

## Fresh Milk Supply Chain Analysis in Kelompok Ternak Mandiri Sejahtera using Food Supply Chain Network Approach

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### ABSTRACT

Supply chain management plays a role in ensuring the availability of raw materials from suppliers to the final product reaching consumers. Kelompok Ternak Mandiri Sejahtera (KTMS) is a cooperative that acts as a link between farmers and dairy processing consumers. However, research on the application of the supply chain concept at KTMS has not yet been explored. One commonly used approach to analyze supply chain conditions is the Food Supply Chain Network (FSCN). Therefore, the aim of this study is to analyze the fresh milk supply chain conditions at KTMS using the FSCN approach to comprehensively understand the supply chain conditions. The research was conducted at the Kelompok Ternak Mandiri Sejahtera (KTMS) from June to July 2024. The method used was qualitative descriptive with observations and interviews using questionnaires relevant to the Food Supply Chain Network (FSCN) framework with 17 respondents. The results of the study indicate that the fresh milk supply chain conditions at Kelompok Ternak Mandiri Sejahtera (KTMS), based on the Food Supply Chain Network framework approach, have been running smoothly, although transportation resources and technology resources remain weaknesses for both the farmers and KTMS.

**Keywords:** Food Supply Chain Network, Fresh Milk, Supply Chain

### ABSTRAK

Manajemen rantai pasok memiliki peran dalam menjamin ketersediaan bahan baku dari pemasok hingga produk sampai ke konsumen. Kelompok Ternak Mandiri Sejahtera (KTMS) merupakan salah satu koperasi yang berperan sebagai penghubung antara peternak dan konsumen pengolahan susu. Namun penelitian terkait penerapan konsep rantai pasok di KTMS belum dikaji. Salah satu pendekatan yang banyak digunakan untuk menganalisis kondisi rantai pasok adalah *Food Supply Chain Network*. Oleh sebab itu, tujuan dari penelitian ini ialah menganalisis kondisi rantai pasok susu segar di KTMS dengan menggunakan pendekatan FSCN untuk memahami kondisi rantai pasok secara komprehensif. Penelitian dilakukan di Kelompok Ternak Mandiri Sejahtera (KTMS) mulai bulan Juni hingga Juli 2024. Metode yang digunakan adalah deskriptif kualitatif dengan observasi dan wawancara menggunakan kuesioner yang relevan dengan kerangka *Food Supply Chain Network* (FSCN) kepada 17 orang responden. Hasil penelitian menunjukkan bahwa kondisi rantai pasok susu segar di Kelompok Ternak Mandiri Sejahtera (KTMS) berdasarkan pendekatan kerangka *Food Supply Chain Network* sudah berjalan dengan lancar, namun sumber daya modal dan sumber daya teknologi masih menjadi kelemahan bagi peternak maupun KTMS.

**Kata kunci:** *Food Supply Chain Network*, Rantai Pasok, Susu Segar

## INTRODUCTION

The increase in population, income, and public understanding of the importance of animal protein has led to an increasing demand for livestock products. However, Domestic Fresh Milk (SSDN) production is only able to meet 22% of national needs and the remaining 78% still comes from imports (Pusdatin Pertanian 2022). Currently, livestock businesses in Indonesia are still dominated by smallholder farmers with only 2-5 cows owned with relatively low production results, namely 6-10 liters/head/day (Nurhayu *et al.* 2017). Another problem that arises is that fresh milk is a food product that is very easily damaged. Fresh cow's milk has a resistance at room temperature for only 4 hours. If left for more than that, the milk will be damaged due to uncontrolled microbial growth, so farmers must sell their fresh milk or process it immediately after milking (Nababan *et al.* 2014).

