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Traceability System Model Rice Supply Chain during the COVID-19 Pandemic

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ABSTRACT

Rice commodity is a staple food product that is generally needed by the community, especially in times of natural disasters like a Covid-19 pandemic. The high public demand for rice commodity can cause the issue of the possibility of food scarcity related to the stock or quantity of rice along the rice supply chain. Some of the problems due to the pandemic include obstacles to the chain distribution channels and limited human resources which have hampered the flow of rice products, especially in the Jabodetabek area. Therefore, it is necessary to develop a technology and information system that are integrated between all chain actors to maintain and mitigate the problems. The aim of this study is to model a traceability system in rice supply chain to mitigate the risk of food scarcity during the Covid-19 pandemic. This research was conducted using a qualitative descriptive method through in-depth interviews and literature studies to make a rice supply chain traceability system model with Unified Modeling Language. In addition, the traceability system model is also divided into four main activities: unhulled rice production and distribution activity by farmers or farmers group (gapoktan) and middleman, processing activities by the processing industry, rice distribution and logistics activities by distributors, retailers and Bulog, and the last is traceability system activities by the chain consumers.

Keywords: rice supply chain network, traceability system, unified modeling language

INTRODUCTION

Beginning in 2020, various countries around the world are facing a new disease known as the Covid-19 pandemic (coronavirus disease 2019). Before Covid-19 vaccines and antiviral drugs are found, it is necessary to prevent the spread of the virus from spreading to reduce the number of victims. One of the policies taken by the Indonesian government is the application of physical distancing or known as Large-Scale Social Restrictions (PSBB) which has now been evaluated as the Enforcement of Community Activity Restrictions (PPKM) to deal with the widespread spread of Covid-19. Policy. To maximize this movement, many schools, places of worship, tourist attractions and workplaces are closed so that people can carry out their activities from home. This phenomenon encourages people to make massive purchases of basic foodstuffs to meet supplies for some time to come (panic buying). As a result, the rate of public demand for food soared sharply at the start of the pandemic, one of which was the rice commodity.

Staple food products, such as rice, need to be considered for availability and distribution channels to prevent food shortages in the community. There are several factors that drive food scarcity during the Covid-19 pandemic. According to Yasin (2013), one of the factors of food scarcity is due to the hoarding of foodstuffs by some unscrupulous traders or

entrepreneurs so that food prices in the market can increase. In addition, a pandemic can also reduce the productivity of some members of the supply chain due to the possibility of contracting the virus and disrupting the process of food production and distribution. Other factors, such as the possibility of delay in the import process in meeting food availability, also need to be considered.

Food scarcity itself is related to the stock and quantity of the food product. For this reason, in order to control the stock and quantity of foodstuffs along the supply chain, the government needs to guarantee food availability with a system to map, detect and be transparent to the public regarding available food stocks so that the possibility of food shortages can be detected as early as possible. One system that may be able to detect and trace food stocks in overcoming the food scarcity crisis is a traceability system along the food supply chain.

Various countries around the world implement food traceability systems in handling food safety cases. In addition to food safety, the food traceability system can also detect fraud, such as research conducted by Setyaningrum (2018). The main purpose of the traceability system is to record and document a product, including all the ingredients used in the production process to the product distributed to consumers (Sudibyo, 2012). If there is a problem in the chain, the traceability system can trace the point of cause of the problem so that risks can be avoided and food safety can be guaranteed.

Therefore, the promotion of coffee, especially for products from coffee-to-go shops, is expected to increase its marketing through social media, because social media platforms are used by the millennial generation. According to Rahmah et al. (2018) coffee producers must be able to know what consumers really want and expect from the coffee products offered, so that in the end consumers will decide to make a purchase of the coffee product. The problems and phenomena that have been mentioned are interesting to study about how knowledge of repurchase intentions of coffee-to-go shops is measured based on product and service quality, E-WOM, brand image, and to test how much it affects satisfaction and purchase intentions. repeat to millennial generation consumers. Based on this background, the problem to be discussed in this study is how to model the traceability system in the supply chain can rice be used to prevent the risk of food scarcity. In connection with the formulation of the problem, the purpose of this study is create a traceability system model in the rice supply chain to prevent the risk of food scarcity during the Covid-19 pandemic.

This research is a case study research because it examines the exploration of a problem with detailed boundaries. The research was carried out specifically on the rice supply chain network as a staple food commodity and specific location, namely in Jakarta, Bogor, Depok, Tangerang, and Bekasi (Jabodetabek), because it is considered as the area that has the most red zone for the spread of Covid-19 in Indonesia. System modeling in this study is limited to the traceability system modeling process using the Unified Modeling Language (UML) method only, not to software development.

LITERATURE REVIEW

Production and Consumption of Rice in Indonesia

According to the Central Statistics Agency, the average rice consumption in Indonesia for a year is around 29.6 million tons. In addition to rice consumption figures, rice production in 2019 also decreased, reaching around 31.31 million tons compared to 2018, which was 33.94 million tons. If you compare the level of rice production and rice consumption in the year, there will be a surplus of 4.37 million tonnes in 2018 and 1.53 million tonnes in 2019. This rice supply surplus causes rice prices to remain stable due to these reserves (Musyaffa, 2020).

The Covid-19 pandemic at the beginning of 2020 and the beginning of the holy month of Ramadan at the beginning of the pandemic caused an increase in demand for rice by 30-40 % from retailers (Hamdani, 2020). Bulog and the Ministry of Agriculture stated that the national rice stock was sufficient to meet demand, namely 3.3 million tons consisting of Bulog warehouse stock of 1.39 million tons, stock in mills 1.2 million tons, stock in rice traders 728 thousand tons, stocks in PIBC are 30,620 tons and stocks in BKP-assisted community food barns are 2,939 tons. In addition, based on data from the Food Security Agency (BKP), it is known that rice production in March-August 2020 is estimated to reach 17.8 million tons, so it is known that rice availability will reach 21.3 million tons.

