

Supply chain analysis of dry and wet cocoa beans

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Abstract. Aims of this study is to analyze the comparison of the characteristics and performance of dry and wet cocoa bean supply chains. The analytical method used the characteristics and supply chain performance with qualitative descriptive analysis using the FSCN (Food Supply Chain Networking) analysis framework. The research results indicated that there are currently two cocoa bean supply chain models in East Luwu District, namely the Dry Cocoa Bean Supply Chain and the Wet Cocoa Bean Supply Chain. The dry cocoa bean supply chain consisted of farmers, collectors, wholesalers and exporters / processing industries, while the wet cocoa bean supply chain consisted of the farmers, collectors and purchasing units (PT. Mars Symbioscience). The Supply chain performance of the wet bean supply chain models showed more effective and more efficient performances with a marketing margin of IDR 31,200 per kilogram and farmer's share of 100%. The wet supply chain model could become a role model in cocoa agribusiness activities in South Sulawesi because it showed effective and efficient performance.

1. Introduction

Cocoa is the fourth highest plantation commodity after oil palm, coconut and rubber. In 2000 the area of cocoa in Indonesia was only 749,917 hectares and continued to increase until 2010 to amount to 1,651,539 hectares. The development of the cocoa planting area was not followed by an increase in production which was in line with the increase in area. This can be seen in the production of smallholder cocoa plantations which in 2003 amounted to 634,877 tons with an planting area of 861,099 hectares, increasing only



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773,707 tons with an area of 1,555,596 hectares in 2010 [1]. If viewed from the cocoa plantation area of the smallholder plantations, there is an almost 100% increase but the production produced by smallholders is not more than 30%. This means that the productivity of cocoa cultivated by smallholders has decreased for a decade.

Various efforts were made in the past decade which aimed to explore the problems that caused a decline in cocoa production in Indonesia both through on-farm. such as tree rejuvenation, replanting and off-farm such as handling post-harvest cocoa beans by fermenting harvested cocoa beans and other sustainable agriculture programs. But the program went slow or was unsuccessful. This is because in addition to program management that is not managed well it is also caused by limited knowledge of farmers and access to capital. Another reason is the poor delivery of quality price information that reflects the less effective and efficiently cocoa supply chains in indonesia that is too long, unorganized, and full of competition [2].

An integrated supply chain will increase the overall value produced by the supply chain. The activity of the flow of goods productively creates added value due to changes in form, space, function, and ownership [3]. To meet the criteria of the definition, a coordination between stakeholders involved in the supply chain is needed. Successful coordination, integration and management of business processes for all supply chain members / actors will balance the level of profit and risk between the upstream and downstream sides. So that supply chains remain sustainable it is necessary to increase the involvement of several stakeholders who can support financial strengthening and the performance of the supply chain [4,5].

This phenomenon inspired researchers to analyze how the characteristics and performance of each of the key stakeholders in the cocoa bean supply chain were both dry cocoa bean and wet cocoa bean supply chains in East Luwu District, South Sulawesi Province. The results of this study are expected to identify characteristics and performance of the supply chain are more effective and efficient and integrated to all the main stakeholders involved in the cocoa bean supply chain, thus giving birth to a policy recommendation in overcoming various cocoa problems, especially from the supply chain management side.

