.5

Infrastructure and resources Land use This indicator is the area of land or region's land that must be harvested and utilized as a place for planting and processing nutmeg

products. Based on data [22], the productivity of nutmeg per year is 827 kg of dried seeds per ha of nutmeg farm. Essential oils produced from dried nutmeg are as much as 10% so that a one ha of nutmeg plant provides about 82.27 kg of nutmeg oil per year.

If it is assumed, 1 (one) nutmeg refining unit produces 12 tons per year. The total nutmeg oil produced for 14 refining units is 168 tons. To provide the nutmeg oil, it needs 2042 ha of nutmeg farm or 0.49% of the total area of the regency. Table 11 shows a comparison of land use for nine primary commodities in Aceh province.

In Table 11 can be seen that nutmeg land use in Aceh province is the eight rankings or at 0.42%, far less when compared to oil palm (4.09%), rubber (2.26%), or coffee (2.16%). Waste treatment Nutmeg compose of the flesh, mace, and nutmeg seeds that have economic value. Fruit flesh is used to make foods and drinks such as sweets, dodol (Indonesian traditional food), and syrup.

Nutmeg seeds and mace are processed into essential oils or can be sold directly to traders. Nutmeg oil refining produces solid waste, which can be used as organic fertilizer. Because the waste produced is organic solid waste, It generally left on the ground, so that it can be used as fertilizer. 4.2.6

Partnership with stakeholders Partnership contract procedures standard This indicator shows that there are quality standard provisions both of the finished products produced and raw materials used among fellow supply chain actors. Along the nutmeg supply chain, there are several types of partnerships, including 1) nutmeg farmers and collectors, 2) nutmeg collectors and agro-industries, 3) nutmeg oil agro-industries and exporters, and 4) nutmeg-based food and beverage agro-industries and traders.

Nutmeg-based agro-industry, generally in the form of small and medium business industries, so that there are no quality standard provisions either for raw materials or finished products. The nutmeg oil refinery produces crude essential oil so that before it is exported, it is refined by exporters in Medan city. Provisions on the quality standards between partnerships along the supply chain can be seen in Table 12.

Partnership Agreement This indicator is several provisions that must be obeyed by each actor (stakeholders) to ensure the smooth running of business processes throughout the nutmeg supply chain. We measured this indicator base on available or not available of agreements in each partnership throughout the supply chain. Based on interviews and observations, the cooperation agreement was only carried out on collaboration between the nutmeg oil agro-industry and exporters.

Other types of partnerships do not yet have a cooperation agreement. 4.2.7 Macro social performance Trading opportunities This indicator shows the existence of an appropriate or decent price guarantee from both suppliers and consumers, opportunities to bargain, and others. Like other commodities, nutmeg prices fluctuate based on global price trends.

If demand is high, then the value of nutmeg seeds and oils is also high and vice versa. Farmers as suppliers cannot bargain prices, as well as nutmeg oil. Meanwhile, for food-based agroindustry, prices can be determined by production costs, so they get the profit they want. Poverty alleviation This indicator shows the reduction of poverty due to nutmeg supply chain activities.

We determined this indicator based on data on the number or percentage of poor people in the last five years. If there is a decrease in poverty from year to year, the supply chain activity affects poverty reduction and vice versa. Table 13 shows data on the number and percentage of poor people from the nutmeg producing area in South Aceh Regency.

Based on Table 13, we can see that data on the number of poor people in the last five years of nutmeg producing areas had increased every year. That shows that activities throughout the nutmeg supply chain have not been able to reduce poverty. 4.3 Determination of social sustainability of nutmeg supply chains The calculation of the social sustainability of the nutmeg supply chain is based on a modified supply-chain operations reference (SCOR) framework as needed. SCOR is a supply chain management performance measurement analysis tool.

The SCOR method applies a systematic approach that combines elements such as: technical business, benchmarking, and best practices in the supply chain. The steps used to measure the social sustainability of the nutmeg supply chain, namely: 1) determining the weight of social sustainability indicators, 2) determining the value of each specified indicator, 3) determining the expected benchmark for each indicator, 4) calculating the performance of each indicator, and 5) calculation of overall social performance, 6) determination of supply chain sustainability.

In this study, data on environmental conditions indicator was not available, so it was considered to be eliminated. The elimination caused a change in the weight of the indicators. The recalculation of its weights and its values respectively can be seen in Table 14. To simplify the calculation of the social sustainability of supply chains, the values of "Y" and "N" are converted to numerical values, namely 1 and 0.

Comparative values indicate how far the supply chain indicator performances reach the expected value. That means, the farther away from the comparison value, the lower the sustainability of the supply chain, and vice versa. Eighteen indicators used are categorized as positive and negative indicators. If the value of the indicator is higher, the better, it is called a positive indicator.

Furthermore, vice versa, when the lower the value of the indicator, the better, it is called a negative indicator. In this study, negative indicators are work accidents, noise, traffic jams, and land use. In the negative indicator, if it has a lower value than the comparison, then it is given a value of 100%.

To determine the sustainability category in the study, we use six criteria based on the reference standard of supply chain performance Monczka [23], as shown in Table 15. Entirely, the results of the assessment of the social sustainability index can be seen in Appendix 1. Nutmeg oil agroindustry sustainability was obtained 66.42%, and the food and beverage-based agroindustry was 54.02%.

Based on the criteria of Monczka , the social sustainability of the nutmeg supply chain was very poor for the nutmeg oil agroindustry and bad for the food and beverage agroindustry. That was because more than 50% of social sustainability indicators do not reach the targets set, as shown in Table 14. For improving social sustainability, it is essential to pay attention to key indicators, namely community welfare, which are still below the target set.

Moreover, the other indicators were still below the benchmark; also, it is important to be improved. 5. Conclusions The assessment of the social sustainability of the nutmeg supply chain uses 19 indicators based on various sources of literature and expert opinions. The weight of each indicator was based on expert judgment and was calculated using the ranking method.

The combined results of expert opinion showed that respect for policy and community welfare are the most important indicators, then followed by the use of local labor, work accidents, trading opportunities, and poverty alleviation. In this study, data of environmental conditions indicator was difficulty in obtaining it, so it was eliminated to 18 indicators to be analyzed.

The assessment of social sustainability was based on the value of each indicator multiplied by the weight, then compared to the determined target, the further from the target, the smaller the value of social sustainability, and vice versa. The social sustainability of the nutmeg supply chain was found to be very poor for the nutmeg oil

agroindustry and bad for the nutmeg based food agroindustry.

That is because the agroindustry is still in the form of MSME, so that it has not contributed much to the community, especially to improve welfare. Social sustainability is obtained as a basis for policymakers to improve and enhance social impacts for the community along the nutmeg supply chain. This study still has many weaknesses, primarily to obtain complete data and determine the comparative values of indicators.

For further research, we can use the weighting method in another way. Besides that, it can use other social indicators according to the characteristics of the product or commodity being studied. Acknowledge We thank the Ministry of Research, Technology, and Higher Education, Republic of Indonesia who funded this research activity under Basic Research Grant number 180/SP2H/LT/DRPM/2019 for funding in 2019. References [1] Direktorat Jenderal Perkebunan, "STATISTIK PERKEBUNAN INDONESIA 2015-2017: Pala," Jakarta, 2017.

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