The Condition of the Rice Supply Chain During the Covid-19 Pandemic

According to Chopra and Meindl (2007), supply chain management is a set of practices that are mutually integrated effectively between suppliers, producers, distributors and consumers to improve long-term business performance in their supply chains. Requests from customers are submitted through distributors to producers and then conveyed to suppliers to prepare raw materials to be used. Supply chain management activities include coordination and collaboration of processes and activities in various functions such as marketing, sales, production, product design, procurement, logistics, finance, and information technology in organizational networks (Blos et al. 2009).

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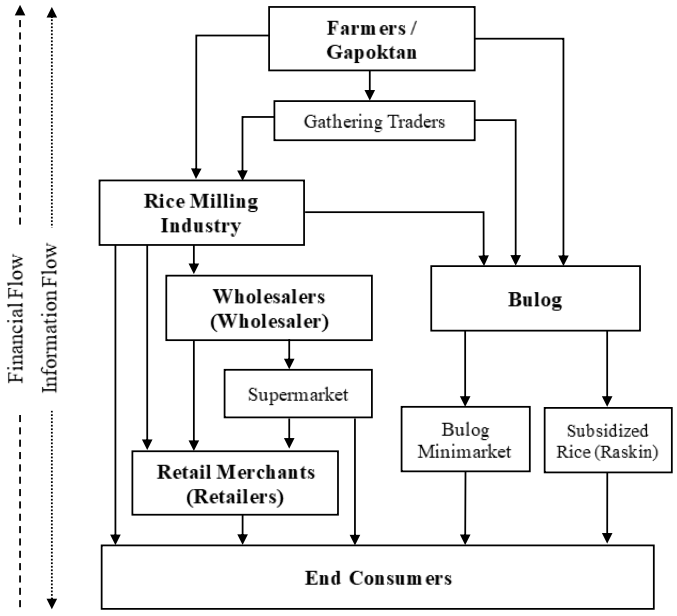


Figure 1 Rice supply chain network structure

However, the existence of a pandemic certainly has several impacts and obstacles to the distribution channel as well as a reduction in chain human resources so

that the flow of products and the flow of information on the rice supply chain is also disrupted. In addition, the pandemic has resulted in an increase in demand for rice, thus becoming an opportunity for new entrepreneurs to enter the industry and causing an increase in the level of competition in the industry. The traceability system functions to record and document the entire production and distribution flow of the product so that it can control the chain, especially when demand is increasing. The system can also be used to control the stock and quantity of products along the chain to prevent food crises or over supply. In addition, with information on all actors involved, then the act of cheating or other problems can be tracked and prevented.

Traceability System

Sudibyo (2012) explains that the traceability system can be used to deal with various problems due to contamination or contamination of food ingredients and products that can be monitored and controlled from the start of raw materials to consumers. According to Opara (2003), the simple concept of a food traceability system covers the problem of collecting, documenting, maintaining and applying information along the supply chain to help solve the problem of management crisis in cases of food quality and safety violations. In addition, Regatteri et al. (2007) also describes 4 components of the traceability system, namely:

1) Product identification, including dimensions, volume, weight, and cost or price of food.
2) Data for tracing (data to trace), including data at depth level, data storage requirements and data typology.
3) Product routing, including activities in handling the product, as well.
4) Traceability tools are related to data accuracy, data reality and company knowledge.

With this concept, a traceability system might be used to mitigate the risk of food scarcity by looking at documentation, product track records and the amount of stock or quantity of product inventory along the food supply chain so that it can be traced to where there is a possibility of scarcity and various food problems. Preventive treatment as early as possible.

Unified Modeling Language (UML)

In creating a business process model, information is needed about all activities and entities in the supply chain to ensure that the products and activities in the supply chain form one unit as the basis for building a traceability system. Traceability systems can be built using a variety of methods, one of which is the Unified Modeling Language (UML) method. According to Whitten and Bentley (2007), UML is a modeling language to describe object-based systems or software. The object observed in this study is the rice commodity which will be divided into several classes which have reciprocal relationships between classes using UML diagrams. The UML method can be used to create a systemtraceability because it is considered capable of describing the four components of the system, namely processes or activities, information, technology and work organization (Setyaningrum, 2018). Some UML diagrams that can be used to illustrate the requirements of a traceability system are use cases, activities, and class diagrams.

Previous Research

The Covid-19 pandemic in Indonesia has had various effects on the rice supply chain. The high demand for rice with limited production and constraints on distribution channels can lead to the possibility of food scarcity. In addition, economic instability can also encourage entrepreneurs to commit several fraudulent acts. Fraud actions that may occur in the supply chain can be avoided by having a system that can detect and trace the source of triggers in the supply chain, such as research conducted by Setyaningrum (2018). The increase in demand for meat

during holidays in Indonesia encourages local cattle traders to cheat by mixing beef with wild boar meat to reduce their losses due to lack of beef supplies and the cheap price of imported beef. The traceability system is used to detect and trace all supply chain activities through four important elements, namely with physical lot integrity, namely determining the lot size and integrating lots in determining the level of precision of the traceability system, tracing data to record data movements and processes that are considered important with data collection, product identification and process linkages to determine the composition of the product, as well as reporting elements.

In addition, a scientific review of the traceability system in the food industry and agricultural products conducted by Sudibyo (2012) explains the concept, definition of traceability, advantages of the traceability system, as well as constraints and opportunities for implementing a traceability system that is useful for future research. According to Setyaningrum (2018), System modeling using the Unified Modeling Language (UML) can be used to describe the business processes of an activity, because UML is used for object-oriented analysis and design. The object that is observed in this study is the staple food product of the Indonesian people, namely the rice commodity. This is in line with research conducted by Siswanto (2019) who examines the design of a feed corn information system to mitigate food safety risks and problems that arise due to differences in information regarding the amount of maize production between supply chain actors.

