Milk Quality Improvement with AHP (Analytical Hierarchy Process) Based on SCOR (Supply Chain Operation References) Performance and Business Canvas Model in Giri Tani Milk Cooperative

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Abstract. KUD Giri Tani has faced varying quality of milk, resulting in several times rejection of milk by the industry. The programs that have been running are unable to provide the same quality milk. This research aims to prioritize programs that will be implemented by the top management of KUD Giri Tani. This research uses SCOR reference and Business Canvas Model to investigate proper improvement methods. The weighting level 1 shows that the top 3 significantly affect milk quality such as production, milk supply from farmers, and delivery. The weighting calculation for core activity shows that Plan Reliability (0.0439), Source Reliability (0.0825), Makes Effectivity (0.1513), Delivery Reliability (0.1160), and Return Reliability (0.0513) are the most significant weights of each criterion. The result shows that improving food quality is the highest score (0.393) followed by improvement hygiene (0.386) and milk grading process (0.221). The Farmer members can focus on those two things to improve the quality of milk produced. Those programs are appropriate to analyze the Business Canvas Model.

1 Introduction

Livestock and Animal Health Statistics data shows that the national dairy cow population in2019 was 561,061 heads with milk production of 996,442 tons, while the national milk demand in 2019 reached 4.3 million tons. To meet the demand for milk from the community, actors in the milk supply chain continue to improve their performance, especially the cooperatives. As the largest cooperative in Bogor Regency, KUD Giri Tani

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has hundreds ofpassive farmer members and over a hundred active members. The cooperative receives milkfrom farmers, carries out a cooling process, and then distributes it to the Cimory milk as the processing company. In addition, to improve the quality and quantity of milk, the cooperative provides support services for member farmers, such as providing loans for operational, credit for animal feed, veterinary medicines, and other services to support dairy farming activities [1]. It is supported by the results of the SWOT analysis [2]. The strategy to improve dairy cooperatives can be achieved by increasing awareness of the important role of farmers and their function as cooperatives.

Only 6.8% of the total milk production is marketed directly to end customers. To gain greater profits and sustain, the farmer members must improve their product quality, provide cheaper products, and follow customer wishes. Measurement of supply chain performance for a company's needs aims to reduce costs, meet customer satisfaction, increasecompany profits, and determine the extent to which its supply chain performance [3, 4]. Performance measurement aims to support the design of goals, evaluate performance, anddetermine future steps at the strategic, tactical, and operational levels [5, 6], and an integrated measurement is obtained between suppliers, internal companies, and consumers [7].

Nasrudin and Rivana [8] revealed that 50 performance indicators could be assessed to increase milk production productivity with the SCOR approach. The AHP method is faster than manual calculations, it can be more efficient and accurate for the result analysis [9]. In contrast to Nasrudin and Rivana [8], this study is more focused on improving the quality of milk in a village cooperative, so that is the basis for the AHP method. For the weighting of performance indicators, the Analytical Hierarchy Process (AHP) method is used [10, 11].

2 Methodology

The research was conducted at the Giri Tani KUD for three months, from September to November 2020. It focused on improving milk quality by identifying supply chain performance indicators from farmers to the milk processing company. The study began by conducting interviews and direct observations regarding general data and describing the working methods of cooperatives, then continued with in-depth observations on the process of procuring milk from the farmer members, processing cooling units in cooperatives, and the delivery process to the milk processing company. It is to find out the problems on the supply chain in improving the milk quality process.

2.1 Data Collection

There were two types of data needed to conduct this research, namely primary data and secondary data. Primary data is data obtained from interviews, questionnaires, and direct observations at the Giri Tani KUD. Meanwhile, secondary data was data already exists or generaland historical data of KUD Giri Tani. Based on data collection, Bussiness Canvas Model wasconducted [12].

2.2 Data Processing and Analysis

Processing begins with supply chain identification, process decomposition based on the SCOR model [5, 6], KPI validation (Key Performance Indicator), weighting the KPI hierarchy using the AHP (Pairwise Comparison) [9] method until recommendations are given for improvement. Flowchart of data processing methodology in Figure 1.

2.3 The decomposition process of SCOR (Supply Chain Operation Reference) and Indicator Validation

Cooperatives used SCOR as a reference for detailed supply chain processes. SCOR defines and classifies each cooperative dairy process to develop measurement indicators needed to measure integrated supply chain performance between suppliers (breeders) and internal companies (Cooperatives) and Milk Processing companies.