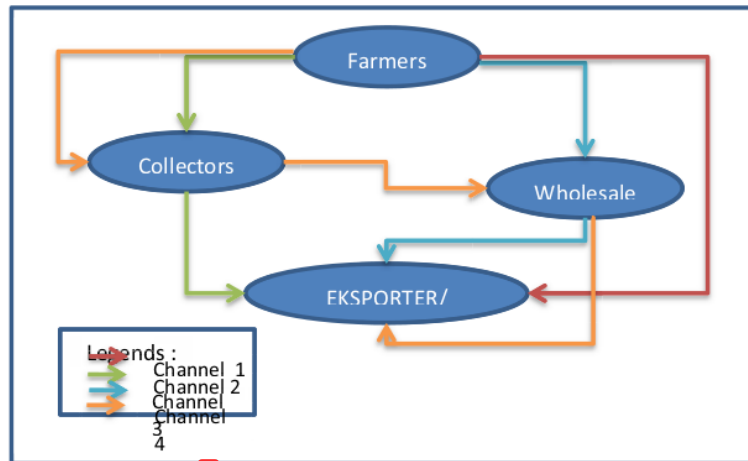
2. Methods

This research was conducted in East Luwu District, South Sulawesi Province. This type of search is a survey method. The population as respondents in this study were the main stakeholders of the cocoa supply chain (farmers, collectors, wholesalers, processing industries, and exporters). The total number of respondents from farmers is 50 people, while respondents from each of the main stakeholders of the cocoa supply chain are 14 people. The cocoa bean supply chain model was analyzed using supply chain development methods that followed the Food Supply Chain Networking (FSCN) process framework from Lambert and Cooper then modified by Van der Vorst [6]. Each part of the supply chain management framework is analyzed descriptively except in the supply chain performance quantitative data processing will be carried out using calculators and Microsoft Excel. Variables in supply chain characteristics are: a) Supply Chain Objectives, including market targets and development goals; b) Supply Chain Structure; c) Supply Chain Management; d) Supply Chain Resources; and e) Supply Chain Business Processes. While the supply chain performance variables include marketing margins and farmer's share.

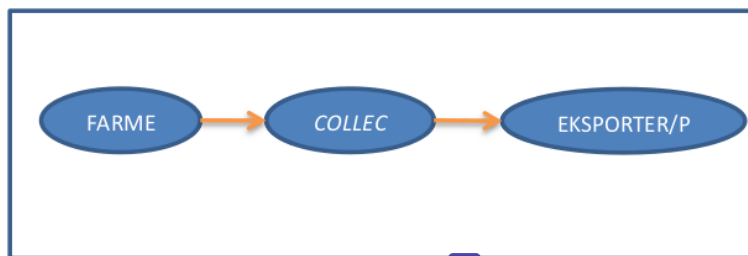
3. Results and discussion

There are two supply chain models for cocoa supply chains that are currently occurring in East Luwu District. The first is the Dry Cocoa Bean Supply Chain, which is the supply chain where the cocoa beans traded from farmers to purchasing units / exporters are dried cocoa beans. Second, the supply chain of Wet Cocoa Bean Supply Chain, which is the supply chain where the cocoa beans traded from farmers to

purchasing units / exporters are wet cocoa beans. This supply chain model has been running for more than a decade and is run by PT. Mars Symbioscience in the regions of South Sulawesi and Southeast Sulawesi. In East Luwu Regency, this supply chain model began to run since 2013. To see cocoa bean supply chain models (figure 1 and figure 2).



1 **Figure 1.** Dry cocoa bean supply chain



11 **Figure 2.** Wet cocoa bean supply chain

The results of the characteristics and performance of the supply chain of dry cocoa beans and wet cocoa beans are as follows:

10 **3.1. Characteristics of cocoa bean supply chain**

3.1.1. Target of supply chain

3.1.1.1. *Market target.* A producer will succeed if he is able to define market targets and prepare appropriate marketing programs [7]. In the supply chain of cocoa beans in East Luwu Regency both dry seed supply chains and wet seeds which are the target of the market are exporters or processing industries both in the East Luwu Regency region and those in Makassar. The purchase unit of cocoa beans is an exporter of cocoa beans as well as export-oriented cocoa bean processing companies both in East Luwu

Regency such as PT. Mars Symbioscience and those in the capital city of South Sulawesi, namely Makassar.

The dried cocoa beans purchased by the Exporter and processing industry are the original cocoa beans. In carrying out purchasing activities, the purchasing unit carries out a quality control system in which there are quality requirements from the cocoa beans to be purchased. The original cocoa beans have quality requirements as follows: bean count 100-110, waste maximum 2.5%, maximum moisture 7.5%, maximum moldy 3%, insect maximum 2% and brown minimum 20%.

Wet cocoa beans purchased by PT. Mars Symbioscience, namely cocoa beans that meet the requirements specified and agreed with partner farmers. The quality requirements of the wet cocoa beans are that the cocoa beans must be clean, there are no rotten or deflated seeds, the seeds are not split and there are no impurities such as leaves mixed with seeds and should not stay overnight (24 hours). The quality control standard offered by PT. Mars includes: waste and mildew not exceeding 4%, moisture content 7% for cacao certification and a minimum level of 75%. Whether in dry or wet cocoa beans, seeds will be valued according to quality. Better quality will be given a reward, whereas if under the quality requirements there will be a penalty (claim).