METHODS

This research will be carried out in all locations involved in the rice commodity supply chain in Indonesia, especially in Jabodetabek. This research will be conducted from May to November 2020. This study uses primary data and secondary data. Primary data were obtained from in-depth interviews with experts and supply chain actors. Secondary data were obtained from literature studies, relevant data from the government or related agencies, articles, journals, reports and previous studies.

This traceability system modeling aims to detect problems that occur along the supply chain in mitigating the risk of food scarcity during the Covid-19 pandemic. In this study, the traceability system modeling was carried out using the Unified Modeling Language (UML) with several stages summarized from several previous studies (Putra, 2017; Handayani and Haryono, 2018; Harwiyani and Vanany, 2014; Putri, 2017). The stages in modeling the rice supply chain traceability system are as follows:

1. Identify existing systems

The identification of the existing system is carried out by direct observation of the related units so that it can clearly identify the condition of the existing system and can provide development in its traceability system, especially in the rice supply chain during the Covid-19 pandemic in Jabodetabek, Indonesia.

2. Identify members or entities and information that need to be recorded in the traceability system

Based on the network structure at FSCN, identification of the members or entities involved along the supply chain is carried out. After being identified, several entities were re-selected as well as some required information related to supply chain traceability. In addition to determining the entities and required information, a traceability point is also determined for each activity and business process in the supply chain. Business process mapping can be done using a Business Process Model and Notation.

3. Modeling the traceability system using the UML method

At this stage, UML will be made for the design of the traceability system so that

later it can be used as the basis for making traceability system software in the rice supply chain. The UML that will be made in this study consists of use case diagrams, activity diagrams and class diagrams.

RESULT

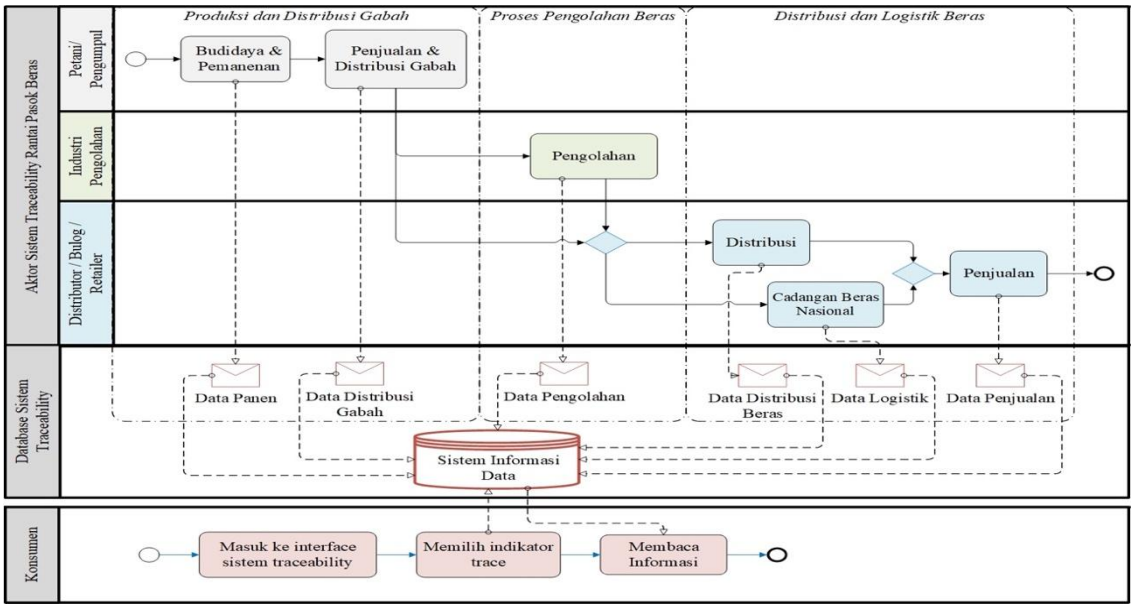
Existing System Identification

According to the results of interviews and observations in the field, it is known that the flow of information and data required for tracing rice products in Indonesia, especially in Jabodetabek, only operates with certain stakeholders. The traceability system that is in the rice supply chain is currently not centrally integrated into one system, so there is a possibility that the information is interrupted by one or more stakeholders.

Information that is integrated throughout the chain can help chain actors quickly access and detect existing problems and prevent multiple parties from committing fraud. Several fraudulent practices in rice products still occur because there is no system that can detect in real-time where, when and how it happened. In addition, misalignment in the amount of rice stocks in each member of the chain can also be prevented through an integrated system in order to avoid hoarding rice products that can cause food scarcity, especially during pandemics or natural disasters. Therefore, it is necessary to consider the proposed model of a traceability system in an integrated rice supply chain.

Identification of System-Related Chain Entities

According to Handayani and Haryono (2018), before modeling the system it is important to identify the chain entities involved in the system because they will carry out the traceability function from upstream to downstream. The chain entities involved in the traceability system in the rice supply chain include unhulled rice producers (farmers/ farmers group association), collectors, rice processing industries, distributors, retailers and Bulog. In addition, the business processes that run in the rice supply chain can be seen in Figure 2.



Source: Primary Data (2020), processed

Figure 2 Mapping of activities and business processes for the rice supply chain traceability system

1) Producers (Farmers/Farmers Group Association)

Farmers and farmer group associations (Gapoktan) as the first actors in the chain have a role in producing unhulled rice which will be processed into rice by milling companies. Information regarding all planting and post-harvest activities that

need to be recorded by farmers/Gapoktan as chain producers is such as the varieties used, the type of water, the date of planting, fertilization, pest and disease control, the area of harvested land and so on.

2) Gathering Traders

Collector traders are actors who are between producers and processors. Collector traders function as distributors of unhulled rice from farmers to the milling industry or Bulog. The data that needs to be recorded by the system from collecting traders is regarding the distribution of grain, whether it is regarding the quantity and quality of grain to sales information and so on.