One of the largest fresh milk markets is the milk processing industry (IPS). IPS has a very important role in efforts to provide and fulfill the community's nutritional needs, especially protein through processed milk products such as pasteurized milk, UHT milk, powdered milk, yogurt, cheese, butter, and so on. So it can be said that IPS is a sector that really needs a supply of fresh milk. Farmers cannot directly sell their milk directly to IPS, because fresh milk production is small. A cooperative is needed as a container to accommodate fresh milk from farmers before selling it to IPS. The supply chain has an important role in the process of fulfilling the milk needs of the Indonesian people. The supply chain is a concept about a regulatory system related to product flow, information flow and financial flow (Emhar *et al.* 2014). Supply chain management has a role in increasing the competitiveness of a product, because supply chain management guarantees the availability of raw materials from suppliers to the delivery of finished products to consumers (Prasetyo and Ngaini 2022; Purwatmini 2015). Various aspects can significantly affect the smoothness of the supply chain product flow process. These aspects have been formulated in the Food Supply Chain Network (FSCN) framework which has been modified by Van Der Vorst (2006).

Kelompok Ternak Mandiri Sejahtera (KTMS) is a cooperative located in Cijeruk District, Bogor Regency, which collects milk from its members. Most of the sales destinations for fresh milk at KTMS are to the milk processing industry in Bogor Regency. Research related to fresh milk marketing channels at KTMS has previously been studied by Sarwi (2022) and 4 channels were obtained. The application of an effective and efficient supply chain concept can facilitate the marketing process starting from sending orders, procuring raw materials, disseminating information, collaborative planning, measuring performance, and shipping to end consumers. Based on the formulation of the problem above, the purpose of this study is to analyze the condition of the fresh milk supply chain at KTMS using the FSCN approach to understand the condition of the supply chain comprehensively.

## METHOD

This research was conducted at the Kelompok Ternak Mandiri Sejahtera (KTMS) that was located in Tajurhalang Village, Cijeruk District, Bogor Regency, West Java Province. The data collection period started from June to July 2024. The selection of the research location was carried out intentionally (purposive sampling) based on the consideration that the research location is one of the cow's milk centers in Bogor Regency. The selection of respondents was carried out to analyze the condition of the fresh milk supply chain using the snowball sampling technique, namely tracing the supply chain channels at the research location based on information obtained from previous supply chain members. The respondents selected were KTMS member farmers and the head of the KTMS cooperative. The farmer respondents were all KTMS member farmers who met the criteria as active KTMS members, had lactating dairy cows, actively sold milk to the KTMS cooperative, and were willing to be interviewed. There were 18 farmers from a total of 24 active KTMS members who met the criteria for respondents in this study, with an average ownership of 6 cows. The data collected in this study were primary and secondary data. Primary data was obtained through observation and interviews. The interview process was carried out in depth using a questionnaire that was relevant to the Food Supply Chain Network (FSCN) framework to describe the condition of the supply chain at KTMS. Secondary data is obtained from literature, journals, articles, or previous research as a comparison and support for primary data.

The data processing techniques and data analysis methods in this study were carried out through quantitative descriptive analysis stages to describe the condition of the fresh milk supply chain using the Food Supply Chain Network (FSCN) framework. The FSCN framework can describe the condition of a complex supply chain by analyzing its six elements, supply chain targets, chain structures, chain resources, chain business processes, and chain performance as can be seen in Figure 1 (Van der Vorst, 2006). In the FSCN framework, there are one-way and two-way lines connecting each element, where a one-way connecting line indicates that an element influences another element and a two-way connecting line indicates that there is a mutual influence relationship between the two elements.

## RESULTS AND DISCUSSION

### KTMS Fresh Milk Supply Chain Targets

Chain targets are the goals to be achieved in the supply chain. According to Marzuki *et al.* (2023) chain targets can be seen from two sides, namely market targets and development targets. The target market targeted by KTMS is the milk processing business (UPS) around Bogor Regency. The reason for choosing this market is that KTMS has a lot of fresh milk supply from farmers but not enough to sell it to the milk processing industry (IPS) market. In addition, KTMS still uses pick-up trucks without cooling to distribute its milk. So it is feared that the milk sent to IPS will be damaged during the trip, because the location

