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KATA PENGANTAR

Salam,

Dengan mengucap syukur kepada Allah Tuhan Yang Maha Esa, kami terbitkan Agrointek edisi September 2021. Di tengah pandemi yang berkepanjangan ini, ilmuwan Indonesia masih tetap berkarya. Pada edisi kali ini 32 artikel hasil penelitian, yang terdiri dari 11 artikel dari bidang pengolahan pangan dan nutrisi, sistem manajemen, rantai pasok, dan pengendalian kualitas; 3 artikel tentang rekayasa pangan, dan 2 artikel tentang manajemen limbah. Para penulis berasal dari berbagai institusi pendidikan dan penelitian di Indonesia.

Kami mengucapkan terima kasih kepada para penulis dan penelaah yang telah bekerja keras untuk menyiapkan manuskrip hingga final. Kami juga berterimakasih kepada ibu dan bapak yang memberi kritik dan masukan berharga bagi Agrointek.

Untuk menyiapkan peringkat jurnal Agrointek di masa depan, kami mengharap kontribusi para peneliti untuk mengirimkan manuskrip dalam bahasa Inggris. Semoga kita akan mampu menerbitkan sendiri karya-karya unggul para ilmuwan Indonesia.

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SUPPLY CHAIN UNCERTAINTY: AN EMPIRICAL STUDY OF INDONESIA'S AGROINDUSTRY

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ABSTRACT

Supply chain management (SCM) is a multi-stakeholder network for managing raw materials, finished products, information, and money flow. The supply chain's network refers to the interdependence of the processes and activities. Taking this into account, stakeholders deal with a volatile, uncertain, complex, and ambiguous (VUCA). The dynamic nature of the supply chain's environment implies uncertainty in the upstream and downstream sides. Drawing from the literature, manufacturers need to mitigate any uncertainty in their supply chains, consisting of supply, demand, and technology uncertainties. However, the previous literature neglected any discussion of supply chain uncertainty in the context of the agroindustry. Hence, to answer this gap, this study investigates the supply chain environmental uncertainty factors in the agroindustry sectors. Accordingly, this study obtained 30 respondents from the agroindustry in Indonesia. This study reported that the agroindustry in Indonesia has uncertainties about supply, demand, and technology. It is faced with the inability of suppliers to consistently deliver raw materials in terms of their quantity and quality. Meanwhile, demand uncertainty is caused by the fluctuations in customers' demands and the industry's low forecasting accuracy. Moreover, the rapidly changing technology has implications for uncertainty in services and product standards, making it difficult for manufacturers to anticipate the changes. The agroindustry needs to control this uncertainty in the supply chain's environment through supply chain integration.

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INTRODUCTION

Conceptually, the agroindustry supply chain is a series of procurement, production, transportation, and consumption processes involving suppliers (farmers), manufacturers, distributors, and consumers (Routroy and Behera, 2017). This series of processes illustrates the complexities in the supply chain network, one of which is the supply chain's environment, which is volatile, uncertain, complex, and ambiguous (VUCA)(Bennett and Lemoine, 2014).

The uncertainty is challenging to manage and exists in every process in the supply chain's network (Hudnurkar et al., 2017; Michael, 2018). On the supply or upstream side, producers bear the challenge of suppliers' uncertainty about replenishing and delivering the suitable raw materials, of the specified quality, in the correct quantity, and at the right time. Suppliers' failures create difficulties for manufacturers to manage their optimum inventory level; it results in excess inventory or shortages (Angkiriwang et al., 2014).

Following this, on the downstream side, fluctuations and variations in consumer needs indicate uncertainty in demand. Inaccurate demand forecasts will result in lower consumer satisfaction and lost profits. Furthermore, technological developments and data velocity lead to product specifications and standards changing, making it difficult to predict what consumers require. Mismatched strategies to anticipate demand, supply, and technology uncertainty negatively affect competitive advantage (Ahmad et al., 2020).