3) Processor (Milling Company)

Processors play a role in changing the value of the product from unhulled rice to rice that is ready for public consumption. Processors must record all details of processing activities starting from raw material procurement, purchasing information, processing and sales, packaging, labeling, stock or quantity, quality and so on.

4) Distributor (Wholesalers)

Wholesalers act as distributors of rice in large quantities from the milling industry and are resold to small rice traders in their respective regions. Information that needs to be recorded by wholesalers includes detailed data on quantities, lists of purchases and sales, and so on.

5) Retailers

Retailers have an important role in the rice supply chain because it can facilitate product access to the end consumer. The number of rice retailers is very large due to the high demand for rice, both in cities and in small areas, so that the possibility of fraud is quite high on the side of the retailers. Therefore, the information that retailers need to record needs to be monitored for accuracy so that the traceability system can run properly. Some of the information that needs to be recorded is such as data on purchases and sales such as quantity and quality of rice, and so on.

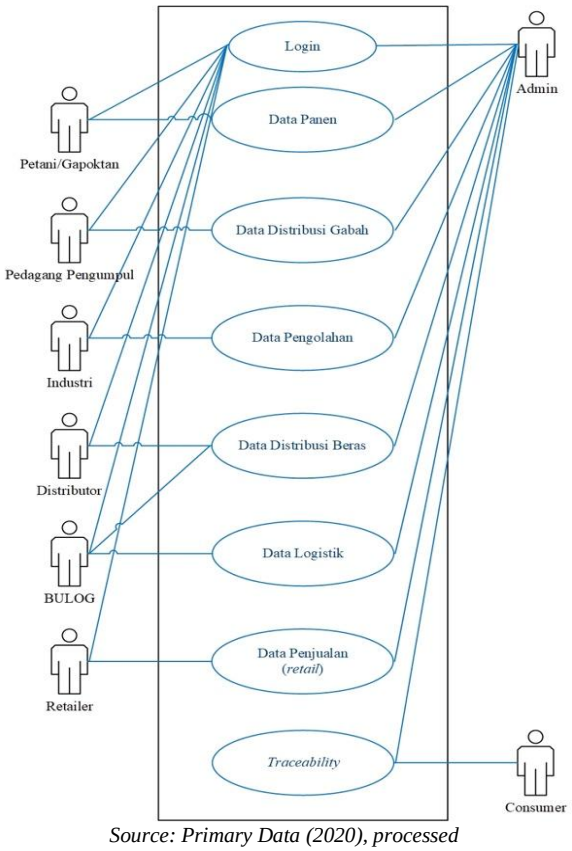
6) Bulog

Bulog as a government agency has a role in maintaining national rice stocks, rice procurement and market balance. The information that needs to be recorded includes the details of storage at Bulog's warehouse, rice distribution, and so on.

Traceability System Modelling

The system modeling stage is carried out by designing a UML diagram model to be able to visualize and document the product chain flow specifically in the system. System modeling includes modeling usecase diagrams, class diagrams, and activity diagrams as follows:

