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Value chain management strategy of sugar cane in Takalar sugar factory

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ABSTRACT

The primary and supporting activities of the Takalar Sugar Factory have been hindered by limited resources, resulting in low productivity. This research aims to determine strategies to enhance productivity effectively by adding value. It involves analyzing relationships among stakeholders using a Value Chain Analysis for internal activities and a PESTLE Analysis for external environmental factors. A TOWS Analysis is then formed, considering threats, opportunities, weaknesses, and strengths. This process helps develop a prioritized management strategy plan through the Analytical Hierarchy Process (AHP). The sugarcane commodity chain comprises production flows, price information in the supply chain, and income streams involving four key actors: farmers, producers, traders, and end consumers. This analysis reveals suboptimal service activities and production technology. Moreover, low bidding prices contribute to uneven income distribution. Additionally, existing policies aimed at empowering sugarcane farmers result in low-value creation. Consequently, the proposed priority strategies for management revolve around enhancing efficiency in sugarcane production, leveraging modern cultivation techniques, employing Internet of Things technology, increasing sugarcane production capacity through on-farm restructuring, revitalizing off-farm factories for sugar production, and expanding market share by promoting new packaging products.

1. Introduction

The Statistical Record of the National Leading Estate Crops Commodity recognizes sugarcane as a prioritized plantation commodity due to its role in producing sugar, a key ingredient catering to Indonesia's daily food needs, encompassing household and industrial requirements on both large and small scales [1]. Consequently, sugar has emerged as a leading trade commodity with a consistently growing demand over the years. As the population increases, the consumption of sugar is expected to rise. Even with the availability of alternative sweeteners, sugar's status as a crucial sweetener in Indonesia remains irreplaceable. It's classified as a staple food regulated by the Government, as indicated in Presidential Decree Number 71 of 2015 and Number 59 of 2020, significantly impacting economic sustainability.

However, challenges such as the disparity between sugar production and demand, limited land for sugarcane cultivation and superior varieties, the government's role and support, and technological advancements pose complex issues that sugarcane processors must address comprehensively [2].

In response to the escalating demand for sugar, the government has ambitiously launched a national sugar self-sufficiency program. Yet, this initiative has yet to yield significant results, particularly in South Sulawesi, where the demand for sugar reaches 200,000 tons annually, with only approximately 27% of the total sugar produced each year [3]. Situated in South Sulawesi, the Takalar Sugar Factory operates as a business unit of PT Perkebunan Nusantara XIV. Given its position as one of the active factories in the region, the Takalar Sugar Factory holds significant potential to contribute to the future realization of national sugar self-sufficiency.

2. Material and method

2.1. Problem formulation

The Takalar Sugar Factory faces various productivity challenges, such as low yield rates, suboptimal factory performance, and higher production costs. These hindrances prevent the factory from meeting the increasing demand for sugar,

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especially in South Sulawesi. Additionally, market prices significantly impact sugar demand due to the extensive marketing channels employed by distributors and retailers. The length of these channels underscores the necessity for the Takalar Sugar Factory to enhance its production efficiency and performance, stabilize selling prices, fulfill sugar demand, and add value both to itself and its customers while establishing an effective business management system.

Given these circumstances, a compelling avenue of study lies in conducting a Value Chain Analysis. This analysis can reveal potential advantageous activities for the company, depict the actions undertaken by dominant actors within the chain, and ascertain the profitability of each actor to streamline the supply chain. Apart from enhancing factory efficiency and ensuring stable sugar prices, strategic planning is crucial. Utilizing the Threats, Opportunities, Weaknesses, and Strengths (TOWS) method aids in identifying internal and external factory conditions, serving as the foundation for realistic programs and strategic planning.

Once the company comprehends its situation, location, and conditions, it can develop strategy formulations aligned with the company's decision-makers' vision. To prioritize strategies, the Takalar Sugar Factory requires a decision-making technique. Therefore, the researchers have chosen the Analytical Hierarchy Process (AHP).

Given sugar's significant contribution to long-term economic growth, enhancing sugarcane productivity through the value chain management at the Takalar Sugar Factory is of interest to the researchers.

2.2. Value chain

The value chain is used to internally determine the condition of the Takalar Sugar Factory by mapping supply chain activities. The initial stage is through the point of entry for the value chain, to find out whom the actors involved in the Takalar Sugar Factory value chain and through mapping the value chains regarding the flow of roles and functions of actors, costs, and benefits incurred or generated by value chain actors by considering the factors of production [4].

The final stage is Porter's Mapping Value Chains which are used for value chain analysis of all activities namely, primary (main) activities and secondary (supporting) activities [5]. There is a standard set value, namely an average value of 2 (two) and it is carried out by giving weights, scores, and scores to each value chain activity.

2.3. PESTLE

PESTLE is a method used to analyze external environmental conditions at a macro level regarding matters that will harm and benefit through political, economic, social, technological, legal, and environmental factors on business continuity in the future and assist stakeholders in evaluating opportunities and minimizing threats from obstacles influenced by its external environment [6].

2.4. TOWS

Attention to both the external and internal environments, the TOWS analysis method aids in formulating appropriate strategic plans for stakeholders and decision-makers within the company. The outcomes of this analysis manifest as a matrix showcasing the combinations of external-internal alternative strategies. These matrices effectively outline threats and opportunities stemming from the external environment, correlating them with the company's strengths and weaknesses [7].

Moreover, the method yields an overall assessment of the weighting (Y, X) for the EFE (Y) and IFE (X) matrices, which range between 1.0 to 4.0, with an average standard value of 2.5. When the total value exceeds the average value, it indicates that the business has a very strong response to both external and internal factors. Conversely, if the total value is below the average value, it suggests that the business has a very weak response to external and internal factors.

2.5. Alternative strategy formulation

The productivity level Takalar Sugar Factory through analysis of internal and external environmental conditions has been identified through the Value Chain Analysis and PESTLE Analysis approach, so the next stage is the formulation of alternative strategies through a review of the following TOWS matrix [8].

The input stage involves plotting the values of the TOWS matrix, including External Factor Evaluation (EFE) and Internal Factor Evaluation (IFE), to form an EI matrix. The External-Internal (EI) strategy model is classified into three core strategies [9]. The external-internal matrix matching stage [10]. The first strategy is a growth and development strategy (growth and focus build), found in cells I, II, and V. This strategy focuses on intensification (product development, market development, and market penetration) and integration, encompassing forward integration, backward integration, as well as horizontal and vertical integration. The second strategy is a defense strategy (stability), identified in cell IV, emphasizing enhanced performance efficiency, added value, growth, and diversification strategies (growth and diversification) in cells VII and VIII. The third strategy is a retrenchment strategy, located in cells III, VI, and IX, involving the elimination of less efficient activities that do not add value to products or services to ensure financial and asset stability.