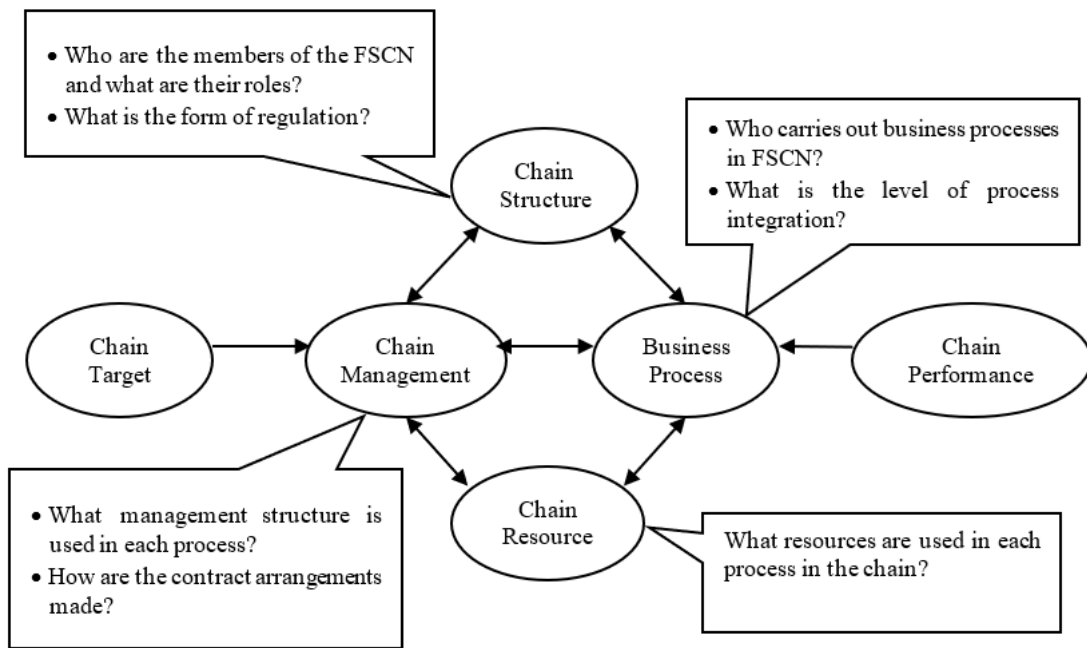


Figure 1. Food Supply Chain Network Framework

of IPS is quite far from the KTMS cooling unit. Fresh milk produced by KTMS members has very good quality and can compete with the quality of milk produced by dairy farming companies. Based on the test results using lactoscan shown in Table 1, fresh milk in KTMS has a specific density of 1.031 g mL<sup>-3</sup>, a protein content of 3.2%, a fat content of 3.4%, a lactose content of 4.9%, and a total solid of 8.9%. This quality is said to be very good because it has met the minimum limit for fresh milk set by the Badan Standarisasi Nasional (BSN 2011). In addition, the quality of fresh milk in KTMS has a difference that is not too far from dairy companies such as PT. Sumber Citarasa Alam (PT. SCA), PT. Global Dairy Alami (PT. GDA), and PT. Ultra Peternakan Bandung Selatan (PT. UPBS) both in terms of specific density, fat content, total solid, lactose, and protein. KTMS has realized the importance of maintaining the quality of its members' fresh milk, such as increasing sorting when receiving milk from farmers, increasing socialization regarding milk quality, and choosing their own concentrate feed to be used by group members. This is also supported by Hassen *et al.* (2022) who stated that 70% of the quality and production of cow's milk is influenced by the nutrients contained in the feed.

The development targets that KTMS wants to achieve are improving the quality of fresh milk with a total solid target of 13%, increasing the number of members

and the quantity of daily production of dairy cows of group members, and expanding the reach of members to the Tajurhalang Village level. By increasing the daily milk production of dairy cows, it is expected to increase the income of farmers and increase the supply of fresh milk to the cooperative without having to increase the operational costs of the barn.