1) Usecase diagram



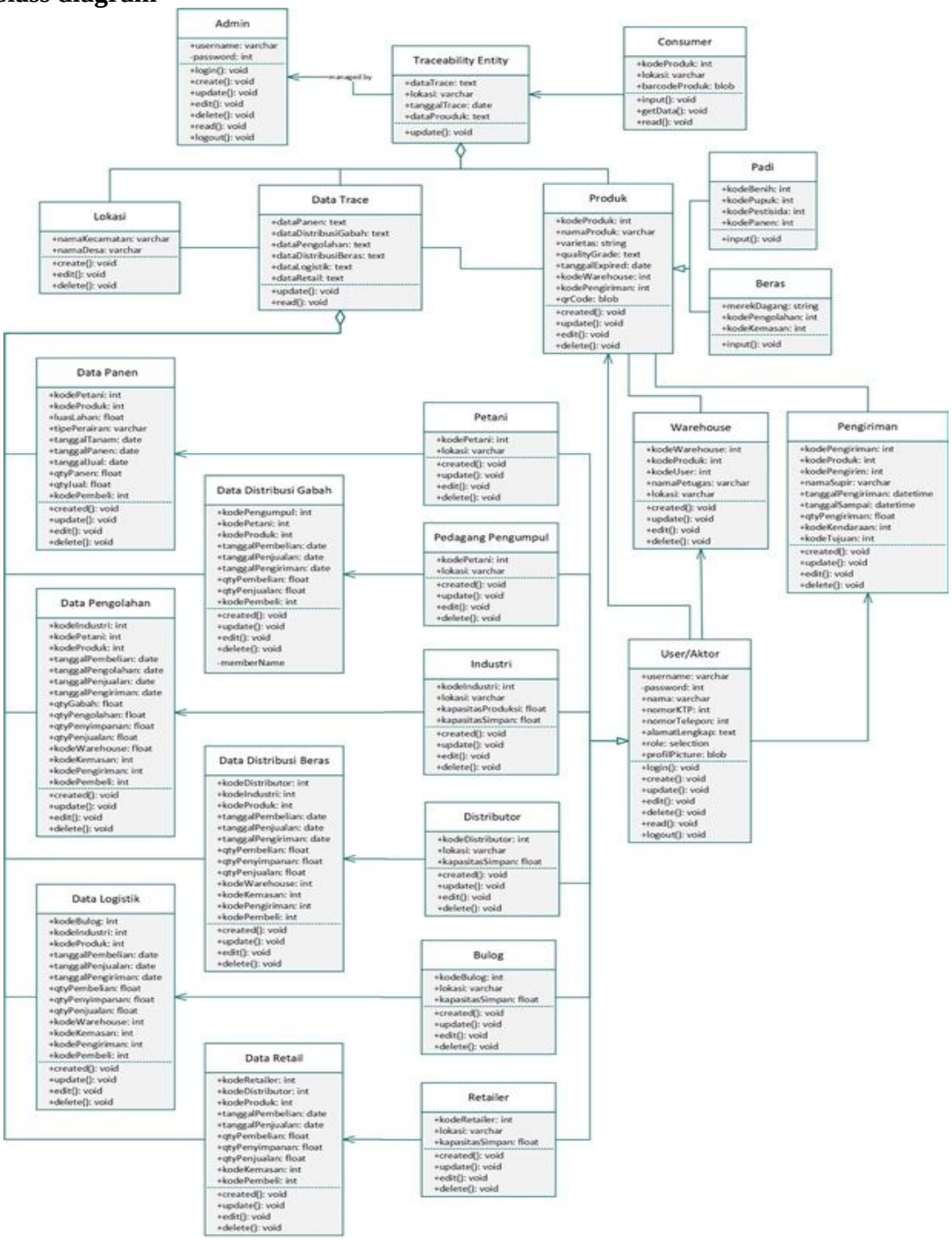
Source: Primary Data (2020), processed

Figure 3 Usecase diagram of the rice traceability system

Figure 3 describes the interactions and functions between one or more actors in the system to be created. There are several

components that need to be explained in the usecase diagram, namely actors or objects interacting in the system, use cases that describe the functions of the system as a unit that exchanges messages between the system and actors, a description of the interactions and relationships that occur between actors and system boundaries. In the use case diagram, it can be seen that the actors involved in the traceability system of the rice supply chain include producers where there are farmers and gapoktan, collector traders, industries, namely rice mills, distributors or wholesalers, retailers or retailers and Bulog as a logistics rice and distribution body.

2) Class diagram



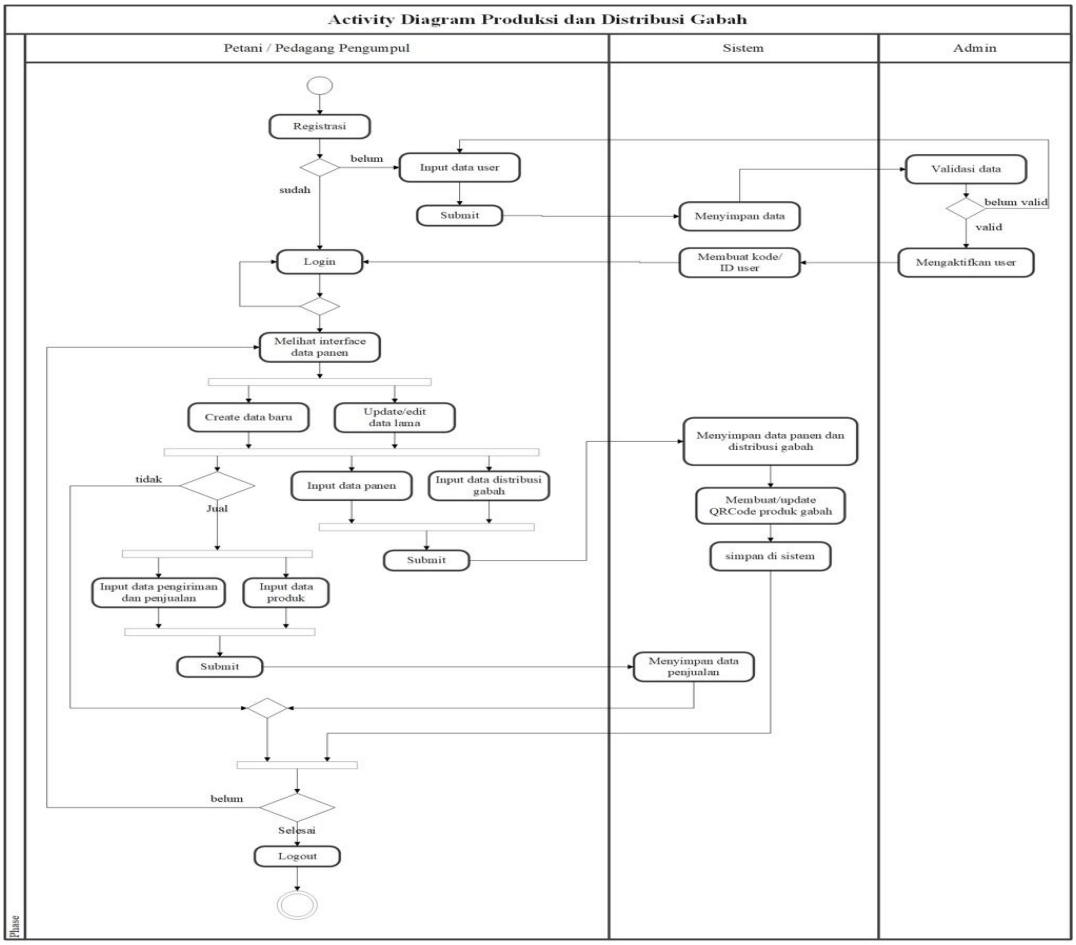
Source: Primary Data (2020), processed, **Figure 4 Class diagram of the rice traceability system**

Furthermore, a class diagram is also illustrated which explains the relationship between object classes and what attributes will be entered into the database in each actor. The class diagram shown in Figure 4 describes the attributes involved in the rice supply chain traceability system. Each attribute provides the information needed for the search process. The diagram shows information in the form of what data attributes must be recorded in the system and shared with other actors in the chain. Based on this data, it is known that the attributes that can be used to carry out the search process include product codes in the form of ID numbers or barcodes and the location of the search. Each attribute has an ID number that can be tracked because it is equipped with the required data such as harvesting data, product processing data, distribution and logistics data, retail data, warehouse data, shipping data and user data filling in the information into the database.