2.6. Analytical Hierarchy Process

The Analytical Hierarchy Process is a method of ranking decisions with several criteria so that companies can determine the best alternative for the following decisions [11]. The procedure of AHP in this research are as follows.

1. Hierarchical Arrangement.

Multicriteria problems in the analytic hierarchy process are summarized in a hierarchical form consisting of 3 main parts, namely goals, criteria, and choices.

2. Assessment of criteria and alternatives.

The form of the criteria and alternatives is carried out by pairwise comparisons so that the importance scale of each available criterion will be known against the other criteria based on the TOWS matrix using a scale of 1–9.

3. Determination of priorities.

This priority is called the priority vector, which is a limitation on decisions to be taken by correcting together the number of columns and number of rows so that the average value (priority vector) is obtained.

4. Calculation of the Consistency Ratio (CR)

Logical consistency contains the results of the comparison of the consistency index (CI) and random index (RI) with the optimal expected answer as follows.

- The total of the initial pairwise comparison matrix is multiplied by the priority vector. Furthermore, the new vector value is expressed as the vector of the number of weights (eigenvalue).
- The sum of the eigenvalues is denoted by λ max.
- Calculation of the consistency index (CI) using Eq. (1).

$$CI = \frac{\lambda max - n}{n - 1} \quad (1)$$

- Calculation of the consistency ratio (CR) using Eq. (2).

$$CR = \frac{CI}{RI} \quad (2)$$

- The RI table (random index) is shown at the Table 1 [12].

Table 1.
Random index

N	1	2	3	4	5	6	7	8	9	10
R			0,5	0	1,1	1,2	1,3	1,4	1,4	1,4
I	0	0	0,8	9	2	4	2	1	5	9

The results from the ratio consistency analysis (CR) indicate that respondents' assessments are considered consistent when the consistency ratio value approaches 0.1. Similarly, the pairwise comparison matrix is deemed consistent if its CR value is ≥ 0.1 (10%).

3. Results and discussions

3.1. The point of entry value chain analysis

In the stages of the point of the entry value chain, it was found that the factory is the second actor (producer) which has the main actor as a supplier of raw materials (farmers) and has 2 (two) levels of final consumers, namely traders (buyers) and households so that the flow of entry points as Fig. 1.

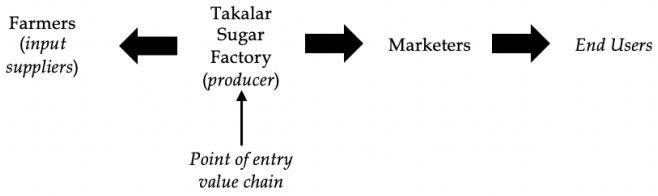

Figure 1. The point of entry value chain

a. Farmers (suppliers)

Farmers in the sugar cane value chain have a role as providers of production inputs (raw materials) in the form of sugarcane. Farmers carry out a series of sugarcane farming activities starting from cultivating the planting land, sowing seeds, planting seeds, fertilizing, caring for, and maintaining them until the harvest season. Farmers are divided into two parts, namely Tebu HGU Gapoktan Farmers and Tebu Rakyat Mandiri Farmers. Tebu HGU Gapoktan Farmers are farmers who are given land by the Takalar Sugar Factory with HGU (Business Use Right) status. Meanwhile, Tebu Rakyat Mandiri Farmers are farmers who have their land and then carry out sugarcane cultivation activities, and the entire sugarcane harvest is transported to the Takalar Sugar Factory.

b. Takalar Sugar Factory

The Takalar Sugar Factory acts as a producer that distributes white crystal sugar and molasses products to traders and consumers directly. The process of processing sugar cane into sugar is carried out with the help of a machine and human labor which is divided into several stages, namely, milling, refining, evaporation, crystallization, separation, and final finishing (sugar handling). The sugar obtained is packaged in 50 kg and 1 kg packages with the trademark Walini for 50 kg packaging and Gollata for 1 kg packaging as well as molasses which is the remaining sugarcane juice that cannot be formed into sugar crystals per ton.

c. Marketers (2nd level)

The marketing agency that also acts as a shop trader, namely PT. Gelael and Berkah Supermarket are actors (traders) in the value chain who are closest to the so-called 2nd level consumers and end users. The thing that distinguishes marketers or shop traders from retail traders is that marketers or shops buy white crystal sugar products in 1 kg packaging and sell them directly to end consumers (households). Meanwhile, retail traders buy white crystal sugar in large quantities (50 kg) which are then resold to consumers in small quantities (1 kg). Meanwhile, the purchase of molasses is carried out by the amount per ton weight unit. The purchasing process is carried out in one milling period during the auction system. In addition, marketing agencies or shop traders carry out several handling activities such as storage and loading and unloading as well as periodic temperature and humidity checks so that the quality of sugar is maintained so that it is hoped that it will reach the final consumer with good quality.

d. Wholesalers (2nd level)

Large traders in this chain are also known as 2nd level consumers who obtain supplies of sugar and molasses

from several sugar factories spread across the South Sulawesi region, namely Takalar, Bone, and Makassar, namely UD. Surya Putera and CV, Benteng Putra Sejahtera as well as marketing authorities. The quantity purchased by wholesalers is greater and the repurchasing period is carried out more quickly. Purchasing through an auction process and buying sugar with the condition that the total purchase is above 10 tons, and the purchase period is 1-3 days. Sugar that is usually purchased is 50 kg packaged sugar and shipping costs are calculated directly with the purchase price of sugar, so buyers (wholesalers) do not need to incur special shipping costs for each delivery. In addition, wholesalers also become sugar distributors for other traders who do not win auctions and sales through the PO system, such as shops, food or beverage businesses, or restaurants.

It is also known from the above description that several different wholesalers are involved in the cane sugar value chain for white crystal sugar and cane molasses products indicating that there are two different value chains between the sugar produced and marketed. The difference in the value chain that occurs in the cane sugar commodity indicates that there are differences in costs and income that have been incurred and received by the Takalar Sugar Factory business.