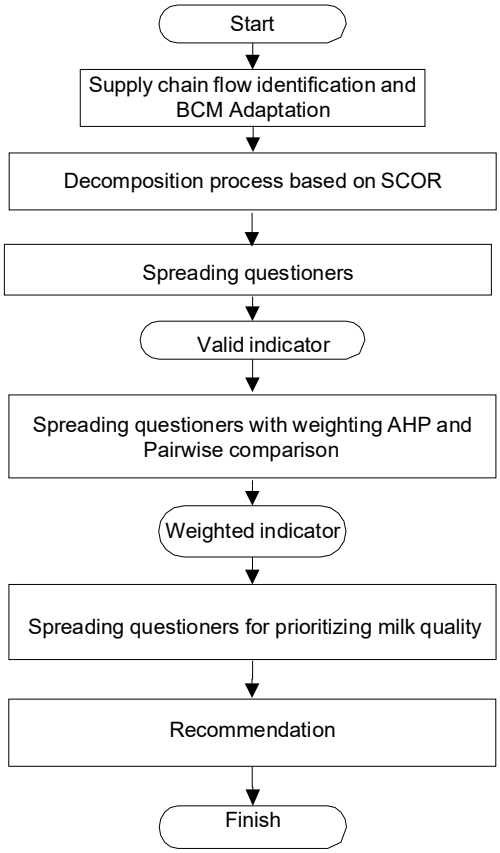

Fig. 1 Methodology

The supply chain processes in the cooperative are divided into five integrated processes such as planning (Plan), source of supply (Source), production (Make), delivery (Delivery), and return (Return). The scoring metrics in the SCOR model are expressed at two levels. The supply chain process model is a process hierarchy, and assessment metrics expressed in a ranking hierarchy. The number and levels of the metrics adjust to the type and number of processes in the cooperative. The researchers hold Focus Group Discussions (FGD) and ask questionnaires to identify and validate several Key Performance Indicators of the cooperative.

2.4 Weighing Indicator with AHP

The initial stage of this weighting was to make a questionnaire paired which the weighting filled in by the related respondents. The respondents were the chairman, the treasurer, the secretary, and two senior cooperative members. Then, the Analytical Hierarchy Process (AHP) calculates the data obtained from the questionnaire results. The weighting process consists of 2 levels. Level 1 was the weighting for each perspective such as plan, source, make, deliver and return. Level 2 was a weighting for each dimension of each supply chain perspective with the dimensions were reliability, responsiveness, cost, assets, flexibility. Each perspective adjusted to efforts to improve milk quality.

2.5 Prioritization program with AHP

The chairman, treasurer, secretary, and the senior farmer members of the cooperative attended the FGD to obtain three main programs to improve milk quality. There were three main programs, (1) Improving the quality of feed, (2) Improving the hygiene and sanitation of farmers (3) Payments to farmers according to the quality of milk.

This research compares the three alternatives in pairs by pairwise comparison, for each level 2 indicator was weighted previously. The process uses a questionnaire, filled out by five respondents and then combined respondents' opinions into one matrix. Then, multiplying the results of the assessment of each indicator for each alternative by the weight of each indicator carried out previously. The sum of the multiplication results becomes the final value of each option. The most significant value was the recommendation to become a priority cooperatives program.

3 Result and Discussion

The flow supply chain KUD Giri Tani identification was carried out directly and followed by interviews with the cooperative chairman and secretary. Figure 2 shows that the green line indicates the milk material flow from the farmers to downstream, the brown line indicates the flow of animal feed. In contrast, the red line indicates the flow of returns from the milk processor to the cooperative and the farmer. The supply chain flow cycle has several entities, including the Cimory Milk Processing Industry, Cooperatives, Breeders, feed suppliers, direct consumers, and milk beverage SMEs. This study focuses on the milk flow from the farmers to consumers and the return.

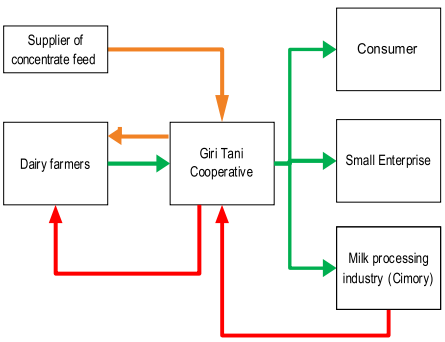

Fig. 2. Supply Chain Flow

The next stage describes the processes based on the SCOR model. The decomposition of supply chain flow processes from general to detail refers to the Supply Chain Operation Reference manual version 10 by the Supply Chain Council (SCC). It adjusted the vision and mission of the cooperative and the results of interviews with the cooperative's chairman.