Regarding the supply chain's uncertainty, the resources dependency theory (RDT) from Pfeffer and Salancik (2003) assumed that manufacturers need to control and reduce uncertainty to gain a sustainable competitive advantage. Uncertainty refers to future occasions in the supply chain that can be difficult to predict accurately. The RDT is considered to be the appropriate theory to take account of supply chain management (SCM), as it offers an approach for identifying and reducing the supply chain's uncertainty, compared to other theories, e.g., the contingency theory, resource-based view theory, transaction cost economics theory, or the agency theory (Perdana et al., 2019).

Drawing from the RDT, the decision about uncertainty mitigation needs to identify the characteristics of a commodity or product because each has different challenges and influences supply chain strategic decisions (Singh et al., 2011). In general, commodities can be classified into two categories, namely agroindustry, and non-agro-industry. Meanwhile, the supply chain for the agroindustry has relatively complex uncertainties compared to that for the non-agro-industry (e.g., machinery and transport equipment) (Wilkinson and Rocha, 2009).

For example, procurement and inventory decisions for fish commodities, which depend on the weather, are difficult to predict accurately in terms of their numbers and lead time. In addition, the agroindustry supply chain is faced with the uncertainty of suppliers being able to provide packaging that is temperature resistant and not easily damaged (Widodo et al., 2012). Moreover, transportation activities also require a cold system chain to ensure quality; this process is more difficult to control (Widodo et al., 2018). Following these characteristics, the agroindustry's supply chain activities require special handling, especially purchasing, production, and transportation. Failure to manage the quality of each process will lead to underperformance of the supply chain network.

The prior literature shows that the supply chain's uncertainty is an essential issue in the SCM research stream. Most researchers (Flynn et al., 2016; Huo et al., 2018; Kim et al., 2016; Michael, 2018; Minkyun, 2016; Sreedevi and Saranga, 2017; Yuji et al., 2020) investigated this supply chain uncertainty in the setting of non-agro-industries. In contrast, agroindustry products have unique and different characteristics. Sensitivity to the temperature, weather, and perishability are the main characteristics of agroindustry products, which have implications for more significant uncertainty than non-agro-industry products. This description shows a shortcoming in the literature exploring the uncertainty in the supply chain's environment for agroindustry manufacturing companies. Accordingly, this study formulates the following research question (RQ):

RQ: Reflecting on the RDT's assumption, what are the supply chain's uncertainty factors in the agroindustry?

Thus, this study makes two contributions: First, this study attempts to identify the factors of uncertainty in the agroindustry. Second, this study employs the RDT as a proxy to explain this phenomenon.

METHOD

This study aims to identify and describe the supply chain's uncertainty regarding agroindustry. This study uses the agroindustry in Indonesia as its sample. Terminologically, the agroindustry is an activity utilizing the products from farming that are produced, marketed, and distributed to consumers and activities upstream and downstream.

The agricultural products are from the agroindustry on the upstream side, while these products' processing activities are on the downstream side (Rachbini et al., 2011). The sample selection process used purposive sampling, based on data from Statistics Indonesia. Accordingly, there were 452 manufacturers which were identified, and they were sent an email questionnaire, which 37 were willing to complete. After verifying the completeness of the questionnaire, there were 30 respondents, so the response rate was 6.6%.

Furthermore, the respondents were categorized by the UN International Standard Industrial Classification (ISIC) for all economic activities, as used by Statistics Indonesia, which identified 12 types of manufacturers. The most significant number of respondents came from the food industry, as shown in Table 1. Moreover, the respondents' characteristics are shown in Table 2. Most of them were supervisors. In addition, almost half of them worked in production departments.

Drawing from the RDT's assumption, this study adopts the instruments from Paulraj and Chen (2007) to measure the demand uncertainty, supply uncertainty, and technology uncertainty. Similarly, Ahmad et al. (2020) posit that the supply chain's uncertainty can be indicated by its uncertainty about supply, demand and technology. From the supplier side, RDT assumed that the uncertainty arises about the supplier's ability to consistently provide quality material. Meanwhile, demand uncertainty is indicated by fluctuations in consumer demand—lastly, dramatic changes and unpredictable technological life cycles create uncertainty about the technological factors.