Fig. 2 shows the flow of the molasses at the Takalar Sugar Factory starts from the initial input (raw material) to the final output (product). Meanwhile, the difference in the process shown in Fig. 3 is the white crystalline sugar.

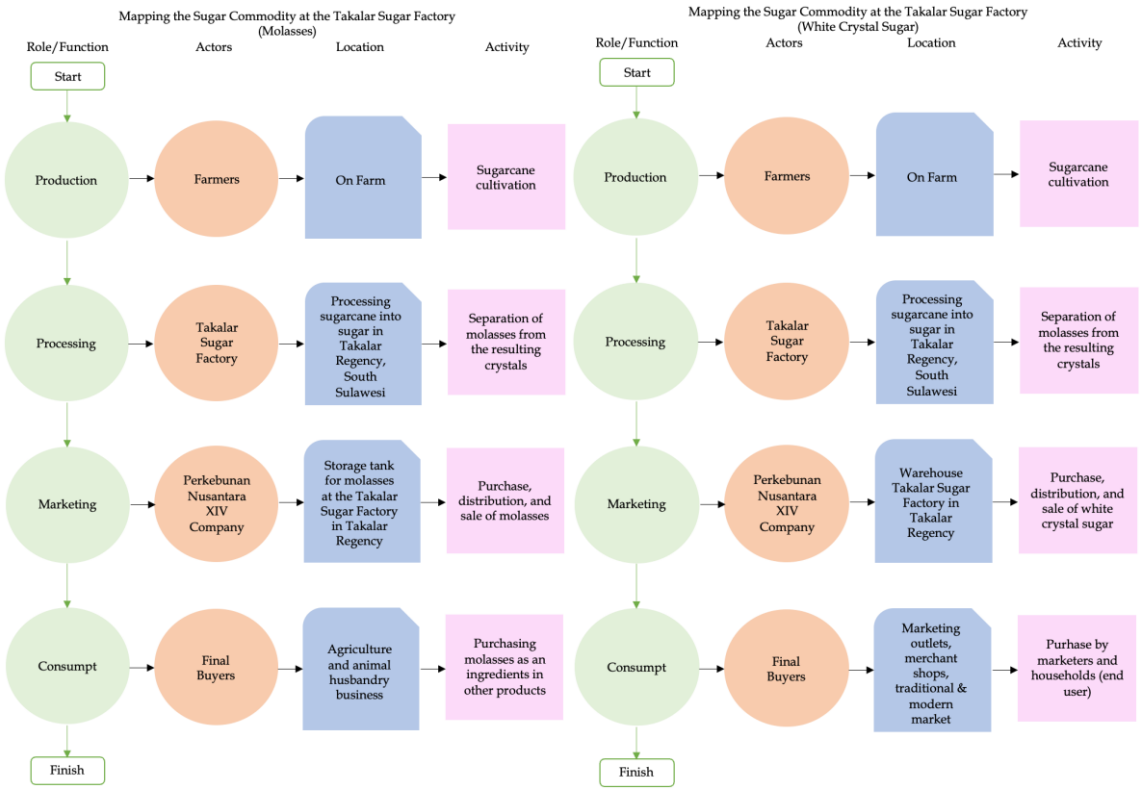

Figure 2. Value chain mapping of molasses and white crystal sugar

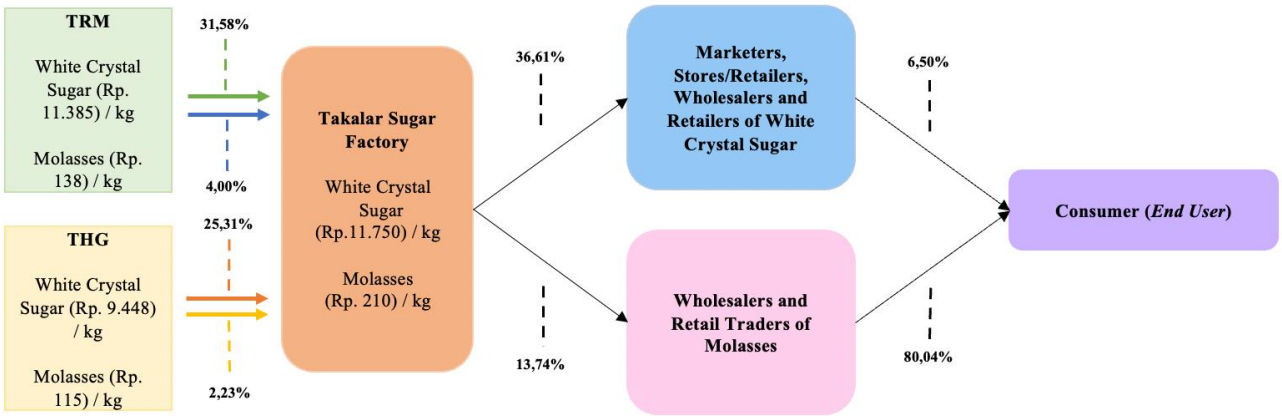

Figure 3. Value Chain Model of Takalar Sugar Factory Value Chain Actors

Table 2.
Total productions costs (IDR)

Actors	2018	2019	2020	2021	2022
Tebu Rakyat Mandiri Farmers	10,400,000	12,000,000	13,300,000	14,800,000	15,300,000
Tebu HGU Gapoktan Farmers	10,400,000	12,000,000	13,300,000	14,800,000	15,300,000
Takalar Sugar Factory	9,863,504,932	11,963,804,213	12,229,288,992	12,203,270,747	12,825,811,225

Table 3.
Selling price of Takalar sugar factory (IDR)

Commodity	Actors	2018	2019	2020	2021	2022
White Cristal Sugar (HET)/kg	Tebu Rakyat Mandiri Farmers	7,590	7,755	7,920	8,085	8,250
	Tebu HGU Gapoktan Farmers	6,325	6,463	6,600	6,738	6,875
	Takalar Sugar Factory	11,500	11,750	12,000	12,250	12,500
Molasses (HET)/Ton	Tebu Rakyat Mandiri Farmers	125,400	128,700	132,000	135,300	138,600
	Tebu HGU Gapoktan Farmers	104,500	107,250	110,000	112,750	115,500
	Takalar Sugar Factory	190,000	195,000	200,000	205,000	210,000