The objective of using BCM was to identify key partners, activities, resources, value proposition, customer relationship, and channel and customer segment of Giri Tani in mapping existing conditions and develop an alternative strategy.

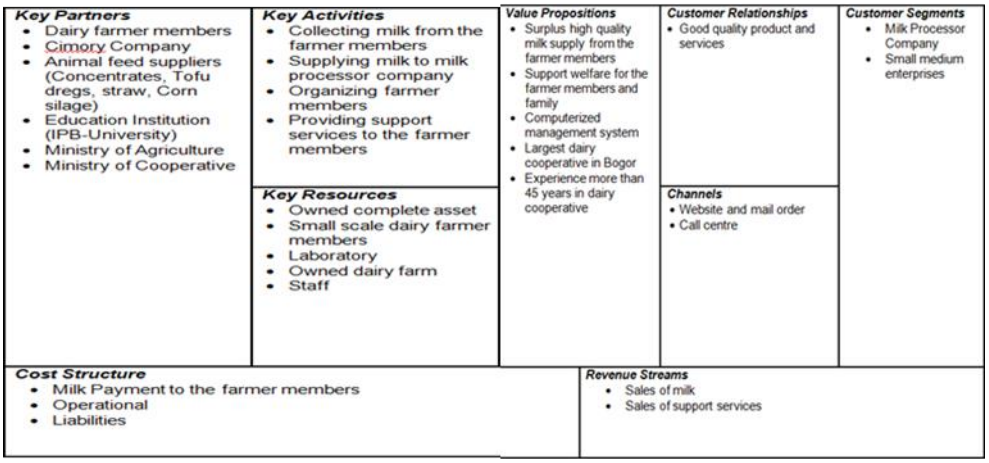

Fig. 3. Business Model Canvas

Therefore, the BCM identified that the key activities to improve milk quality are collecting milk from the farmers, supplying milk to milk processors, organizing farmer members, and providing support services Fig 3.

The SCOR model framework begins with decomposition into five core processes (plan, source, make, delivery, and return). Each of the five core processes contains five performance attributes (reliability, responsiveness, flexibility, costs, and assets). However, based on the FGD results, not all core processes have five performance attributes.

By carrying out the validation stages of the results from the decomposition of the SCOR process, these indicators can present the performance of the Giri Tani cooperative. The chairman of the cooperative validated the indicator metrics through discussions and questionnaires 19 indicators used, where previously there were 24 indicators in measuring supply chain performance to improve milk quality in the cooperative. In detail, validation produces two indicators for the planning process (plan), six indicators for the supply source process (source), three indicators for the production process (make), five indicators for the delivery process (delivery), and three indicators for the return process. Figure 4 shows the indicator validation result.

One of the crucial things in milk supply chain management is milk quality. The milk quality is the basis for paying the milk price received by the Giri Tani cooperative from Cimory. Meanwhile, Giri Tani paid the milk to all farmers at the same price based on the quantity dropped. Giri Tani cooperative set a minimum standard for the quality of milk from the farmers. However, due to one price for milk payment policy, it makes the farmer members deliver the milk to the cooperative by varying quality. They are not motivated to provide high-quality dairy. As a result, the price paid by Cimory to the cooperative is not very satisfactory. It causes some farmers to often sell their milk to other parties who are willing to pay higher than cooperative. Realizing this problem, the head of the Giri Tani cooperative intends to change the milk payment policy based on quality. For this reason, the measurement

of supply chain performance emphasizes milk quality. The milk payment policies for the Giri Tani can use the result of supply chain performance measurement