3.1.1.2. Development target. The development target is the goal to be achieved by developing a matter in the form of coordination, collaboration, the use of technology in the supply chain that can improve supply chain performance. The development process should not only benefit one party in the supply chain in order to create a competitive advantage in the supply chain of cocoa beans. The development target to be achieved by the supply chain of dry and wet cocoa beans in East Luwu Regency is to increase the production of cocoa beans and be accompanied by an increase in the quality of cocoa beans. The desired quality improvement is in the form of cocoa beans that are in accordance with good quality requirements for the original cocoa beans and fermentation.

3.1.2. Supply chain structure

3.1.2.1. Dry cocoa bean supply chain. In the dry cocoa bean supply chain, the members of the supply chain are farmers, collectors, wholesalers and exporters or processing industries. Cocoa farmers as producers of cocoa beans are members of a chain that initiates the supply chain of cocoa beans. Farmers have an important role because farmers determine the quantity, quality and continuity of supply of cocoa beans. All cultivation and post-harvest activities are carried out by the farmers themselves. Limited information and the lack of roles of farmer groups make farmers have a weak bargaining position.

Collector traders collect cocoa beans from farmers around them. Generally, collectors are also cocoa farmers. Collecting traders make purchases to cocoa farmers at prices that are appropriate to the treatment and quality of the cocoa beans produced by cocoa farmers. Pricing by guessing. That is, there are no special tests such as quality control. Collectors must carry out re-drying activities to obtain dry, originated cocoa beans with low water content. Collector traders obtain market information in the form of cocoa prices from wholesalers and purchase units of cocoa beans.

Large traders are traders who hold larger amounts of cocoa beans from collectors. Large traders receive cocoa beans from farmers and collectors. Large traders provide different prices for farmers and collectors. The price difference given to collector traders with farmers is IDR 1,000 - IDR 1,700 per kilogram. The price difference given is based on the cost of sorting and packaging that will be carried out by wholesalers.

Exporters and Industries Processing of cocoa beans is the last place of sale in the supply chain of dry cocoa beans in East Luwu Regency. In the purchase unit of cocoa beans, quality control tests were carried out. The cocoa beans received by the purchase unit of this cocoa bean are dried dried seeds. In this purchasing unit there are still processes such as sorting, grading, mixing and packing. However, the cocoa

beans that have gone through the process at wholesalers, the next process is only to replace the sack with the sack used for export, namely gunny sacks weighing 16.5 kg. The cocoa bean processing industry processes purchased cocoa beans into various processed products such as cocoa cake, cocoa butter and cocoa powder.

3.1.2.2. *Wet cocoa bean supply chain.* In the wet cocoa beans supply chain, those who are members of the supply chain are farmers, collectors (Collectors) and purchasing units of cocoa beans, namely PT. Mars Symbioscience. At the beginning of the purchase of wet cocoa beans by PT. Mars Symbioscience, the supply chain consists of only farmers and companies. But over time and to streamline and streamline the time and process of purchasing operational activities, a collector is formed by PT. Mars Symbioscience.

Cocoa farmers in the supply chain are cocoa farmers who join as partners from PT. Mars Symbioscience. The requirements to become a partner of the company: (a) The quality of beans must meet the quality standards where the beans are not rotten, not flat and should not be split and may not stay overnight; (b) Certification of the plantation, this requirement must be fully fulfilled by the farmer before partnering with PT MARS to review the farmer's farm for certification; (c) Farmers have groups. Fostered farmers from Mars Symbioscience obtain technical information on cocoa cultivation in accordance with GAP (Good Agriculture Practice) in order to increase cocoa production and quality.

The collector in carrying out the duties and responsibilities of coordinating the company's assisted farmers in collecting wet beans, packing them into plastic sacks and delivering them to the purchasing center with the help of an expedition. One collector can oversee one or more assisted villages depending on the area and the number of assisted farmers in the area. Collectors will be given an incentive of IDR 280 per kg, with details of IDR 150 per kg for the volume of goods and IDR 130 per kg for bridge incentives or scales.