Table 4.
Actor Value Streams

No.	Sugar Marketing Chain	Value Chain (Rp/kg)		Profit Margin (Rp/kg)		Margin (%)	
		1	2	1	2	1	2
1.	The Cost of sugarcane production Tebu Rakyat Mandiri Farmers	1,827	86	-	-	-	-
2.	The cost of sugarcane production HGU Gapoktan Farmers	1,827	86	-	-	-	-
3.	Sugar cane processing costs at the Takalar Sugar Factory	667	31	-	-	-	-
4.	Prices are at the level of Tebu Rakyat Mandiri Farmers	11,385	138	9,558	52	31.58	4.00
5.	Prices are at the level of Tebu HGU Gapoktan Farmers	9,488	115	7,661	29	25.31	2.23
6.	Prices are at the producer level of the Takalar Sugar Factory	11,750	210	11,083	170	36.61	13.74
7.	Prices at the marketer level	13,718	1.250	1,988	1,040	6.50	80.04
8.	The final price received by consumers	13,718	1.250	-	-	-	-
	Total			30,271	1,299	100	100

Note: 1 = White Crystal Sugar, 2 = Molasses

1. Production.

Farmers as the main producers in producing sugarcane. Independent People's Sugarcane Farmers carry out sugarcane cultivation activities with a minimum area of 1 ha/person and are combined with other farmers to form a farmer partner group. Farmer partner groups consist of 10-25 people with an average of 30-50 ha of plantation land per group. Meanwhile, the Gapoktan Sugarcane HGU Farmers are a combination of farmer groups and have an average of 80-100 ha of land available for management.

2. Processing

At the grinding processing stage, the Takalar Sugar Factory is the main actor involved in the processing function of the sugar value chain flow at the Takalar Sugar Factory. The activity carried out by PG Takalar as a sugar cane processor is receiving sugar cane from farmers and processing it into white crystal sugar for consumption and molasses which is ready for sale.

3. Marketing

The main actors involved in the sugar value chain of the Takalar Sugar Factory are PT. Nusantara Plantation, shop traders, and other traders located around Takalar Regency and Makassar City. The first form of activity carried out in this stream is the purchase of sugar by traders called buyers to producers. The sales and purchases process are carried out by the PO (purchase order) when the sugar supply is ready in the warehouse owned by the Takalar Sugar Factory. The selling price of sugar from the Takalar Sugar Factory to buyers for 1 kg of packaged sugar is Rp. 12,500.00, 50 kg of packaged sugar is Rp. 550,000.00 while the price for drops is Rp. 210,000.00 per ton.

4. Consumers

The role of the consumer is as a giver of value in the form of purchases issued for sugar products and usually follows the price determined by the trader and is the last activity in the flow that purchases sugar.

Through secondary time series data along with the costs incurred by sugar cane farmers and sugar producers for the sugar cane commodity. The production of sugarcane, which is then processed into ready-to-use products in the form of white crystal sugar and by-products in the form of molasses, is then marketed at the following offering prices.

Table 2 and 3 show the total farmer production costs up to harvest and the selling prices that apply to each actor in the chain up to the end user. The table also shows the level of production costs and price bids increasing each year, so it is assumed that the profit margins of actors with projected production costs and revenues of actors in the value chain are the same each year.

Table 5.
Calculation results of the Takalar Sugar Factory value chain based on Porter weights

Activity	Relative weight	Value	Score
Primary Activity:			
Inbound logistics a. Farmers have difficulty dealing with resource management issues related to sugarcane productivity such as land, seeds, fertilizer, saproni, and labor. b. Due to the difficult (limited) supply of raw materials, the impact on the business of managing the value chain of the Takalar Sugar Factory was disrupted.	0,13	1,7	0,22
Operation c. Low milling capacity and a limited supply of raw materials resulted in sub-optimal sugar productivity. On the other hand, the Takalar Sugar Factory is still experiencing difficulties in monitoring the use of all the machines in the factory. d. The use of factory machines and equipment does not entirely use renewable technology, so the Takalar Sugar Factory has difficulty in supervising and controlling operating processes following operational standards.	0,13	2,05	0,27
Outbound logistics e. The Takalar Sugar Factory has difficulty managing the number of defective products that do not comply with national product standards. f. The Takalar Sugar Factory finds it difficult to create a balanced distribution channel between the factory network and the head office where product handling and sales (offline) are at the head office. In addition, it is difficult to use information technology because the factory is in a rural area.	0,11	2,45	0,27
Marketing and sales g. The Takalar Sugar Factory has weaknesses in sales and promotion due to the lack of quality human resources, resulting in less innovative and competitive product results, and has not made strategic branch office location arrangements that can function more effectively as product providers and product services to end consumers. h. The Takalar Sugar Factory in product sales and promotions has not fully utilized salespeople, causing the unavailability of sufficient information to convey information to consumers.	0,13	1,85	0,24
Service i. The Takalar Sugar Factory has difficulties in carrying out internal services to both partners and employees and it is difficult to interact with consumers directly due to the limited sales force	0,05	1,4	0,07
Total	0,55		1,07
Support Activities:			
Company Infrastructure a. The general management information system and controls that are not optimal cause the Takalar Sugar Factory to still have difficulties in dealing with the problem of product accumulation in the warehouse. b. And have an impact on operations and financial management. c. As well as the drafting of the work budget becomes weak.	0,19	2,03	0,39
Human Resource Management d. The system of recruiting employees, especially seasonal and PKWT owned by the Takalar Sugar Factory, is through ordinary and weak selection. e. This is due to the lack of implemented HR training units, such as developing HR management, developing a reward & punishment system, developing OSH for HR, and developing HR information technology.	0,12	1,7	0,20
Technology Development f. The Takalar Sugar Factory has not fully used modern sugar cane processing technology so it cannot produce high-quality products. In addition, the Takalar Sugar Factory has not been able to increase innovation and modernize its products.	0,07	1,5	0,11
Procurement g. The Takalar Sugar Factory relies on a structure to supply raw materials from partners, namely farmers. So, if there are difficulties in procuring raw materials because the raw materials are not sufficient to meet the needs for raw materials, plus external factors that greatly influence. In addition, the raw materials needed by the Takalar Sugar Factory have not met the specifications in terms of cleanliness, freshness, and the target of the required yield level so the quantity and continuity of the supply of raw materials has not been as planned. In addition, there are frequent delays for production inputs such as transportation equipment, weighing, inspectors, and waste processing which also have an impact on operational activities.	0,07	1,7	0,12
Total	0,45		0,82

Therefore, the calculation is carried out using the projected year of the highest bidding price or HET (highest retail price), in 2022. The calculation results for the average sugar value chain at Takalar Sugar Factory in 3 periods in 2022, Takalar Regency can be seen in Table 4.