#### KTMS Fresh Milk Supply Chain Structure

**Supply chain members.** The main supply chain members in KTMS are KTMS member farmers who act as the main providers of fresh milk raw materials, the KTMS cooperative which acts as a collector of fresh milk from farmers and markets it, and consumers (UPS) namely BRIN, Susu Mbok Darmi, and B'Gurt. KTMS has been established since January 15, 2011 through a discussion between dairy farmers with an initial membership of 18 farmers. Currently, KTMS has 24 active members and 20 of them actively sell fresh milk to KTMS. The production of fresh milk collected by the KTMS cooperative ranges from 200 to 400 liters per day.

The activities of supply chain members consist of exchange activities, physical activities, and facility activities. Exchange activities carried out by farmers include purchasing production inputs to support cultivation

Table 1. Comparison of Fresh Milk Quality at KTMS with Dairy Cow Companies

Company	Fat (%)	SNF (%)	Lactose (%)	Density (g mL <sup>-3</sup> )	Protein (%)
KTMS	3.4 <sup>1</sup>	8.9 <sup>1</sup>	4.9 <sup>1</sup>	1.0308 <sup>1</sup>	3.2 <sup>1</sup>
PT. SCA	4.7 <sup>2</sup>	9.0 <sup>2</sup>	4.9 <sup>2</sup>	1.0304 <sup>2</sup>	3.3 <sup>2</sup>
PT. GDA	4.0 <sup>2</sup>	9.4 <sup>2</sup>	5.1 <sup>2</sup>	1.0322 <sup>2</sup>	3.4 <sup>2</sup>
SNI	3.0 <sup>3</sup>	7.8 <sup>3</sup>	4.0 <sup>3</sup>	1.0270 <sup>3</sup>	2.8 <sup>3</sup>

<sup>1</sup>Primary data 2024; <sup>2</sup>(Rahmatunisa 2023); <sup>3</sup>(BSN 2011)

activities in the form of feed, artificial insemination (AI), medicines, and so on, as well as selling fresh milk to the KTMS cooperative. KTMS also carries out all exchange activities in the form of purchases and sales. The purchasing activities carried out by KTMS are buying fresh milk sold by member farmers and buying concentrate feed, while the sales activities carried out are selling fresh milk to consumers and selling concentrate feed to KTMS members. Because consumers of KTMS are UPS, consumers also still carry out all activities from exchange activities, namely purchasing and selling. Purchasing activities include buying fresh milk from KTMS and sales activities include selling fresh milk that they have processed to end consumers.

The physical activities carried out by farmers are only dairy cattle farming activities, packaging them in milk cans and transporting fresh milk from each farmer's pen to the KTMS cooperative. Farmers do not carry out storage activities because in addition to the lack of good storage locations and equipment, so that every day farmers must directly process milk to sell themselves or sell it directly to KTMS. Meanwhile, KTMS and Consumers carry out almost all physical activities, namely transportation, packaging, and storage, except for cultivation activities. The role of raw material providers only comes from farmers, KTMS only acts as a collector and market provider for farmers. Milk processing consumers are not end consumers and still carry out the processing process before selling it to household consumers, so milk processing consumers still carry out storage activities, both fresh milk purchased from KTMS or processed milk products, processed product packaging activities, and product transportation activities to end consumers.

All members of the KTMS supply chain, be it farmers, KTMS, or consumers, carry out all facility activities in the form of sorting and market information. Sorting activities are carried out by farmers before sending milk to the KTMS cooperative, then KTMS will re-sort by testing its quality with lactoscan, organoleptic tests, and alcohol tests to ensure that the milk sold by farmers is in accordance with standards. Finally, consumers will also re-sort when fresh milk sent from KTMS has arrived in their hands. Market information is regulated by KTMS as an intermediary between farmers and milk processing consumers, generally KTMS will negotiate prices with milk processing consumers based on feed prices, so that

price agreements on agreements between supply chain members can be reached.

**Flow pattern.** There are 3 flow patterns in the KTMS fresh milk supply chain, namely the flow of goods in the form of fresh milk from upstream to downstream, financial flow from downstream to upstream, and information flow from upstream to downstream or vice versa as seen in Figure 2.