PT. Mars Symbioscience is the last purchasing unit in the wet bean supply chain in East Luwu Regency. The company built a buying center for cocoa beans in Cendana Hijau Village, Wotu Sub-District, East Luwu Regency since 2013. In this purchasing unit, the cocoa beans received are generally wet with the required quality standards. Wet cocoa beans received from collectors will go through a quality control process, and then the price will be determined. The price given is the price of wet cocoa beans and is higher than the price of dried cocoa beans. The next process of the wet cocoa beans will be through a process of fermentation and drying, then packaged to be sent to the cocoa processing center at the factory in Makassar.

3.1.3. *Supply chain management*

3.1.3.1. *Selection of partners.* Selection of partners is the process of choosing colleagues who can be collaborated in a business. The selection of important partners to consider because the success of a business is also determined by the performance of partners. Supply chain cocoa farmers dry cocoa beans choose buyers of cocoa beans based on price. Apart from price, distance is also a benchmark by farmers in selling cocoa beans. The cooperative relationship that has been formed in capital lending and borrowing activities helps farmers to sell cocoa beans to lenders.

Cocoa farmers in the supply chain of wet cocoa beans sell their cocoa beans to PT. Mars Symbioscience because in addition to having joined as a partner company, the price given by the company is also higher if converted to the price of dry or sour seeds. Besides that, farmers do not need to carry out postharvest activities, especially drying activities which lead to reducing the operational costs of farmers. The distance from the location of the center for buying and processing cocoa beans is also the reason for farmers to join as partners and sell their cocoa beans. In selecting partners, large traders choose based on the price given. In general, large traders already have subscriptions. This subscription is formed due to

capital loan activities. Through capital lending activities, traders have tied farmers and collectors to obtain supplies of cocoa beans.

3.1.3.2. Contractual agreement. Contractual agreements are contracts containing everything agreed upon between the partners or cooperating both formally and informally to protect all parties in the supply chain members. Contractual agreements function in the long term to give the boundaries and responsibilities that must be done by each partner party. The existence of a system of contracts between farmers and traders or middlemen both formally and informally is one solution or instrument to reduce transaction costs and prevent moral hazard [8].

The supply chain for dry cocoa beans makes informal contractual agreements. Oral agreements made regarding the quality of cocoa beans, the price and quantity of cocoa beans. The agreement made between cocoa farmers, collector traders and purchasing units is not done through a formal contract, but only through verbal agreement after which recording is carried out.

In the supply chain of wet cocoa beans, contractual agreements are formally carried out between farmers and partners with PT. Mars Symbioscience. After farmers are selected and selected as certified farmers, they will be bound by companies with formal contracts which include agreements on selling prices, quality of cocoa beans, quantity or volume of cocoa beans and contract period which generally lasts for one year.

3.1.3.3. Transaction system. The transaction system formed in the supply chain of dry and wet cocoa beans is generally relatively the same. Cocoa farmers and collecting traders conduct transactions directly and payment in cash. However, for dry or traditional cocoa bean farmers, farmers can ask for money upfront if they are pressed for needs and can exchange harvested cocoa beans with basic necessities that are in the stores of the collectors. Collector traders directly pay cocoa beans to cocoa farmers with cash after the cocoa beans are assessed for their quality. Transactions by farmers and direct purchase units at the unit of purchase are made in cash. Likewise, transactions carried out by large traders with purchasing units are carried out in cash and non-cash via bank transfers.

3.1.3.4. Government support. The policies that have been issued by the government are (i) Cocoa Production and Quality Improvement National Movement (GernasKakao); (ii) policies regarding the cocoa processing industry stipulated in Presidential Regulation No. 28 of 2008 concerning National Industrial Policy which is reinforced by the Minister of Industry Regulation Number 113 / MIND / Per / 1/2010 concerning the Cocoa Industry Cluster; (iii) policies that regulate cocoa quality standards in Indonesia issued by the National Standardization Agency (BSN); (iv) cocoa trade policy through Minister of Finance Regulation Number 67 / PMK.0.11 / 2010 concerning Imposition of Export Levy on Cocoa Beans Exports; (v) the elimination of Value Added Tax on the trade in cocoa beans set by the Government through Government Regulation Number 7 of 2007 [9,10]. In general, the activity of cocoa beans production has not been efficient yet to compete as raw materials for domestic and foreign industries [11]. The government through research and development activities can foster seedling agricultural technology or superior seed farming technology, post-harvest technology, processing technology, and technology in marketing by establishing the Indonesian Coffee and Cocoa Research Center (ICCRC) in Jember.