The results of the analysis at the mapping value chains stage have explained the function of each actor and found out the size of the profit margin obtained by each actor involved in the flow of products from farmers, producers, and marketers to consumers as shown in Fig. 3. The largest profit margin in the sugar value chain of the Takalar Sugar Factory is obtained by the second end consumer, namely wholesalers and retailers for this type of molasses with a percentage value of 80.04%.

The large profit margins owned by wholesalers and retailers who are level 2 consumers are due to the many value-added processes such as during the interview process, level 2 consumers provide additional treatment, namely handling and maintenance during the distribution process, processing into new products, designing design for re-packaging on retail packaging, separation, and packaging process for products sold in retail, after-sales services and so on to add value to the product.

Table 6.
Performance measurement of the total value chain of Takalar sugar factory

No.	Value chain activity	End of score
1.	Primary Activity	1.87
2.	Supported Activity	0.82
	Total	1.89

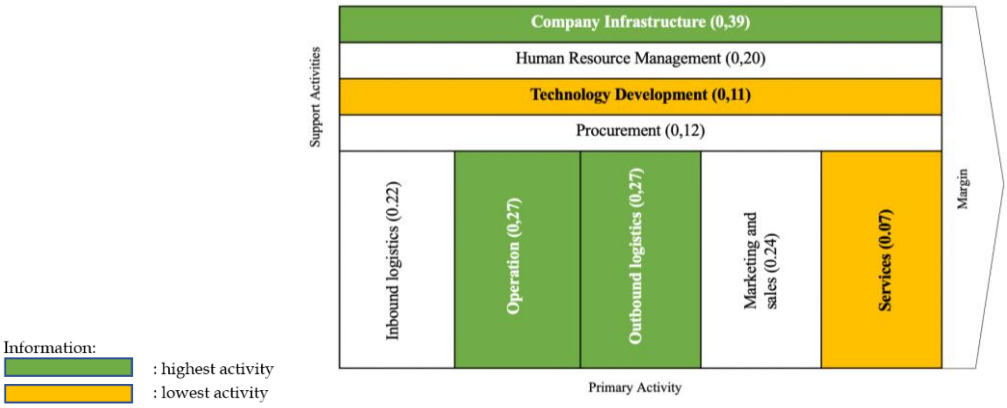

Figure 4. Mapping the highest and lowest activities in the value chain at the Takalar sugar factory

The smallest profit margin in the value chain of white crystal sugar and cane molasses is obtained by the second-level end consumers, namely marketing institutions, or shops by 6.50% and sugar cane farmers from Gapoktan HGU by 2.23%. Seeing the actual condition that the distribution of benefits is not evenly distributed between farmers, producers, and consumers level 2 in the sugar value chain at the Takalar Sugar Factory, it indicates the need for performance improvements in terms of the performance efficiency of processing plants (producers) to optimize white crystal sugar products which are the main product compared to waste products or molasses. The target of this optimization will be a competitive advantage which is expected to increase productivity in the value chain at the Takalar Sugar Factory.

3.2. *Mapping value chain analysis*

Information that is known that the flow of value (supply and income) is not balanced for the Takalar Sugar Factory and Farmers, reveals the need to identify product flows by mapping the value chain according to activities, namely primary (main) activities, and supporting activities. The application of each primary and supporting activity is then given weighting and scoring to determine the level of performance in each activity in the value chain. The weighting and assessment are carried out directly by the actors involved in the value chain according to the conditions in the internal environment of the Takalar Sugar Factory. In direct proportion to the weighting and assessment of activities, performance measurement has also been carried out and it has been identified which activities act as the biggest value creators in the sugar value chain at the Takalar Sugar Factory.

Table 5 shows the breakdown of constraints that each indicator has for each activity and has the potential in the form of numbers that have been measured previously. The low performance in this service activity is because the Takalar Sugar Factory is still limited by the minimum quality of human resources.

On the other side, technological development greatly influences all activities that occur within the factory. The acquisition of low-performance scores is because the Takalar Sugar Factory still uses old machine technology and equipment (old machine) so machine downtime often occurs and there has been no revitalization from a technological point of view. Considering that the yield of sugarcane to be obtained is greatly influenced using machines during the sugarcane extraction process, development from a technological standpoint needs to be done. If the machine does not work effectively, then the level of sugar productivity is not optimal and the potential for value creation is not optimal so many parties feel disadvantaged.

3.3. *Value chain performance measurement*

Performance measurement is the final stage in Porter's value chain analysis to measure which activity acts as the largest value creator in the sugar commodity value chain sold through the Takalar Sugar Factory and can be used as a reference for performance improvement in small value-creating activities that are not yet optimal. Table 6 shows the total score obtained was 1.89, meaning that the performance of the value chain at the Takalar Sugar Factory was still below average because the final score was less than 2. Several activities still had a low score indicating that all potential value creators throughout the value chain at Takalar Sugar Factory are not optimal.

Nevertheless, activities at the Takalar Sugar Factory have competitive advantages, namely the results of an assessment that shows several 2 or more such as operational activities, outgoing logistics, and company infrastructure. Based on the scores obtained, these activities are arranged into a mapping matrix of value chain activities based on the highest and lowest scores.

The highest activity on Fig. 4 needs to be maintained and used as an internal strength of the Takalar Sugar Factory. While the lowest activity requires full attention to improve performance to add product value and add indicators of competitive advantage that will be owned by the Takalar Sugar Factory in its value chain.

3.4. *PESTLE analysis*

Factors influencing internal activities and performance that can create value in the business have been identified through previous discussions. Meanwhile, the following is an analysis of PESTLE affecting activity and performance in the external conditions of the Takalar Sugar Factory.

1. Politics (Politics)

The production pattern involves farmers and the Takalar Sugar Factory whereas actors who participate in maintaining the stability of national sugar, the government is still ambitious about establishing policies and regulations so that the supply and value obtained from the distribution of sugar can help meet the needs and benefit all parties who involved.

2. Economic (Economy)

The Takalar Sugar Factory has a broad market because it produces food products for consumer groups at all levels, both for direct and indirect consumption. The market is very closely related to the fulfillment of goods (supply) for the demands of needs (demand) and vice versa. According to the Minister of Industry No. 3 of 2021 concerning guarantees for the availability of raw materials for the sugar industry to meet national sugar needs, the limited availability of raw materials for sugar production requires sugar imports. The above shows that indeed the demand for sugar is increasing, but the domestic (domestic) sugar industry has not been able to meet market demand.