Before being distributed to the respondents, this instrument was translated from English into Indonesian for face validity. After that, the instrument was translated back into English to ensure no changes to the operational definitions. Each indicator was measured on a Likert scale of 1 to 5 (1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree). The validity of the measurement instruments was examined by Spearman's correlation coefficient, which showed that all the indicators were valid. For the reliability test, Cronbach's alpha coefficients showed all the indicators were reliable, as their values were greater than the threshold of 0.6 (Fiksel, 2006). The coefficients' values for the validity and reliability tests are shown in Table 3.

Table 1 Respondents' Category Based on Industry Type

ISIC Code	Manufacturers	Number
102	Processing and preserving fish, crustaceans and molluscs	1
104	Vegetable and animal oils and fats	3
105	Dairy products	2
107	Other food products	6
108	Prepared animal feeds	2
110	Beverages	4
120	Tobacco products	1
151	Leather and related products included artificial leather	2
170	Paper and paper products	2
201	Chemicals (Fertilizer)	1
210	Pharmaceuticals, medicinal, chemical, and botanical products	3
221	Rubber products	3
	Total	30

Table 2 Respondents' Characteristics

Position of Respondent	Number
Assistant Manager	3
Director	4
Manager	6
Supervisor	17
Total	**30**

Function/Department of Respondent	Number
Distribution	2
Engineering	2
Warehouse	2
Quality control	1
Logistics	1
Marketing and Sales	4
Procurement/purchasing	2
Production	16
Total	30

Furthermore, the results of the questionnaire were analyzed descriptively using the frequency method from the Likert scale. This method classifies the number of answers on the measurement scale, showing the proportion (Sullivan and Artino Jr, 2013). So, the answers "strongly agree" and "agree" were accumulated into the agree category. Also, the answers "strongly disagree" and "disagree" were placed into the disagree category, while the neutral responses were not moved.

RESULTS AND DISCUSSION

Results

Frequency analysis was conducted to identify the proportion of each respondent's answer. According to the Likert scale, the proportion of answers was divided into five answers, which is illustrated in Table 4.

According to Table 4, the percentage values for the "strongly disagree" and "disagree" categories were accumulated into a disagree cluster; also, "strongly agree" and "agree" were accumulated into an agree cluster. This combined value shows the proportion of answers to supply, demand, and technology uncertainty descriptively.

Moreover, as shown in Table 5, the proportion value of each indicator showed that all the respondents agreed with the uncertainties of supply, demand, and technology—the explanation of these results is discussed in the next section.

Discussion

Based on the SCM's view, business transactions are interactions between organizations involving the transformation of resources (data, information, materials, technology, and money). The integration of planning, implementing, and controlling the supply chain's activities is the key to excellence for the stakeholders in the supply chain (Sutduean et al., 2019). The alignment of activities and processes is a mandatory requirement, as the disruption of one of the chains influences the whole system, from upstream to downstream (Simangunsong et al., 2012). Disruptions arising along the supply chain include the reliability of the suppliers' capabilities, the accuracy of the data on consumers' needs, and changes in the standardization process due to radical changes in the technology being used (Sreedevi and Saranga, 2017).

Referring to the RDT, organizations in the supply chain face the threat of supply, demand, and technology uncertainties. Organizations are open; external turbulence becomes a challenge to their decision-making processes (Paulraj and Chen, 2007). Dynamic changes and instability make it difficult for organizations to manage their supply chains accurately (Yunus and Tadisina, 2016). The fundamental postulate of the RDT is that an organization tries to stabilize the environmental uncertainties, one of which is the planning, implementing, and controlling of supply

chains (Kembro et al., 2014). Therefore, mitigating this situation requires identifying the sources of the uncertainties in the supply chain's environment, consisting of supply, demand, and technology uncertainties.