**Communication system.** The Information System in KTMS has been running well between supply chain members. The flow of information from KTMS and farmers is generally related to milk prices, feed prices, quantity and quality of fresh milk that must be achieved by farmers. The communication that occurs is done using telephones, or regular meetings with members. The flow of information between milk processing consumers and KTMS is also not much different, namely still related to milk prices, quality, and quantity of fresh milk that must be achieved. The communication that occurs is done using telephones, and visits from milk processing consumers to KTMS. Scholten and Schilder (2015) stated that communication plays an important role in the supply chain because it can increase visibility, flexibility, and speed of product flow in the supply chain. Therefore, good communication can lead to partnerships between supply chain actors running well.

#### Business Procces

**Business process relationship.** One aspect that can be used to see the process that occurs in the supply chain business is the cycle view which consists of four process cycles, namely procurement cycle, manufacturing cycle, replenishment cycle, and customer order cycle. In the procurement cycle, the supply chain members who play a role are KTMS and milk processing consumers. KTMS gets a supply of fresh milk from member farmers while consumers get a supply of milk from KTMS. The manufacturing cycle or processing is also carried out by KTMS and milk processing consumers, namely the cooling process in the KTMS cooperative cooling unit and the production process of processed milk products by each milk processing consumer. The milk cooling process is intended to inhibit microbial growth, so that the milk can have an extended shelf life (Torres-Toledo *et al.* 2015). Perin *et al.* (2019) also stated that the ideal temperature for storing fresh milk to inhibit damage due to the growth of microorganisms is 4°C.

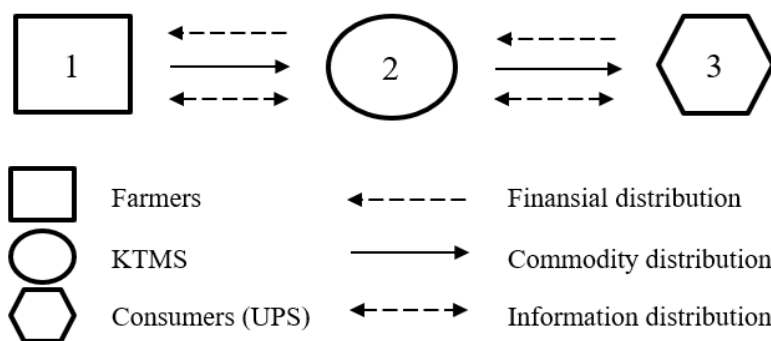


Figure 2. KTMS Fresh Milk Supply Chain Flow Pattern

Replenishment cycle is the replenishment of products purchased from previous supply chain members when there is a large number of orders or unexpected orders from consumers. This cycle is only carried out by milk processing consumers. KTMS does not carry out a replenishment cycle because all milk produced by members has been counted so that no milk is unsold. The customer order cycle is the last cycle and this cycle is also only carried out by milk processing consumers by ordering milk from KTMS.

**Distribution patterns.** There are 3 distribution patterns that need to be considered in the supply chain, namely commodity, financial, and information distribution. The flow of commodities in the fresh milk supply chain at KTMS starts from farmers who are members of KTMS, then sell their milk to the KTMS cooperative. Milk from farmers will be stored in a 500 liter cooling unit until the milk delivery schedule to milk processing consumers arrives. Based on the interview results, milk delivery to consumers is scheduled every Monday, Tuesday, Thursday and Saturday using a pick-up truck as a means of transportation.

Financial flows occur starting from consumers, KTMS, and farmers. The payment process by consumers to KTMS is carried out within 1-3 days after the goods are received according to the agreed standards. Furthermore, farmers will receive payment from KTMS every 30 days with a reduction in how much concentrate feed is taken by farmers within the 30 days. However, if it is urgent, farmers can submit a request to collect the fee before 30 days with a waiting time of 1-3 days from the day of the request. The flow of information in the fresh milk supply chain at KTMS is in the form of price, quantity, and quality information. The flow of information takes place from downstream to upstream, and vice versa.