3.1.3.5. Supply chain collaboration. Supply chain collaboration can be seen from the existence of voluntary and reciprocal information sharing between each member of the supply chain. Information comes from the purchase unit of cocoa beans that is delivered to farmers, collectors and wholesalers. This information includes the price of cocoa beans and the quality of cocoa beans.

3.1.4 Supply chain resources

Physical and human resources in the supply chain of dry and wet cocoa beans are basically almost the same. It's just that in the wet supply chain, the collector's position is almost the same as the collecting trader in the dry seed supply chain. For capital resources in the supply chain, wet cocoa beans are facilitated by PT. Mars Symbioscience to work with the Bank Rakyat Indonesia (BRI). While in the dry seed chain capital is only carried out by traders (from large traders) and large traders (from banks and exporters).

3.1.5 Supply chain business process

The chain business process reflects the processes that occur along the supply chain of cocoa beans. A good chain business process is a business process that is integrated with each other. The things that can be studied in chain business processes are the relationship of chain business processes, distribution patterns, supporting chain members, collaborative planning, and the process of building trust (trust building).

3.1.5.1. Supply chain business process relations. In the cocoa bean supply chain in East Luwu Regency, the procurement cycle is carried out by collectors, wholesalers and purchasing units of cocoa beans (exporters & processing industries) as distributors by buying cocoa beans from cocoa farmers as suppliers. Cocoa farmers only do postharvest processing of cocoa fruit into cocoa beans, while collectors only do simple processing such as drying so that the water content of cocoa beans is low at around seven percent. So, the supply chain of cocoa beans only does one cycle of business processes, namely the procurement cycle.

3.1.5.2. Distribution pattern. The distribution pattern in the cocoa bean supply chain explains how the product flow, financial flow, and flow of information occurs between each member of the supply chain. The product flow in this case is wet cocoa beans and dried cocoa beans. The difference is only in the post-harvest process where the dry cocoa bean chain still requires the process of drying and sorting from the farmers, while the wet cocoa beans after the seeds are split are sold directly to the purchasing unit through the collector. The financial flow in this case is the flow of payment of cocoa beans received to farmers. The difference is in the chain of wet cocoa beans payments directly to farmers while the dried beans have to go through large traders, then new collectors get to the farmers.

3.1.5.3. Collaborative planning. Collaborative planning is carried out through a variety of methods including continuing to transfer knowledge from collectors and purchasing units to cocoa beans, guidance from field extension workers and officers from the East Luwu District Plantation and Agriculture Office, as well as counseling and assistance from PT. Mars Symbioscience. Increasing productivity of cocoa commodities and improving the quality of cocoa beans must be followed by improving the marketing system of cocoa beans in East Luwu Regency.

3.1.5.4. Collaborative research. PT. Mars Symbioscience in East Luwu District which also acts as a center for cocoa research in South Sulawesi also participates in developing the existence of cocoa in the future. The seriousness of PT. Mars Symbioscience in developing cocoa in South Sulawesi was also shown by building a cocoa research center in Pangkep District, South Sulawesi, which was built on a 95.2 hectare land.

3.1.5.5. Brand identity guarantee. A brand is a product attribute as a product of other products. The brand can be said as an identity containing information from where the product originates. Brands can be used as an attraction for consumers to buy because the brand reflects the image of a product. Cocoa beans

produced and sold by cocoa farmers assisted by Mars Symbioscience have a brand whereas farmers who are not members of Mars Symbioscience or traditional farmers do not have a brand. This brand can be seen from the sack used and each sack has the name label of the farmer who produces the cocoa beans.

3.1.5.6. *Trust building.* Trust building is the process of building trust among all members of the supply chain. The supply chain of cocoa beans develops based on the growing sense of trust among members of the supply chain because the cooperation that has been carried out so far has been well established despite the formal and informal contractual attachments. As is known that contracts are needed to avoid moral hazard that can be done by partners so that cooperation can work in the long term.

