Performing Demand Management Strategy on Palm Sugar Supply Chain in Kutai Kartanegara Regency's Commodities

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Abstract. Unfortunately, there are unsolved critical issues of demand in a palm sugar supply chain, such as a propensity for the mismatch of demand and supply due to no local livelihood sustainability, inconsistency in handling palm sugar quality, and inappropriate institutional mechanisms. Highlighting the problems and proposing demonstrated "demand management", this research draws on empirical evidence from case studies. The case study evidence based on the conceptual framework is drawn exclusively from Tuana Toha Village, in the Peatland Hydrological Unit area in Kutai Kartanegara Regency, where palm sugar potential is generally more mature than in other districts of Kutai Kertanegara Regency. So, this research objective proposes a comprehensive instrument of "demand management" for stabilizing the palm sugar supply chain through the improvement framework for the demand management process. The research method by participatory observation involves researchers actively participating to understand better the role and activities of micro-enterprises/ local communities in the development of palm sugar. This method can help identify problems and challenges that may not see through other research methods. Establishing four stages in the improvement framework for the demand management process: stage of definition, distribution, diagnosis, and execution. This research's essential results state that collaboration, information sharing, and cooperatives are instruments to meet supply and demand efficiently.

1 Introduction

Palm plantations in the Peatland Hydrological Unit area, Kutai Kartanegara Regency, East Kalimantan, are indicated to have comparative advantages regarding the palm sugar industrial center's planning. It refers to a concentrated location or region with palm sugar production and related activities to leverage local economic growth[1]. Potentially, this value addition considers a more natural and healthy food alternative that relies on palm-based resources rather than refined sugar[2]. Moreover, this local competitiveness promotes

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sustainable livelihood, opportunities for product diversification, and domestic and international market expansion. Being strategically positioned in East Kalimantan, this palm sugar industrial will contribute to meeting the logistical requirements for the new capital city of Indonesia.

Among the characteristics of agricultural and food chains is variability in consumer demand [3]and mismatch of supply[4]. Furthermore, based on prior research, demand in agricultural and food chains is commonly managed along the chain using demand planning[5]. Demand planning is the technique used to foresee consumer demand. It guarantees that enough product is available at the appropriate level of service, at the required location, at the time necessary, and at the lowest possible supply chain costs. Demand forecasting, inventory management, capacity planning, production planning, and planning for the timing of material requirements are all included here. However, this research has not emphasized all those demand planning analyses. Instead, this research attempts to challenge demand management strategy for better-solved along the unstable palm sugar supply chain.

There is quite a difference between demand planning versus demand management strategy. While demand planning is reactive to customer demand, demand management is proactive[6]. Demand management focuses on actively creating and managing demand rather than simply reacting to customer demands. In other words, while demand planning is concerned with forecasting and estimating future demand, demand management focuses on shaping and managing customer demand through various strategies and actions.

As a consequence of reengineering the palm sugar supply chain, this research studies the instrument of demand management strategies for the palm sugar supply chain in Kutai Kartanegara Regency's commodities. To date, these instruments of demand management need to be better understood. To make it easier for the supply chain to meet demand, studies across a comprehensive how to use those instruments are required. So, this research objective proposes a comprehensive instrument for stabilizing the palm sugar supply chain based on a process improvement framework for demand management, which are the definition stage, distribution stage, diagnosis stage, and execution stage.

2 Materials and methods

2.1 Location and time of research

Research observation in January – February 2021 involves researchers actively participating to understand better the role and activities of micro-enterprises/ local communities in the development of palm sugar. Data about conformity of those various demand management instruments in the palm sugar supply chain was taken by purposive and accidental sampling in Tuana Toha Village, in the Peatland Hydrological Unit area in Kutai Kartanegara Regency **(Fig.1)**.