**Collaborative planning.** To meet consumer needs, collaboration is needed in sharing information reciprocally at each actor in the supply chain. Milk processing consumers will provide information on the demand for fresh milk, then the cooperative will plan by recording how much milk is needed by milk processing consumers. When the milk production of KTMS members decreases due to the dry season of the barn, the KTMS chairman will ask his members to prioritize selling milk to the cooperative first so that consumer demand can be met. When milk production starts to return to normal, the KTMS chairman will free farmers to sell their milk outside the cooperative. This is in accordance with the opinion of Rasoki and Nurmalia (2021) who stated that collaborative planning that prioritizes openness of information between supply chains is the key to the success of activities in the supply chain.

**Risk aspects.** KTMS member farmers face the risk of milk damage such as milk that breaks during an alcohol test. According to Wiranti *et al.* (2022) some things that cause milk to break are milk that has started to sour or has even become sour (pH <6.4), milk mixed with colostrum, at the beginning of mastitis, milk is unstable due to physiological changes, and unhygienic conditions during the milking process. The risk faced by KTMS is milk damage during the transportation process. This is

because the KTMS transportation system is still traditional, namely using pick-up trucks and milk is still packaged in milk cans. Damaged milk will have an impact on the cooperative's income, because damaged milk will not be received by consumers while the cooperative will not receive payment, while the cooperative still has to pay farmers for their milk. This will certainly be detrimental to the KTMS cooperative.

**The building trust process.** The process of building trust between KTMS member is formed because farmers have known each other and have the same goal, namely to continue to develop. By joining KTMS, farmers receive various benefits such as training from both the government and academics, certainty of payment, availability of good quality concentrate feed and lower prices compared to purchases outside the cooperative, price transparency, and free health services related to diseases, IB and pregnancy checks. Meanwhile, trust between KTMS and the processing consumers is established because KTMS has very good milk quality and KTMS's ability to meet all requests for fresh milk from milk processing consumers. In addition, consumers also agree to continuously buy milk from KTMS without any holidays so that there will be no unsold milk at KTMS. The agreement regarding continuity, quality, and quantity between KTMS and milk processing consumers is bound by a written agreement. Yolandika *et al.* (2016) in their research also stated that trust between farmers and companies is established due to the ability to provide quality products and a strong commitment from each supply chain actor.

### Supply Chain Resources

The physical resources owned by farmers are farmland, infrastructure in the form of pens, and dairy cattle maintenance equipment such as milk cans and motorbikes as vehicles used by farmers to deliver milk to the cooperative. Meanwhile, the physical resources owned by KTMS are cooperative buildings, feed warehouses, 2 cooling units, 1 lactoscan, several milk cans as places to store milk during delivery and pick-up trucks as vehicles used to deliver milk to milk processing consumers. In the cultivation process, KTMS member farmers still carry out all livestock activities alone. Meanwhile, the human resources owned by KTMS to assist its business activities are assisted by 2 workers. 1 person is tasked with testing the quality of milk sold by farmers, 1 other person is tasked as a driver to transport fresh milk from KTMS to milk processing consumers.

Both farmers and cooperatives still use personal capital to carry out their respective business activities. The capital obtained by farmers comes from the sale of fresh milk to cooperatives or the sale of milk door-to-door, while the capital obtained by KTMS comes from the sale of fresh milk to consumers, milk processing and the sale of concentrate to farmers. The technological resources owned by KTMS are only IB. Currently, technological resources are still a weakness for the supply chain at KTMS, because all livestock business activities are still carried out in a simple way. The condition of supply chain resources in KTMS is not much different when compared to the condition of the broccoli supply chain in Bandung

Batat Regency, where technological resources are still simple, still using family labor and capital resources that are still independent. According to Yolandika *et al.* (2016) capitalization, especially in the agricultural sector, is still quite difficult because banks consider agriculture to be a high-risk sector and a relatively low turnover rate, so farmers are reluctant to borrow capital from banks.