Table 3 Validity and Reliability Coefficients

Variables	Indicators	Validity	Reliability
Supply uncertainty (SU)	The suppliers meet the requirements of our company consistently (SU1)	0.796**	0.628
	The suppliers produce quality materials consistently (SU2)	0.749**	
	Our company carries out an extensive inspection of incoming critical materials from suppliers (SU3)	0.587**	
	Our company has a high rejection rate of incoming critical materials from suppliers (SU4)	0.651**	
Demand uncertainty (DU)	Our company has a master production schedule with a high percentage of variation in demand (DU1)	0.605**	0.810
	Our company's demand fluctuates drastically from week to week (DU2)	0.842**	
	Our company's supply requirement varies drastically from week to week (DU3)	0.909**	
	Our company keep weeks of critical materials inventory to meet the changing demand (DU4)	0.450*	
	The volume and/or composition of the demand is difficult to predict (DU5)	0.877**	
Technology uncertainty (TU)	Our industry is characterized by rapidly changing technology (TU1)	0.777**	0.735
	If our company does not keep up with technological changes, it will be difficult for our company to remain competitive (TU2)	0.601**	
	The rate of process obsolescence in our industry is very high (TU3)	0.821**	
	The production technology changes frequently and sufficiently (TU4)	0.773**	

*$p<0.05$
**$p<0.01$

Table 4 Frequency Analysis of Likert Scale

Indicators	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
SU1	3.3%	3.3%	10.0%	66.7%	16.7%
SU2	3.3%	3.3%	6.7%	63.3%	23.3%
SU3	0.0%	3.3%	0.0%	56.7%	40.0%
SU4	3.3%	23.3%	13.3%	46.7%	13.3%
DU1	0.0%	6.7%	6.7%	50.0%	36.7%
DU2	0.0%	30.0%	13.3%	36.7%	20.0%
DU3	0.0%	33.3%	10.0%	43.3%	13.3%
DU4	0.0%	10.0%	6.7%	66.7%	16.7%
DU5	0.0%	36.7%	10.0%	43.3%	10.0%
TU1	0.0%	33.3%	10.0%	36.7%	20.0%
TU2	0.0%	3.3%	6.7%	43.3%	46.7%
TU3	6.7%	30.0%	20.0%	33.3%	10.0%
TU4	0.0%	23.3%	16.7%	33.3%	26.7%

Table 5 Proportion of Likert Scale

Indicators	Disagree	Neutral	Agree
SU1	6.7%	10.0%	83.3%
SU2	6.7%	6.7%	86.7%
SU3	3.3%	0.0%	96.7%
SU4	26.7%	13.3%	60.0%
DU1	6.7%	6.7%	86.7%
DU2	30.0%	13.3%	56.7%
DU3	33.3%	10.0%	56.7%
DU4	10.0%	6.7%	83.3%
DU5	36.7%	10.0%	53.3%
TU1	33.3%	10.0%	56.7%
TU2	3.3%	6.7%	90.0%
TU3	36.7%	20.0%	43.3%
TU4	23.3%	16.7%	60.0%

From the RDT's standpoint, this study demonstrated the agroindustry's environmental uncertainties and supply chains. The RDT emphasizes that performance is determined by a company's ability to respond to external pressures (its environment). This study showed that all the respondents agreed that the agroindustry in Indonesia faces uncertainties about supply, demand, and technology; these are elaborated on in the following sub-section. In addition, a way to mitigate each of these uncertainties is proposed in the risk mitigation sub-section.

Supply uncertainty

Production activities require a supply of quality raw materials, but there is no guarantee that the suppliers of these items can consistently meet the targets. Manufacturers ask for assurances about the quality of the items and certainty about their availability and accuracy in their delivery times. Supply uncertainty is caused by inadequate information and unreliable suppliers with uncertain capabilities (Chen and Paulraj, 2004).

For the agroindustry, any uncertainty in its raw material supplies is very much felt, given the nature of the raw materials, which can be affected by the season, temperature changes, the goods' perishability, and food safety. This uncertainty triggers the hoarding of extra stock to keep the producers supplied and meet consumers' demands. Fluctuations on the supply side will spread to the downstream side, resulting in consumers' needs not being fulfilled. This creates low levels of service. At worst, it can cause the consumers to move to other competitors. In summary, fluctuations in the suppliers' abilities may cause the producers to fail to meet the expectations of other companies in the supply chain network.

Demand uncertainty

The decision can reflect consumer demand on how much raw material is needed and how many items are produced. However, it is realized that consumer behavior is unpredictable, which results in demand uncertainty (Chen and Paulraj, 2004). This can be difficult for a company to interpret. In the supply chain, there is a tendency for the data and information accuracy in the downstream side to be stable. However, they become volatile when it comes to producers and suppliers, known as the bullwhip effect. This phenomenon illustrates that data and information errors are shifting from the downstream to the upstream. Thus, the supply chain for the agroindustry can be described as an interconnected set, where barriers in particular processes impact the performance of the entire supply chain.