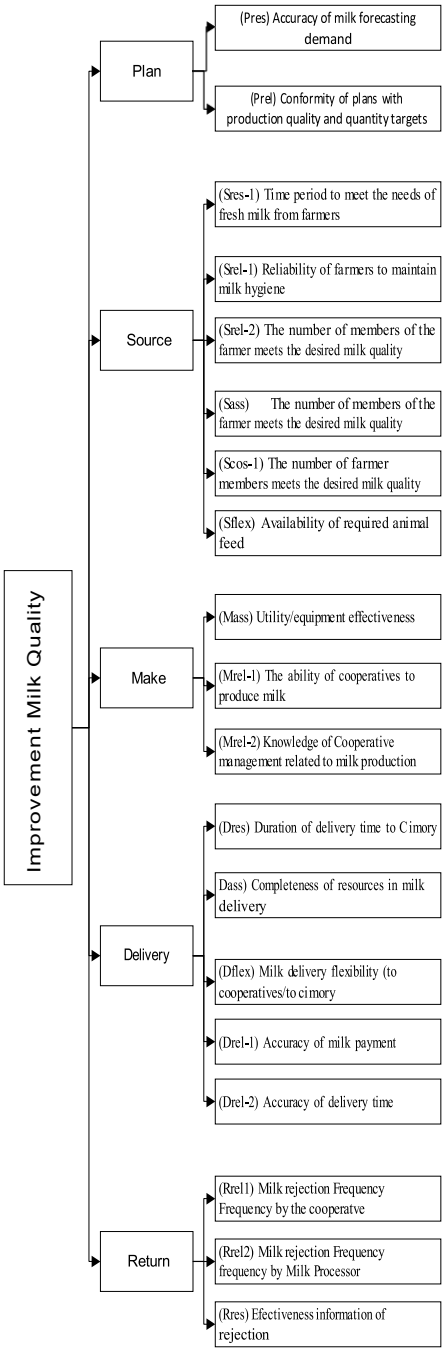

Fig. 2. The Indicator of SCOR Validation Giri Tani Cooperative

The weighting of indicators level 1 and 2 using the AHP method and supported by a pairwise comparison matrix [13]. It started from the AHP hierarchical structure to improve

milk quality, and then continued by classifying levels 1 and 2, namely five core processes and 19 indicator metrics. This weighting to determine the weightiest value of the five core processes and 19 indicators.

The five people who influence the cooperative's policy (as experts) answered the questionnaire for the weighting. The next step was compiling the criteria in a paired matrix until the calculation was known to have a fixed eigenvalue. Before combining the questionnaire results, this study counted the five people separately to determine whether the level of importance was consistent. Then use the geometric mean formula to produce a combination matrix of the five experts in the Giri Tani cooperative environment. The results of the core process questionnaire are shown in the form of a paired matrix in Table 1.

Table 1. Comparison matrix

Combination	Plan	Source	Make	Delivery	Return
Plan	1	0.29	0.19	0.27	1.42
Source	3.21	1	1.12	1.32	4.84
Make	5.24	0.58	1	2	4.55
Delivery	3.55	0.76	0.50	1	4.93
Return	0.51	0.21	0.14	0.20	1

Then, the pairwise comparison matrix results for the combined five respondents were weighted on each core criterion. The process was to multiply each paired matrix and raise it according to the criteria, so the result follows.

Table 2. The result of the comparison matrix

Criteria		Weight
Plan	0.46349	0.07649
Source	1.87331	0.30916
Make	1.94700	0.32132
Delivery	1.46031	0.24100
Return	0.31521	0.05202
Total	6.0593	1.0000

The results of the level 1 weighting show that the top 3 that significantly affect the milk quality are production, milk supply from the farmers, and delivery. The high weight is because these three activities are the main activities in the Giri Tani Cooperative which sometimes have problems in its operational process. It is relevant to research, which states that several issues still occur to obtain milk with good quality and quantity are manual production methods, lack of availability of animal feed, and handling of milk distribution.

The return has the lowest weight because milk is seldom rejected, and until now, the cooperative has not implemented an evaluation system if the Cimory rejects the milk from Giri Tani Cooperative.

Every day, the farmer members supply the milk to Giri Tani in the morning and evening; the group's leader collects the milk, then from the leader group, it is handed over to the tank truck of the cooperative. Although the milk collection trucks were carried out every morning and evening by visiting each farmer member group, the milk delivered to milk processing was carried out every day only in the morning, and the cooperative’s refrigeration machines

usually used before going to Cimory.

The weighting of 19 quality improvement indicators and the weighting of the core process had the same calculation process. Beginning with questionnaire questions regarding pairwise comparisons through 19 questionnaires, then followed by combining the opinions of five respondents. Below are the results of the calculation of the weighting of 19 indicators.