3. Social

Social views of the community include socio-cultural and village aspects such as social status, employment opportunities, social behavior, and social security [13]. This was confirmed in the interviews conducted that the people around the Takalar Sugar Factory are people with livelihoods as farmers who initially planted corn and rice and turned into sugarcane farmers since the factory was founded. Farmers experienced changes and improved living standards, such as income, education, health, and relations between communities around the Takalar Sugar Factory

4. Technology

Takalar Sugar Factory is a factory that has been producing since 1987 using the latest technology applied at that time. Along the time, the use of technology begins to decline, which is indicated by the very low and uncompetitive level of sugarcane and sugar productivity. This is a big threat that the Takalar Sugar Factory must immediately deal with.

5. Legal (Law)

Law is a rule that is made for society derived from the values of life and culture such as religion, customs, decency, and culture in society [14]. According to Constitution No. 3 of 2014 also contains that industry is carried out based on the principles of national interest, economic democracy, business certainty, equal distribution, fair business competition, and industrial linkages as the main guideline for the Takalar Sugar Factory. innovative, tough, and characterized to support the progress of the domestic industry.

6. Environment

External environmental factors in this analysis are environmental factors that are related to and influence the business continuity of the Takalar Sugar Factory, either directly or indirectly. Based on its line of business, the Takalar Sugar Factory is an industrial unit engaged in agribusiness, namely plantations and processing of sugar cane into sugar products. The upstream of the Takalar Sugar Factory business, namely sugar cane as a raw material for sugar production which is an element of the biotic environment, cannot be separated from abiotic environmental elements that affect its growth or productivity. Sugarcane productivity is also strongly influenced by climatic conditions, land (soil), and the management and maintenance of sugarcane plants [15].

3.5. *TOWS Analysis*

The following TOWS factors are known after obtaining results through value chain analysis which describes the internal approach to activities at the Takalar Sugar Factory so that strengths and weaknesses can be identified and through the PESTLE analysis which has described a macro approach to identify threats and opportunities that may occur on Table 7. The next stage is the formulation of an alternative strategy which begins with the weighting and rating of each factor. The formulation of the strategy is shown at the input stage and the matching stage as follows Table 8.

The results of the EFE matrix show that the threat factor has a score of 1.01 and the opportunity factor has a score of 1.56. The total threat score is smaller than the total opportunity score, indicating that the Takalar Sugar Factory has a high response to the opportunities that exist, but the response to threats is low.

Meanwhile, from Table 9 it is known that the internal environmental strategic factors have a response to the Takalar Sugar Factory in a weak position, namely the resulting total score shows an inability to respond to a weakness of 1.08 through the utilization of the strength of 1.35 which is owned because it produces a score below the value average.

Table 7.
External-Internal Environmental Factors

No.	Threats	Opportunities
1.	Fluctuation price that affects the level of inflation	The phenomenon of price fluctuations and demand
2.	Diseases and inhibit sugarcane productivity	Availability of raw materials continuously
3.	The demands for employment opportunities	The growth of farmer groups around the factory
4.	Import levels are getting higher	Direct support by the government
5.	Many substitute products (competitors)	Purchasing power continues to increase
6.	Diversity of farmers' backgrounds and interests	The demand for products is increasing
7.	Climate or extreme weather changes	Advances in technology and information
8.	Brand competition	Local sugar market opportunities
No.	Weaknesses	Strengths
1.	Limitations of sugarcane planting land	Personal branding embedded in the community
2.	Minimal production capacity	Affordable selling price to customers
3.	Underdeveloped technology	Product quality conforms to national standards
4.	High operating costs	Quality assurance of products to be supplied
5.	1 kg packaged sugar operates for 2 years	Company infrastructure support
6.	Implementation of management is still not good	Product innovation to create added value
7.	Insufficient product introduction	Scheduled and timely product distribution

Table 8.
EFE Matrix

No.	External Factor	Weight	Rating	Weight score
Threats				
1	Price fluctuations that affect the inflation rate	0,06	1,75	0,10
2	Diseases and inhibit sugarcane productivity	0,07	1,25	0,07
3	The demands for employment opportunities	0,05	3,50	0,18
4	Import levels are getting higher	0,06	2,25	0,13
5	Many substitute products (competitors)	0,07	1,75	0,12
6	Diversity of farmer backgrounds and interests	0,06	3,50	0,22
7	Climate or extreme weather changes	0,06	1,25	0,07
8	Brand competition	0,07	1,75	0,13
	Threats Total	0,49		1,01
	Opportunities Total	0,51		1,56
Opportunities				
1	The phenomenon of price and demand fluctuations	0,06	2,50	0,16
2	Continuous availability of raw materials	0,07	2,50	0,17
3	Growth of farmer groups around the factory	0,07	2,50	0,19
4	Direct support by the government	0,07	3,25	0,22
5	Purchasing power continues to increase	0,06	3,75	0,22
6	Product demand is getting higher	0,06	3,75	0,24
7	Advances in technology and information	0,07	2,75	0,18
8	Local sugar market opportunities	0,06	3,00	0,19
	Total Value	1,00		2,57

Table 9.
IFE Matrix

No.	Internal Factor	Weight	Rating	Weight score
Weaknesses				
1	Limited land for planting sugarcane	0,07	2,00	0,14
2	Minimal production capacity	0,07	2,50	0,18
3	Backward technology	0,06	2,50	0,15
4	High operational costs	0,07	1,00	0,07
5	Innovation of 1kg packaged sugar products	0,07	2,25	0,17
6	Implementation of management is still not good	0,07	2,50	0,16
7	Product introduction is not optimal	0,06	3,25	0,21
	Weaknesses Total	0,47		1,08
	Strengths Total	0,53		1,35
Strengths				
1	Personal branding embedded in society	0,08	2,25	0,17
2	Affordable selling price to customers	0,08	3,00	0,23
3	Product quality according to national standards	0,07	3,50	0,26
4	Guarantee the quality of the products to be supplied	0,08	3,50	0,28
5	Internal support and company infrastructure	0,08	2,25	0,19
6	Product innovation to create added value	0,07	2,00	0,14
7	Scheduled and timely product distribution	0,07	1,25	0,08
	Total Value	1,00		2,43