Disinformation leads to false requests that impact decision-making errors, resulting in high logistics costs. Contextually, of course, the agroindustry must be able to respond to uncertainty with the proper steps. Data accuracy is an absolute necessity so that there is no disruption to supply chain operations involving suppliers, manufacturers, distributors, retailers, all the way to the end consumer.

The alignment between supply and demand is a decisive factor in the production process. The production department draws data or information

from consumers for forecasting. Furthermore, derived from this forecasting, the quantity of raw materials required is determined and forwarded to suppliers. So, data accuracy is crucial; errors in the data imply planning errors and poor supply chain performance.

Technology uncertainty

Since the alignment between supply and demand is vital, technology plays an essential role in making the data exchange faster and more accurate. However, there is another side to technology that poses a risk to supply chain performance. Technology is characterized by rapid change, followed by changes in dimensions, sizes, and product standards (Chen and Paulraj, 2004). On the other hand, resource constraints hinder the process of technology's adaptation, where companies cannot accept the technological changes. Defining what is demanded by consumers cannot be separated from technology.

Accordingly, a company must adapt to changes; otherwise, it will suffer in competition with other companies. Sharing resources is a way to mitigate technological uncertainty; the exchange of knowledge between companies in a supply chain is a bridge to make it occur. A strong company gives its knowledge to help the weaker company. The enthusiasm to help each other, based on the principle of mutual benefit, is an absolute requirement for companies in a supply chain to control technological uncertainty. Hence, supply chain entities need to eliminate opportunism to achieve effective and efficient supply chain performance.

Risk Mitigation

Operationally, manufacturing companies need certainty about their supply of quality raw materials from the suppliers. The supplier's reliability is a vital variable in production, especially for determining sufficient supplies so that service levels do not decrease (Chang et al., 2016). Also, a company uses consumer demand inputs to calculate the number of products produced. However, dynamic consumer behavior causes forecasting variabilities. The consequence of prediction errors is high inventory costs (Chavez et al., 2015). Moreover, technology contributes to the supply chain, especially in harmonizing the supply and demand (Su and Yang, 2010).

Subsequently, changing consumer behavior impacts changing product criteria, which is accompanied by technological adjustments. Technology has a short life-cycle; eventually, companies face technological uncertainty (Hald and Mouritsen, 2013).

Since uncertainty threatens all businesses, the agroindustry's supply chain cannot escape this. In the supply of raw materials, manufacturers need assistance from suppliers, including information support from consumers for production planning. Also, the role of technology is to increase the reliability and validity of the information. Certainty in the supply chain's procurement, scheduling, production, transportation, and consumption processes is expected. However, considering the dynamics of the supply chain's environment, especially in the agroindustry, it is necessary to mitigate the uncertainty factors.

Companies need to mitigate risks to cope with the uncertainty of supply, demand, and technology in the supply chain. This mitigation measure is carried out by formulating supply chain collaborations that involve all the companies in the supply chain's network. Reflecting on the RDT, collaboration becomes a form of risk distribution. The basic assumption used is that each company has complementary resources (Drees and Heugens, 2013). Businesses are interdependent, including their resources, which they need to share with companies in the supply chain with limited resources. In consequence, collaboration becomes a mutually beneficial action (Frączkiewicz-Wronka and Szymaniec, 2012).

The collaboration of the companies in a network can control the threat of supply chain uncertainty. A vendor-managed inventory is a model of operational collaboration between suppliers and manufacturers (Mittal et al., 2012). Data on the raw material requirements, the availability of space in warehouses, and the fulfillment of raw materials demands are connected in a real-time system (Ramanathan, 2014). If suppliers carry out inventory controls, the issue of raw material shortages becomes more manageable to overcome. If any problems occur, collaborative problem solving becomes a concrete activity to minimize any decision-making errors (Oghazi et al., 2016).