Table 3. Weighting calculation results

Criteria	Subcriteria	Weight
Plan	Pres	0.0166
	Prel	**0.0439**
Source	Sress-1	0.0094
	Srel-1	**0.0255**
	Srel-2	0.0825
	Sass	0.0467
	Scoss-1	**0.0809**
	Sflex	0.0642
Make	Mass	0.1533
	Mrel-1	0.0511
	Mrel-2	0.0511
Delivery	Dress	0.0234
	Dass	0.0261
	Dflex	0.0765
	Drel-1	0.1160
	Drel-2	0.0466
Return	Rrel-1	0.0226
	Rrel-2	0.0513
	Rres	0.0122

In the core of planning activity, the most significant weight is the Prel indicator which explains the achieving of the plan, where the milk obtained by the cooperative is adjusted to supply customer demand. Priyanti and Soedjana [14] states that farmers still provide the dairy industry in Indonesia, and most women are members of the Village Cooperative.

On Sourcing milk from farmers, dairy cooperatives determine the weight of the most significant indicator, Srel-2, indicating that the number of farmers who meet milk standards is an important criterion that significantly affects the quality of milk collected by the cooperative. Based on Hafidh and Purwono [15], the farmer members strongly influence the cooperative's quality and quantity of milk.

In the form of cooling unit activity, the cooperative weighs the largest Mass. Mass is the utility effectiveness of the cooling unit asset. Unused refrigerator equipment maximally will quickly be damaged and directly impacts the quality of milk.

In shipping activities, out of 5 indicators, two indicators are quite large compared to the other 4, Dflex and Drel-2. Dflex describes the flexibility of milk delivery to Cimory, and cooperatives can deliver anytime to the milk processor as long as the quality requested by Cimory meets the requirements. The next most significant indicator is Drel-2 which represents the accuracy of milk payments; psychologically, farmers and cooperatives will be enthusiastic about maintaining milk quality if the milk processing company on time pays to cooperatives.

The return activity that describes the rejection of milk from Cimory to the cooperative, and the cooperative to the farmer members shows that Rrel-2 is an essential indicator of returns. Rrel- 2 is the frequency of refusal of milk by Cimory, because the primary source of income for both farmers and cooperatives is a payment of milk from Cimory, so if there is a refusal, of course, there will be no payment.

Table 4. Result of Prioritization

Subcriteria	weight	Alternative weight for any subcriteria		
		Milk Grading	**Improvement feed quality**	**Hygiene Improvement**
Pres	0.020	0.094	0.642	0.264
Prel	0.057	0.094	0.642	0.264
Sress-1	0.023	0.084	0.750	0.166
Srel-1	0.055	0.084	0.750	0.166
Srel-2	0.005	0.084	0.750	0.166
Sass	0.051	0.084	0.750	0.166
Scoss-1	0.072	0.084	0.750	0.166
Sflex	0.103	0.084	0.750	0.166
Mass	0.103	0.308	0.222	0.470
Mrel-1	0.073	0.308	0.222	0.470
Mrel-2	0.145	0.308	0.222	0.470
Dress	0.020	0.330	0.129	0.541
Dass	0.042	0.330	0.129	0.541
Dflex	0.071	0.330	0.129	0.541
Drel-1	0.056	0.330	0.129	0.541
Drel-2	0.052	0.330	0.129	0.541
Prel-1	0.025	0.169	0.187	0.644
Prel-2	0.012	0.169	0.187	0.644
Rres	0.015	0.169	0.187	0.644
Total				

Determination of each final value for each alternative is calculated by multiplying the weight of each sub-criteria by each alternative weight, then adding up for the entire sub-criteria as many as 19 indicators from SCOR [16].

$$Alternative\ Score = \sum_{i=1}^{19} Weight\ of\ subcriteria\ \ i\ x\ Weight\ of\ alternative \quad (1)$$

Table 5. Final Score of Alternative

No	Alternative	Final score
1	Milk Grading	0.221
2	Feed Quality Improvement	0.393
3	Improve Hygiene of Milk Process	0.386

Based on the final value of each alternative, in addition to the SCOR criteria activities, itis known that improving feed quality and improving hygiene are priorities. Farmer membersand cooperatives can enhance milk quality. It can be part of the cooperative and member program.

4 Conclusion

Milk production in the farmer members must be the focus of cooperatives to improve the milk quality. Improving feed quality and improving hygiene are more priorities than milk grading. This research needs improvement by the cooperative's leadership and itsmembers to become the basis for payment policies and efforts to improve quality. Improvingmilk quality can be done through improving supply chain activities by focusing on specific activities. This research can continue with a broader scope of SCOR to distribute to consumers and implement a more updated AHP such as AHP Fuzzy. In addition, improving quality by increasing the income of farmers and cooperatives is an area that can be conducted after this research.

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