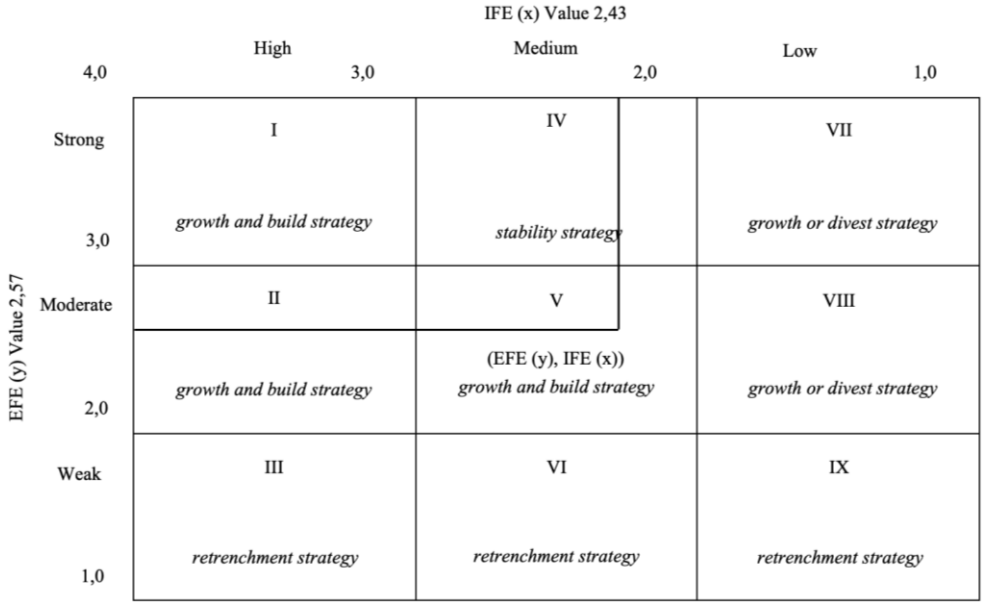

Figure 5. EI Matrix (External-Internal)

EXTERNAL FACTORS	*Strengths – S* 1. Personal branding embedded in the community 2. Affordable selling price 3. Quality of products according to standards 4. Quality assurance of products to be supplied 5. Internal support and company infrastructure 6. Product innovation to add added value 7. Scheduled and timely product distribution	*Weaknesses – W* 1. Limited land for planting sugarcane 2. Minimum production capacity 3. Underdeveloped technology 4. High operational costs 5. 1kg packaged sugar is a new product 6. Implementation of management is still not good 7. Product introduction is not optimal
Opportunities – O 1. The phenomenon of price and demand fluctuations 2. Availability of raw materials continuously 3. The growth of farmer groups around the factory 4. Direct support by the government 5. Purchasing power continues to increase 6. Product demand is getting higher 7. Advances in technology and information 8. Local sugar market opportunities	*SO Strategy (Management)* 1. Maintain and improve product quality (S2, S3, S4, S7, O2, O3, and O7) 2. Maintain and increase market share (S1, S5, S6, O1, O4, O5, O6 and O8)	**WO Strategy (Technology)** 1. Increase sugar cane and sugar production capacity (W1, W2, W4, O2, O3, O5, O6 and O8) 2. IoT technology for added value creation (W3, W7, O4 and O7)
Threats – T 1. Price fluctuations affect inflation 2. Diseases and inhibit sugarcane productivity 3. Society's demand for job opportunities 4. Higher levels of imports 5. Number of substitute products (competitors) 6. Diversity of farmer backgrounds and interests 7. Climate and extreme weather changes 8. Brand competition	*ST Strategy (HR)* 1. The efficiency of the prasaproni sugarcane production process (farm production infrastructure and facilities) (S5 and T6) 2. Supervision and control on product quality (S3, S4, S7, T2 and T7)	*WT Strategy (Marketing)* 1. Implement a sugar protection policy (W1, W2, T2, T6, T7) 2. Doing planning in product development (W6, T5, and T8)

Figure 6. TOWS Matrix

3.6. Alternative management strategy formulation

The preparation of the EFE and IFE matrices has revealed that the position of the Takalar Sugar Factory in responding to external and internal factors is suboptimal. This is evidenced by the EFE matrix (External Factor Evaluation Matrix) obtaining only a value of 2.57, indicating a mere 7% of factory responses,

depicting an average strength in leveraging opportunities and mitigating threats. Meanwhile, the IFE matrix (Internal Factor Evaluation Matrix) scores below the strategic position with a value of 2.43, implying a very weak response from the factory in leveraging strengths and addressing weaknesses in internal business activities. Subsequently, the values generated by the EFE and IFE matrices form an EI matrix, indicating that the intersection point positions at cell V, as illustrated in Fig. 5.

The strategy depicted in that cell advocates an intensive approach to mitigate external threats that might result in losses. This entails enhancing production facilities, leveraging technology, expanding market segments, or broadening business activities while maintaining the current production level, aiming to achieve a singular objective—adding value to the business and its chain. Additionally, an evaluation process is conducted by aligning strategic planning based on the TOWS matrix with capacities, capabilities, and sustainable policies, as illustrated in Fig. 6.

The TOWS matrix clearly describes the external threats and opportunities currently being faced by the Takalar Sugar Factory, so that it is adjusted to its weaknesses and strengths. This matrix produces 4 (four) cells of possible factory strategic alternatives namely, SO strategy (Management), WO strategy (Technology), ST strategy (Human Resources), and WT strategy (Marketing).

3.7. *Analytical Hierarchy Process*

The hierarchical configuration in determining the priority of the Takalar Sugar Factory value chain management strategy uses 2 levels, namely level 2 for factor strategy analysis (criteria) and level 5 for alternative strategies (criteria elements) which produce priority strategies. The results of the Analytical Hierarchy Process (AHP) obtained the eigenvector (score) for each factor as shown on Table 10.

Human resources (HR) is the ST strategy, namely by utilizing internal strengths to avoid external threats to be a factor of choice and very relevant to the strategy results from the TOWS analysis which at the same time shows HR has full responsibility for sugarcane cultivation (sugar cane production) and maintenance as a supply raw materials, processing, supervision, and control in the process of sugar production, product supervision up to the product service process to the end user.