3) Activity diagram

Activity diagrams describe the work flow of an activity in a business process. This diagram can model business processes and workflows in the system by describing the activities of each actor. Based on the usecase diagram and the structure of the rice supply chain network, it is known that modeling the traceability system can be divided into four main activities, namely the production and distribution activities of grain by farmers or farmer groups and collectors, processing activities by the processing industry, distribution and logistics activities by distributors, retailers, and Bulog and the last activity is a tracing system activity that can be carried out by chain consumers.

a) Grain Production and Distribution Activity Diagram

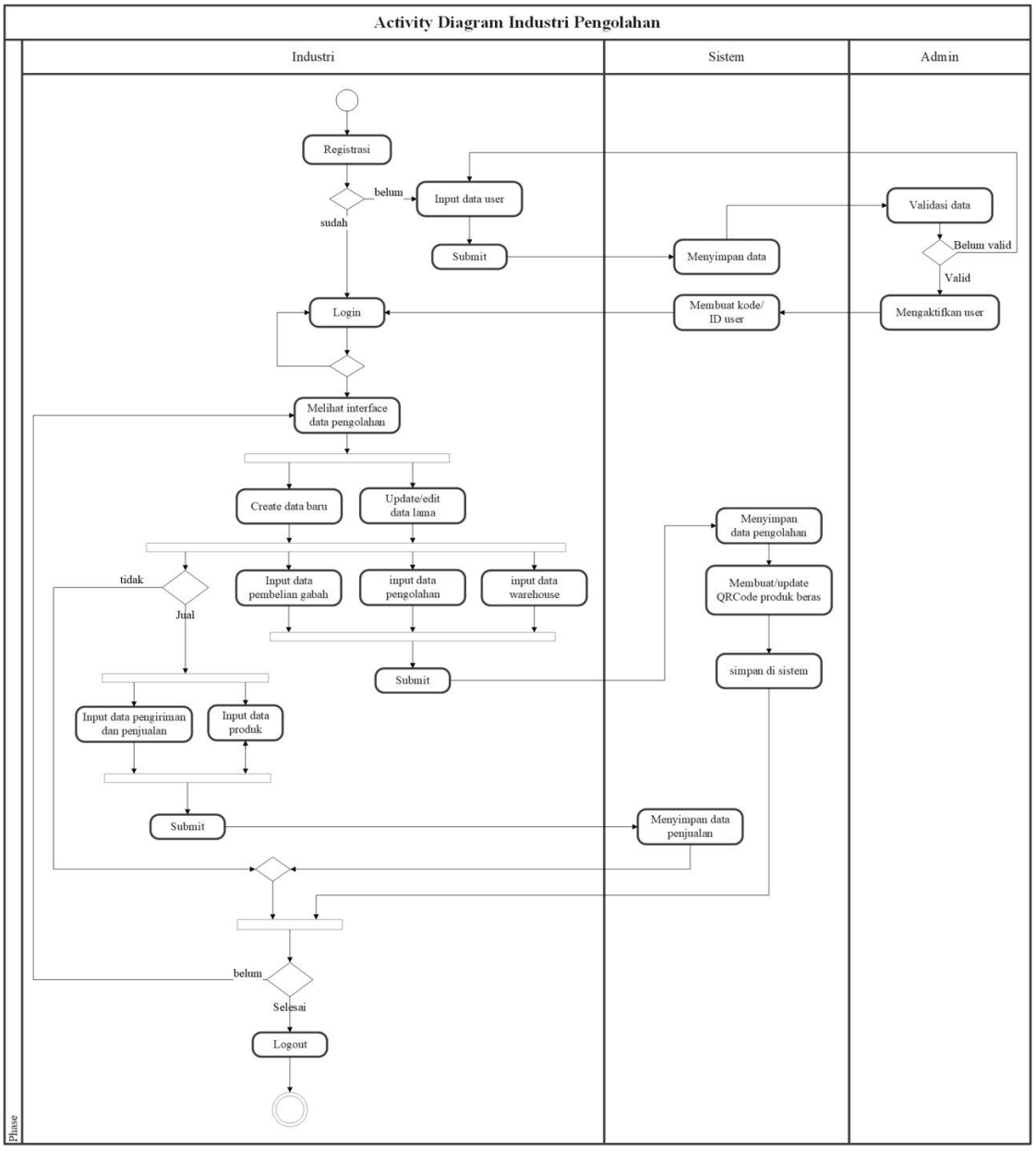


Source: Primary Data (2020), processed, **Figure 5 Activity diagram of grain production and distribution**

The actors involved in the production and distribution of unhulled rice are producers, namely farmers or farmer groups and collecting traders. Farmer or Gapoktan actors are responsible for harvest data that has information attributes about all activities upstream of the chain such as cultivation, harvesting and post-harvest such as planting and harvesting dates, land area, planting quantity, harvest and sale, quality of grain produced and grain information on sales. Actor merchant collectors provide data or information regarding the distribution of grain, whether it is regarding the quantity and quality of grain to sales information and so on.