3.2. Cocoa supply chain performance

3.2.1. Marketing margin.

Marketing margins are seen through calculation of marketing costs and profits. In the supply chain of dry or traditional cocoa beans, the smallest marketing margin is found in channel I, which is IDR 28,565 / kg. This channel I is a channel from farmers directly selling to end consumers, namely purchasing units (exporters & processing industries). It turns out that in the traditional supply chain, channel I is more efficient than other channels. In the supply chain of wet cocoa beans PT. Mars Symbioscience has only one channel, namely farmers sell directly to the purchasing unit. Fostered partner farmers in the supply chain can say no marketing costs because the cocoa beans that have been harvested are sold on that day after being cleaned from dirt. So the marketing margin for wet cocoa beans is 10,400 / kg, and if converted to dry cocoa beans, which is equal to 31,200 / kg, assuming that the conversion factor is 33.33%.

When compared to the dry bean supply chain, it can be seen that the wet bean supply chain is more effective and efficient because farmers do not incur marketing costs anymore and the time usually used for post-harvest activities, especially drying activities is not done. Likewise, the transportation costs are also considered to be non-existent because harvested beans are delivered to collectors who are close to the farmer's house. To see the efficient level of a channel is not enough based on the length of the channel, but also can be seen from the value of profits, costs and margins. An overview of marketing margins (table 1 and table 2).

Table 1.Marketing margin of dry cocoa bean supply chain in East Luwu District

Channel	Profit (IDR/Kg)	Cost (IDR/Kg)	Margin (IDR/Kg)
I	26,349	2,126	28,565
II	27,640	1,500	29,140
III	28,054	1,566	29,620
IV	21,085	7,760	28,845

Table 2. Marketing margin of wet cocoa bean supply chain in east Luwu District

Channel	Profit(IDR/Kg)	Cost (IDR/Kg)	Margin (IDR/Kg)
Wet cocoa bean	10,400	0	10,400
Dry cocoa bean(the conversion factor from wet cocoa bean to dry cacao bean is 33.33%)	31,200	0	31,200

3.2.2 Farmer's share

Farmer's share is a ratio of the percentage of prices received by farmers at prices paid at the final consumer level and expressed as percent. Farmer's share is a second indicator of marketing efficiency in addition to marketing margins. The larger farmer's share reflects an increasingly efficient supply chain. However, a high farmer's share does not absolutely indicate that marketing runs efficiently. This is related to the size of the benefit added to the product (value added) by intermediary or processing institutions to meet consumer needs. The farmer's share is the opposite of the marketing margin value. The greater the farmer's share value, the smaller the marketing margin value.

In the dry cocoa seed supply chain, farmers in channel 1 directly sell cocoa beans to end consumers, namely exporters and processing industries so that farmer's share is obtained by 100%. This means that the farmer gets all parts of the prevailing price in the purchasing unit. Furthermore channel 3 gets the same farmer share value of 88.41%. while channels 2 and 4 get the same farmer share value of 87.78% and the smallest among the four marketing channels. An overview of farmer's shares (table 3 and 4).

Table 3. Farmer's share of dry cocoa bean supply chain in East Luwu District

Channel	Price (IDR/Kg)		Farmer's share (%)
	Farmer	Purchasing unit	
1	31,670	31,670	100.00
2	27,800	31,670	87.78
3	28,000	31,670	88.41
4	27,800	31,670	87.78

Table 4. Farmer's Share of wet cocoa bean supply chain in East Luwu District

Channel	Price (IDR/Kg)		Farmer's share (%)
	Farmer	Purchasing unit	
1	10,400	10,400	100.00

As explained earlier that the marketing channel in the supply chain of wet cocoa beans only applies one channel, namely the purchasing unit in this case PT. Mars Symbioscience directly buys wet cocoa from fostered partner farmers so that the farmer's share value received by farmers is 100%. This shows that the farmer gets the whole of the prices prevailing in the purchasing unit.

4. Conclusion

There are two cocoa bean supply chain models in Luwu Timur District, namely Dry Cocoa Bean Supply Chain and Wet Cocoa Bean Supply Chain. The supply chain for dry or traditional cocoa beans consisted of farmers, collectors, wholesalers and exporters / processing industries, while supply chains of wet cocoa beans consisted of farmers, collectors, and purchasing units (PT. Mars Symbioscience). Supply chain performance of wet seed supply chain models showed more effective and efficient performance with a marketing margin of IDR 31,200 per kilogram and farmer's share of 100%. The wet supply chain model could become a role model in cocoa agribusiness activities in South Sulawesi because it showed effective and efficient performance.

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