The result is also comparable to the results of the value chain analysis which shows that the lowest activity, namely service and technology development, is directly proportional to the factor analysis which shows that human resources and technology are in the 2 (two) highest priority positions. Human resources are related to creating good services carried out in internal and external factory activities, such as giving rewards to employees/farmers/customers to create satisfaction so that factory performance can be optimal, quality management team and integrated employee/farmer training including the use of modern technology-based machines and equipment, developing and studying varieties and superior seeds for sugarcane production, more optimal land use through testing and analysis of soil conditions and the surrounding environment to determine the dosage or use of appropriate types of fertilizers and growing substances (according to soil conditions), understanding (ethics) of the production flow right on target to the services provided to customers after sales to create customer satisfaction for their products. Likewise, without the use of high technology, the utilization of human resources will not work optimally if it is not matched with technology that is following the strategy. Those factors are then interconnected to the criteria elements (alternative strategies) that will form strategic priorities so that the optimal management strategy in the Takalar Sugar Factory value chain can be identified.

3.8. *Optimal alternative strategic plan priority*

The alternative strategy priority to be more optimal is to carry out a form of strategic assessment from the TOWS matrix that has been done before and adapted to the conditions of the Takalar Sugar Factory's capabilities. Then proceed with giving weight to each alternative strategy using the hierarchy process method as has been done in the strategy factor criteria. The weight score calculation is done by multiplying the factor weight values and the alternative strategy weight values, resulting in the following priority design optimal management strategy for the Takalar Sugar Factory value chain on Table 11.

The priority strategy chosen is also very closely related to the achievement of results in the mapping of value chain activities, where the lowest activity, namely technology and service development, needs to achieve management optimization to create added value (value added) as well as a competitive advantage for the Takalar Sugar Factory business.

Table 10.
Weight of factor interests

Factor	Score	Ranking
Human Resources	0,30	1
Technology	0,26	2
Management	0,24	3
Marketing	0,20	4

Table 11.
Value chain strategy priorities

Factor	Ranking
Sugarcane production efficiency (prasaproni)	1
Production of IoT technology for added value creation	2
Increasing sugar cane and sugar production capacity	3
Maintain and increase market share	4
Supervision and control on product quality	5
Product planning and development	6
Maintain and improve product quality	7
Implementation of sugar protection policy	8

1. The efficiency of prasaproni sugarcane production

Infrastructure and farming production facilities are the main factors in the agro-industry business. One prasaproni that has a major contribution is the yield of sugar cane. In the process of processing sugarcane into sugar, the yield level produced by sugar cane affects the total sugar production produced. This is evidenced by looking at the historical time series of the Takalar Sugar Factory, so far it has not been able to achieve a sugar cane yield of 8%. Besides that, production costs used can be reduced if sugarcane production is more efficient and added value is obtained for farmers and producers (factories). Efficiency in sugarcane production can be achieved if farmers as the main supplier of factory raw materials implement better modern sugarcane cultivation techniques such as land use, selection of superior seeds, use of fertilizers, regular and fully scheduled care, and maintenance up to the climate anticipation process during TMA (cutting, loading and transport).

2. Production IoT technology for added value creation

The manufacturing industry is required to keep abreast of technological developments to create efficiency in the production process and can help to increase production capacity and quality so that they can survive and have competitive quality. If you use more modern equipment and machines, it will automatically speed up, facilitate, and increase production activities and productivity levels can be more optimal. Likewise with the case at the Takalar Sugar Factory, the use of old production machines may affect the low yield achievement which has so far been far from the target. One of the most powerful factors for increasing the yield of cane sugar is the use and utilization of technology (techno ware), namely good integrated equipment and machines, such as the use of the Internet of Things (IoT) for each production line. If the factory could take advantage of the use of technology, the expected output is to minimize wasting (molasses), maximize the internal and external performance of the factory, and reduce production costs which will affect the value chain [16].

3. Increasing sugar cane and sugar production capacity

The Takalar Sugar Factory has a milling capacity of only 2400 TCD which is the minimum standard capacity for a sugar factory. Considering that the amount of sugar demand for both consumption and industry tends to increase, this should be a priority consideration for factories to carry out on-farm restructuring through the development of sugarcane planting areas, sugarcane quality (yield), modern cultivation techniques and factory revitalization (off-farm). Factory revitalization by increasing productivity through increasing milling capacity, developing the quality of human resources, especially the factory operations section, and replacing old machines.

4. Maintain and increase market share

Maintaining and increasing market share can increase added value because it makes the factory known and grows rapidly compared to competitors. Automatically this becomes one of the factors of competitive advantage that factories will have in their value chain. The market share for sugar products to date is all types of consumers because sugar products are one of the basic needs. Reviewing its strategic product position, Takalar Sugar Factory must absorb this opportunity as well as possible. A company will have a competitive advantage if the company is in favorable conditions from five (5) competitive factors, namely the spread of new competitors, the potential to develop substitute products, the strength of the factory's position as a supplier, the power of the factory in offering to consumers, and defense. so that it can compete with other existing companies. Likewise, Takalar Sugar Factory could take Porter's competitive factors by taking advantage of external opportunities and internal strengths that it already has, namely as a supplier of products and relatively stable price sells so it survives in business competition. What factories need to do is increase market share optimally by increasing the promotion of their products both through print and digital media. This situation was carried out because the Takalar Sugar Factory already has a new packaged product (1kg) so that it can be offered to its final consumers (level 2 consumers), without going through distributors or level 1 consumers in its value chain.

4. Conclusions

The use of the value chain method through value chain analysis at the Takalar Sugar Factory found that product flow, information, and prices did not run optimally, resulting in weak productivity levels. The results of this analysis serve as a reference for conducting further analysis with the help of the TOWS analysis method to increase productivity through a strategic plan based on an analysis of the external and internal environment which is formed into the threats, opportunities, weaknesses, and strengths of the Takalar Sugar Factory. The results of this strategy are combined with the capabilities, capacity, and internal policies of the Takalar Sugar Factory through focus group discussions with the help of analytical hierarchy process techniques to produce the main factors that influence the value chain are human resources with priority strategies for efficiency in sugarcane production, IoT technology production for creating value added, increasing sugar cane and sugar production capacity as well as maintaining and increasing market share.

Declaration statement

De Naddya YF. Sumarata: **Conceptualization, Methodology, Writing-Original Draft**. Muhammad Rusman: **Design, Creating product prototypes, Writing-Review & Editing**. Syarifuddin M. Parenreng: **Resources, Validation, Formal analysis**, **Visualization, Investigation**.

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