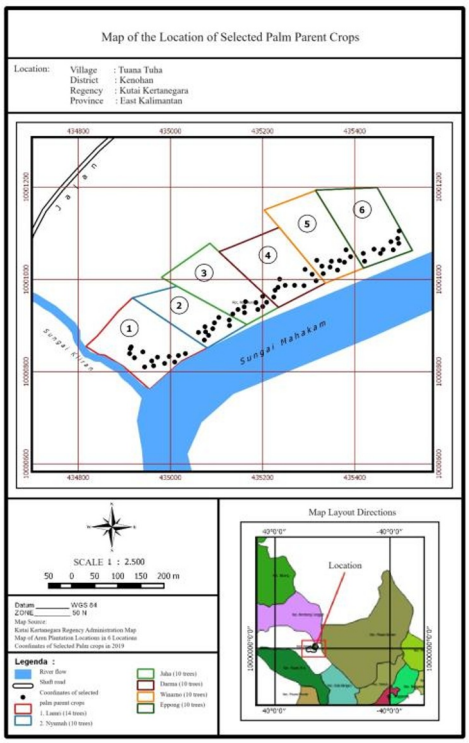
2.2 Research procedures

Data collection was conducted through in-depth interviews with the help of questionnaires designed to gather specific information related to the research objectives or the topic under investigation. The questionnaire is used as a guide to structure the interview, explore relevant topics in more detail, or ask follow-up questions based on the respondent's responses flexibly. After completing the interviews, another procedure is transcribing and organizing the collected data for analysis. The analysis may involve identifying common themes, patterns, or trends in the responses and examining any variations or divergent

perspectives expressed by respondents. The following procedure is drawing conclusions and insights that address the research objectives based on the analysis of the collected data. In **Fig.2**. imply those research procedures.

2.3 Data analysis

Within a process improvement framework for demand management (**Fig. 3**), let us explore how data analysis applies to each stage. First, it defines the scope and objectives of the process improvement initiative. It involves gathering and analyzing relevant data to understand the current state of demand management processes, identify pain points, and set improvement goals. Data analysis techniques such as process mapping, root cause analysis, and performance measurement help define the areas that require improvement and establish baseline metrics for comparison. Second, it distributes information and insights from the analysis to relevant stakeholders. It involves presenting data in a meaningful and actionable format, such as visualizations, reports, or dashboards. Third, it is fundamental to diagnosing problems and identifying improvement opportunities within demand management processes. Statistical analysis techniques can be applied to uncover hidden insights and understand the underlying causes of issues[7]. For the last, it is integral to the execution phase, where improvement initiatives are implemented. It helps in evaluating and selecting improvement strategies based on data-driven insights. Ongoing data analysis during the execution stage helps monitor the progress of implemented changes and measure the effectiveness of improvement efforts[8].