b) Activity Diagram of Rice Processing

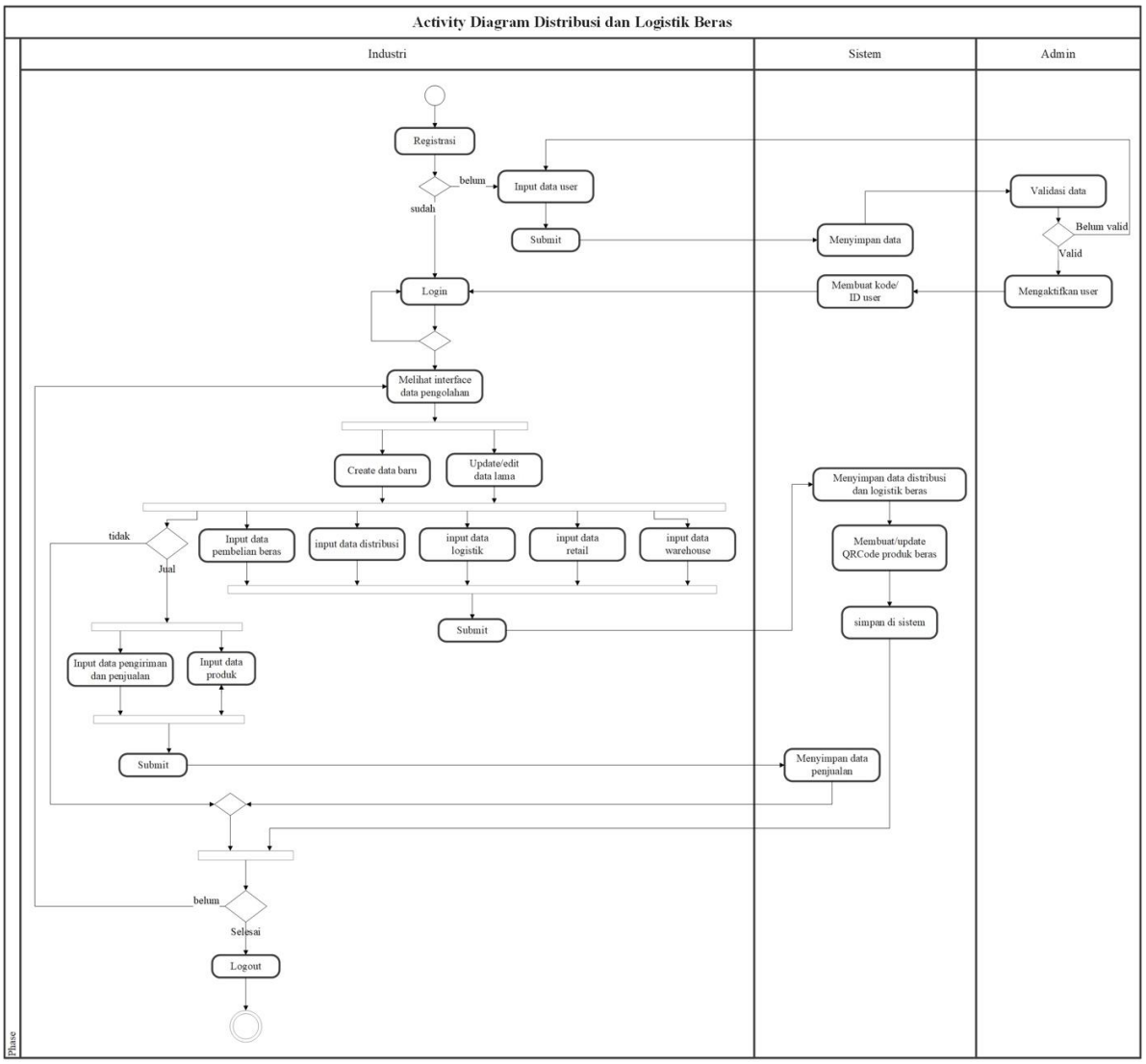
The actors involved in rice processing activities are the rice processing industry or business actors. Based on usecase and class diagrams, processing industry actors are responsible for processing data that has information attributes regarding all processing activities such as date of purchase of grain, date of processing, date of sale, date of delivery, quantity and quality of products produced, storage and information regarding rice sales.



Source: Primary Data (2020), processed, **Figure 6 Processing industry activity diagram**

c) Rice Distribution and Logistics Activity Diagram

The actors involved in rice distribution and logistics activities are distributors, retailers and Bulog. Based on usecase and class diagrams, the three actors are responsible for distribution and logistics data which have information attributes regarding all activities such as dates and quantities of purchases and sales, delivery, storage and information regarding rice sales.