Furthermore, to overcome demand uncertainty, producers need to involve consumers

in their strategic and operational plans. The ultimate goal is to satisfy consumers; it becomes an obligation for producers to translate what the consumers need (Liu et al., 2010). Consumer involvement in product design and development becomes an effort to articulate consumer requirements. Despite dynamic consumer behavior, the existence of big data and technology 4.0 provides an opportunity to predict it (Bigliardi et al., 2020).

Considering the limited resources of each organization in a supply chain, sharing knowledge, materials, and technology is an answer to deal with technological uncertainty (Yan and Azadegan, 2017). While technology provides significant benefits to the supply chain, it requires aligning activities and processes (Shao et al., 2021). It also includes technical issues, namely that the data's format must be aligned to be exchanged and analyzed into shared knowledge (Ozkan-Ozen et al., 2020).

Technology is an enabler for companies to align supply and demand. In addition, tracking and tracing are necessary determinants in the agroindustry to ensure the quality and quantity of raw materials and finished products (Lezoche et al., 2020). The tracking and tracing enhance the accuracy of time and locations, which drives distribution activities to be easier to control. Since the activities are manageable, this lowers the uncertainty (Li and Xiao, 2013).

This discussion makes the point that collaboration is an approach that must be taken in a supply chain. With collaboration, any uncertainties about supply, demand, and technology can be better resolved. However, asymmetry of information and power negatively encourage the only company in a supply chain to exploit the other companies. This situation represents opportunistic behavior, which is against the standpoint of SCM, which stresses mutually beneficial relationships. Thus, to implement SCM effectively and efficiently, the synchronization of the perspectives and goals is mandatory.

CONCLUSION

This study used RDT as a theoretical framework to examine the supply, demand, and technology uncertainty in agroindustry in Indonesia. Accordingly, this study found that the guarantee of quality raw materials from suppliers is critical for the agroindustry. Likewise, the availability of information on consumer needs is a critical factor in determining the number of raw materials to be ordered from suppliers. However, it cannot be denied that producers cannot control all the activities of their suppliers and consumers, which creates supply and demand uncertainties. Apart from these uncertainties in the upstream and downstream domains, threats emerge from the swift changes in technology, making it difficult to determine the standards consumers demand. It means that the agroindustry has the threat of uncertainty in supply, demand, and technology. The results of this study contribute to two aspects, namely the theoretical and managerial ones, which are explained in the following sub-section.

Theoretical implication

Drawing from the RDT, this study captures the uncertainty in the supply chain environment for Indonesia's agroindustry. The results show that the Indonesian agroindustry agrees that supply, demand, and technology uncertainties are part of the external situation. In line with the results, the RDT postulates that when an organization is faced with an external environment that is not fully controlled, uncertainty in the supply chain from upstream to downstream. Companies in a supply chain network need internal and external resources that are interchangeable, complementary, and obtained through collaboration to control the threats and risks from uncertainty.

Managerial implication

The uncertainty of supply and demand is a factor that threatens producers, plus the ever-developing technology presents another risk. It requires awareness by the agroindustry that this uncertainty cannot be handled independently. For example, agroindustry companies whose raw materials are influenced by nature (e.g., fish, vegetables, and rice) need certainty in quantity, quality, and delivery times; on the other hand, these are difficult to manage accurately. This uncertainty forces companies to collaborate with farmers. Collaboration can occur in the form of quality assurance training, farming, and technology. The company depends on the ability and capability of the farmers, so a mutually beneficial relationship is needed. With transportation activities, producers need the ability of logistics service providers to guarantee the quality of the raw materials or finished products that they distribute.

SCM is the appropriate approach to reduce uncertainty, where collaboration is emphasized among supply chain stakeholders. Collaboration is built based on mutual benefits to achieving common goals. At this time, no company can be successful without the contribution of other companies; there must be an interdependent relationship. Hence, there is a view that business competition is not between companies but between supply chains.

Considering this study is limited to the agroindustry in general, to get more detailed results, further studies can examine the derivative sectors in the agroindustry, such as fisheries, rice, and plantations. Also, theoretically, further research can develop organizational mechanisms to respond to supply, demand, and technology uncertainty from a supply chain network's point of view. Therefore, theories such as social networks and stakeholders can be integrated with the RDT to investigate the behavior of the agroindustry to mitigate uncertainty at a network level.

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