Source: Tuana Toha's local government

Fig. 1. Selected palm parent crops in Tuana Toha Village

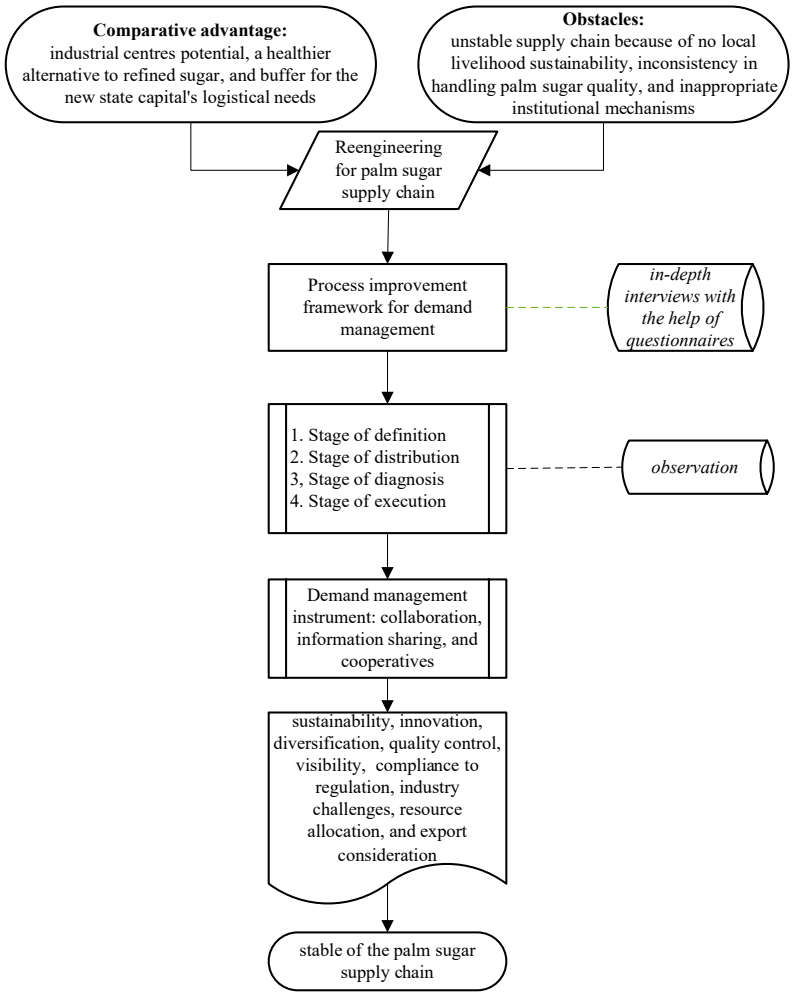


Fig. 2. Research procedures

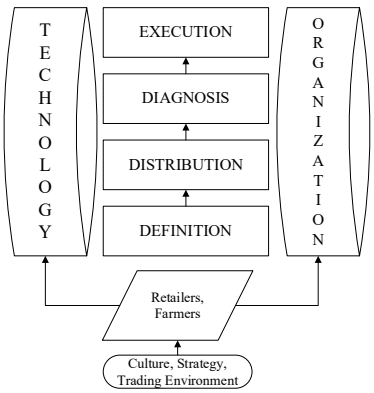


Fig. 3. Process improvement framework for demand management

3 Results and Discussion

3.2 Stage 1- Definition

3.2.1 Palm Sugar-Productivity

Firstly, it is essential to clearly understand what needs to be achieved and how success will be measured in palm sugar productivity. This step involves identifying the potential inputs of East Kalimantan Province. Palm plantations are spread in several districts, and palm sugar production in East Kalimantan increases yearly (**Fig.3**). There are palm plantations with average productivity of 661 kg of palm sugar per hectare[9].

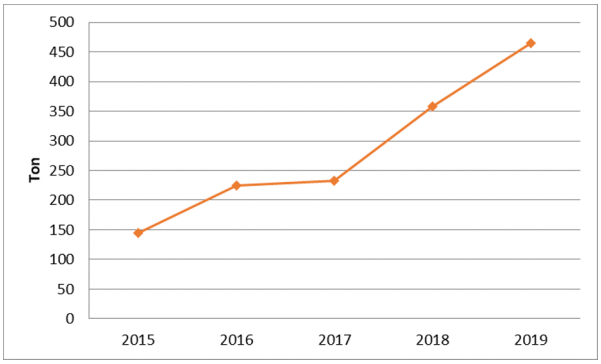


Fig. 3. Palm Sugar Production in East Kalimantan in 2015 – 2019

The increasing area of palm plantations with productive crops in several districts/cities influences the increase in palm sugar production. In a more detailed **Table 1**, the most productive crops are **416** trees in West Kutai, but the palm sugar production is only IDR 115,000 kg/year. Compared to Kutai Kartanegara, **146** productive crops can produce 305,000 kg of brown sugar. It concluded that more people in Kutai Kartanegara process sap water into brown sugar than in West Kutai.

Table 1. Palm Sugar Production per District in 2019

	Regency / City in 2019	Productive crops	Area (hectares)	Production (Kg)	Productivity (Kg/ha)
1.	Kutai Kartanegara	**146**	249	305,000	2,089
2.	East Kutai	95	318	28,000	289
3.	West Kutai	**416**	557	115,000	278
4.	Paser	30	68	10,000	331
5.	Samarinda	14	23	7,000	464
6.	Bontang	3	5	160	53
Total		704	1,220	465,160	660

Source: [9]

Several types of palm crops are classified based on the age of harvest. Palm crops that can be harvested in years 4, 5, and 6 are classified as "genjah" palms. This genjah palm tree is short, so it is easy to harvest. Palm crops can also be harvested in years 7, 8, and 9, classified as "sadang" palms. At the same time, a palm crop that can be harvested over ten

years is called a "dalam" palm. In East Kalimantan, the "genjah" palm is widely found in East Kutai and a small part of Kutai Kartanegara, which generally lives in hill areas.

In the Peatland Hydrological Unit area in Kutai Kartanegara Regency, palm plantations potential is found in Tuana Toha, Kahala, and Teluk Muda, Kenohan District, Kutai Kartanegara Regency, East Kalimantan. Of the three villages in Kenohan District, Tuana Toha village has the most palm sugar potential. While in Kota Bangun District, the potential for palm sugar is found in Kedang Ipil Village. Moreover, in Muara Kaman District, the potential for palm sugar is found in Lebaho Ulak Village and Tratak Village. However, the type of palm in the Kenohan District differs from that in Kota Bangun and Muara Kaman Districts. The type of palm in Kenohan District is a palm sugar that grows naturally and develops in the lowlands near the riverbanks and the dominance of "dalam" palm types. In comparison, the types of sugar palms in Kota Bangun and Muara Kaman sub-districts live in hill areas and are dominated by "genjah" palms.