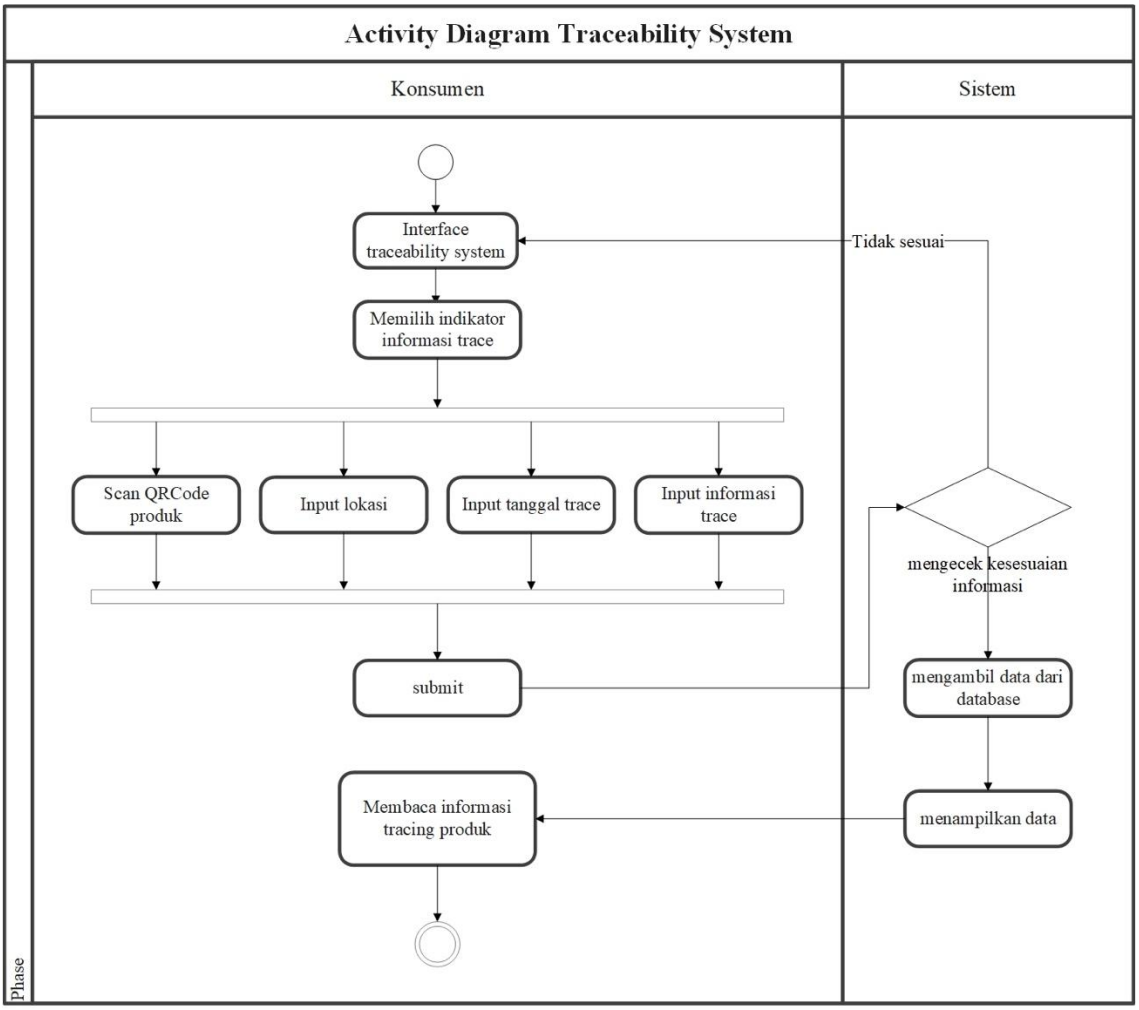


Source: Primary Data (2020), processed

Figure 7 Activity diagram of rice distribution and logistics

d) Activity Diagram of the Rice Supply Chain Traceability System

The last activity is the activity of the rice supply chain traceability system in Figure 8. Based on the usecase and class diagram, consumers can search by reading the product information available in the system. On the chain traceability web interface, consumers can select the tracking indicators they want to know, such as product information based on location, tracing date or can doing tracking with product ID numbers or barcode scans printed on rice products. The data were obtained from a traceability database that was input by actors involved in the rice supply chain. Furthermore, consumers can use the search result data according to their needs, both to ensure sufficient product stock, to trace the causes of possible obstacles along the rice supply chain, especially during a Covid-19 pandemic.



Source: Primary Data (2020), processed

Figure 8 Activity diagram of the traceability system of the rice supply chain

Managerial Implications

Traceability system modeling in this study has implications for the application of rice supply chain information technology so that chain actors will be connected to each other in the system and can easily trace information in real time and provide fast and precise handling of problems during the Covid-19 pandemic.

CONCLUSION

The Covid-19 pandemic presents several obstacles and threats to the industry, such as obstacles to distribution channels, and reduced human resources. Other industry threats that need to be considered are competition between similar competitors and the threat of new competitors. In addition, the condition of the chain structure and management during the pandemic did not change too much, but it is still necessary to develop a chain information technology system because the pandemic causes product flow to be slightly hampered. The proposed model of an integrated traceability system between chain actors can make product flow information well known and traceable to be used in mitigating the risk of food scarcity that may occur during a pandemic. The next studies are necessary to test the system prototype in the Jabodetabek area first. The proposed system is the basis of a traceability system, so that research can be continued with the application of more advanced technology and more secure security with artificial intelligence (AI) or blockchain.

REFERENCES

1. Blos MF, Quaddus M, Wee HM, Watanabe K. 2009. Supply Chain Risk Management

(SCRM): a case study on the automotive and electronic industries in Brazil. Supply Chain Management: An International Journal. 14 (4): 247-252.
2. Chopra S, Meindl P. 2007. Supply Chain Management. Strategy, Planning & Operation. New Jersey: Pearson Prentince Hall.
3. Hamdani T. 2020. The consumption of rice in Cipinang Central Market has increased by 40 % since the Coronavirus outbreak. detikFinance [accessed 2020 Apr 30].
4. Handayani DI. 2013. Identification of Supply Chain Risks Based on Traceability Systems in Apple Cider Drinks. Industrial Spectrum. 11 (2).
5. Handayani DI, Haryono. 2018. Design of Halal Traceability System in Food Supply Chain for Small and Medium Industries. Inside: Djatna T, Mulyati H, Wijaya H, Santosa SH, Amelia R, Zahra N, editor. Agrologistics 4.0 Opportunities and Challenges in the Digital Age at the 2018 Agrologistics National Seminar; 2018 Sep 18; Bogor, Indonesia. Bogor (ID): ISLI. pp. 49-56.
6. Harwiyani AP, I Vanany. 2014. Design of Beef Tracking System at PT. X. Paper and Presentation of Industrian Engineering. Surabaya (ID): ITS
7. Musyaffa I. 2020. BPS: Rice Production In 2019 Reaches 31.31 Million Tons [internet]. Anadolu Agency. [accessed Mar 27 2020].
8. Opara LU. 2003. Traceability in Agriculture and Food Supply Chain: A Review of Basic Concepts, Technological Implications and Future Prospects. Journal of Food Agriculture and Environment. 1 (1): 101-106.
9. Son of AH. 2017. Performance Analysis and Traceability Systems in the Superior Vegetable Supply Chain at Okigaru Farm [thesis]. Bogor (ID): Bogor Agricultural University
10. Princess AM. 2017. Raskin Traceability System at Perum Bulog, North Surabaya Regional Sub Division [thesis]. Surabaya (ID): Sepuluh Nopember Institute of Technology.
11. Regattieri A, Gamberi M, Manzini R. 2007. Buyer-Supplier Relationship's Influence on Traceability Implementation in the Vegetable Industry. Journal of Purchasing and Supply Management. 12: 39-50.
12. Setyaningrum P. 2018. Beef Beef Tracking System Modeling Using Unified Modeling Language (UML). JTIP Indonesia. 10 (2): 1-5.
13. Siswanto. 2019. Design of Feed Corn Traceability Information System [thesis]. Bogor (ID): IPB
14. Sudibyo A. 2012. Traceability System in the Food and Agricultural Products Industry. Journal of Agro-Based Industry. 29 (02): 43-62.
15. Whitten JL, Bentley LD. 2007. System Analysis and Design Methods - 7th Edition. New York (US): McGraw-Hill.

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