### Supply Chain Management

**Management structure.** KTMS has a role as a forum for farmers to improve their welfare. Although KTMS does buy fresh milk from farmers, KTMS was actually founded by, for, and for farmers. The organizational structure in KTMS consists of a group leader, treasurer, secretary, and members. The position of the leader in KTMS is determined by deliberation and is tasked with negotiating with milk processing consumers regarding the price, quality, and quantity of milk, and has the task of managing the cooperative. Both administrators and member farmers in KTMS have a role as the main supplier of fresh milk with an average ownership of 6 dairy cows per member.

**Partnership.** The partnership relationship that is established between all members of the supply chain arises because of the relationship of mutual need and benefit between the two parties. The benefits obtained by farmers after becoming members of KTMS are getting cheaper concentrate feed prices compared to buying it outside the cooperative, health services, artificial insemination, and free health checks provided by the cooperative chairman. In addition, KTMS members are also given the freedom to sell their milk to KTMS or not, so that farmers can determine their respective markets. Most KTMS member farmers sell their milk to KTMS to buy concentrate feed, because the payment process for buying concentrate can be deducted from the sales of fresh milk from farmers. With such facilities, KTMS asks farmers to consistently sell their milk to KTMS with the quality that has been agreed upon previously, such as not adding any ingredients to the milk. In addition, farmers also need to maintain the agreement on the time of selling milk with KTMS, such as whether the farmer wants to sell his milk in the morning or evening, or only in the afternoon. KTMS will not accept sales of milk from farmers outside the agreement to maintain the quantity of milk in the cooperative so that it does not overflow so that the possibility of damaged milk due to overproduction can be avoided. KTMS has criteria in selecting milk processing consumers, namely the ability of consumers to continue to buy milk from KTMS continuously without holidays and provide transparency and discuss problem solving when complaints occur with fresh milk produced by KTMS. On the other hand, consumers choose KTMS as a partner influenced by the ability and knowledge of KTMS members to produce fresh milk with quality that meets demand and can consistently supply to consumers on time.

**Contractual agreement.** The agreement between farmers and KTMS is not made through a formal or written contract, but only through an oral agreement. Meanwhile, the agreement made between KTMS and milk processing consumers is made through a written contract. The agreement concerns the quantity, quality, price, and continuity of fresh milk delivery to consumers. Generally,

written contracts are made with large companies or the government, while verbal contract agreements are usually made by traditional farmers/breeders (Prasetyo 2019).

**Transaction system.** All KTMS members who sell their milk to the cooperative will receive payment every 30 days according to how much milk is sold and minus the amount of concentrate feed purchased. The price given by KTMS to farmers is IDR 6,000 per liter of fresh milk and IDR 220,000 per 25 kg sack of concentrate. The payment process from KTMS to farmers is quite slow when compared to the payment process from other cooperatives, which on average only takes 10 days (Isniah *et al.* 2017). Furthermore, the cooperative will sell fresh milk to milk processing consumers at a price of IDR 8,000 per liter with payment no later than 3 days after delivery.

**Government policy.** Currently, the government has guaranteed the availability of markets for smallholder farmers by creating regulations related to partnership programs between IPS and local farmers to increase integration and reduce dependence on imported raw materials in the Regulation of the Minister of Agriculture Number: 26/Permentan/PK.450/7/2017 concerning the Provision and Distribution of Milk and Regulation of the Minister of Agriculture Number: 13/Permentan/PK.240/5/2017 concerning Livestock Business Partnerships (Permen 2017; Permen 2017). However, the government has not made regulations regarding the price of fresh milk in Indonesia, so most of the price of fresh milk is still determined by IPS. The dependence of dairy cooperatives on IPS in marketing milk makes dairy cooperatives powerless in determining milk prices (Malau *et al.* 2021).

### CONCLUSION

The fresh milk supply chain in the Kelompok Ternak Mandiri Sejahtera (KTMS) based on the Food Supply Chain Network framework approach has been running well. This can be seen from the cooperation between supply chain actors, namely farmers, livestock groups, and milk processing consumers, such as having clear goals, both market targets and development targets, sustainable business processes, good chain management, and adequate chain resources. However, currently capital resources and technological resources are still a weakness for farmers and livestock groups, so it will take a long time for farmers to develop their livestock businesses.

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