In Tuana Toha Village, palm crop production has been cultivated into two variations of sugar forms. Molded palm sugar with a thick texture and the powdered form of palm sugar, also known as ant sugar or crystal sugar. Due to its form, like an ant home that builds its nest on the ground, this sugar is known as "ant sugar." Palm plantations owned by the community grow naturally and have a legacy for generations. The palm crop species is a "dalam" palm crop that can be harvested after ten years. The crops thrive among riverbanks and peat soils. Until now, no one has cultivated palm crops by planting them from seed or seeding them. In Tuana Toha Village, palm crops are a parent selected by the East Kalimantan provincial plantation office.

Most farmers use sap water from palm crops for raw materials to make palm sugar and ant sugar. Sap water in one palm crop is harvested twice daily, namely in the morning (±15 liters), whose production is more significant than in the afternoon (±5 liters). Five liters of sap water can be processed into 1 kg of palm sugar. The average productivity of palm sugar in Tuana Toha Village is 29.62 kg. In more detail, it can be seen in **Table 2**. Making palm sugar from sap water is not done daily and depends on the farmer's free time. It is because making palm sugar is generally not a primary livelihood but a side livelihood. This characteristic occurs in other regions of the palm sugar supply chain, too. The value of palm sugar for local people's livelihoods and conservation should be enhanced [10].

Table 2. Palm Crops Productivity in Tuana Toha Village

Farm location	Number of tapping Crops	Production (kg/month)	Productivity (kg/crops/month)
Srajeh/ Kel. Suwayang	5	180	36.0
Kajeng	5	90	18.0
Bomen	15	300	20.0
Jelan tambek	6	18	3.0
Jelan tambek	6	180	30.0
Danau payang	9	300	33.3
Loa payau	7	180	25.7
Jln. M. Husni thamrin	4	150	37.5
Danau payang	8	240	30.0
Mawar merah	7	210	30.0
Mawar merah	10	300	30.0
Telok capi	8	240	30.0
Bomen	7	240	34.3
Bomen	6	180	30.0
Segruding	5	100	20.0

Farm location	Number of tapping Crops	Production (kg/month)	Productivity (kg/crops/month)
Suwayang	7	244	34.9
Kliran bebe	3	60	20.0
Slutung	7	50	7.1
Kliran bebe	7	300	42.9
Suwayang	6	210	35.0
Geneh	7	150	21.4
Slutung	3	70	23.3
Plampung	5	300	60.0
Geneh	6	210	35.0
Danau payang	4	40	10.0
Suwayang	5	150	30.0
Suwayang	4	120	30.0
Suwayang	3	90	30.0
Suwayang	4	120	30.0
Suwayang	4	120	30.0
Klontong	3	90	30.0
Serajeh	5	150	30.0
Lembo Sading	10	300	30.0
Danau Payang	5	120	24.0
Kliran Bebe	7	150	21.4
Jalan Tambek	6	120	20.0
Haur Geding	8	180	22.5
Jalan Limbang	9	210	23.3
Haur Geding	11	240	21.8
Jalan Inpres	7	150	21.4
Kliran Bebe	3	105	35.0
Telok Capi	8	300	37.5
Kliran Bebe	12	600	50.0
Kliran Bebe	5	210	42.0
Kliran Bebe	3	90	30.0
Geneh	5	150	30.0
Telok Capi	5	150	30.0
Jalan Inpres	3	90	30.0
Kliran Bebe	2	60	30.0
Kliran Bebe	5	150	30.0
Bomen	5	180	36.0
Telok Capi	3	90	30.0
Telok Capi	3	90	30.0
Telok Capi	5	150	30.0
Danau Payang	7	300	42.9
Jalan Inpres	4	150	37.5
Telok Capi	3	90	30.0
Danau Payang	4	180	45.0
Total	**339**	**9,987**	**29.62**

Source: Tuana Toha's local government

3.2.2 Palm Sugar-Making Process

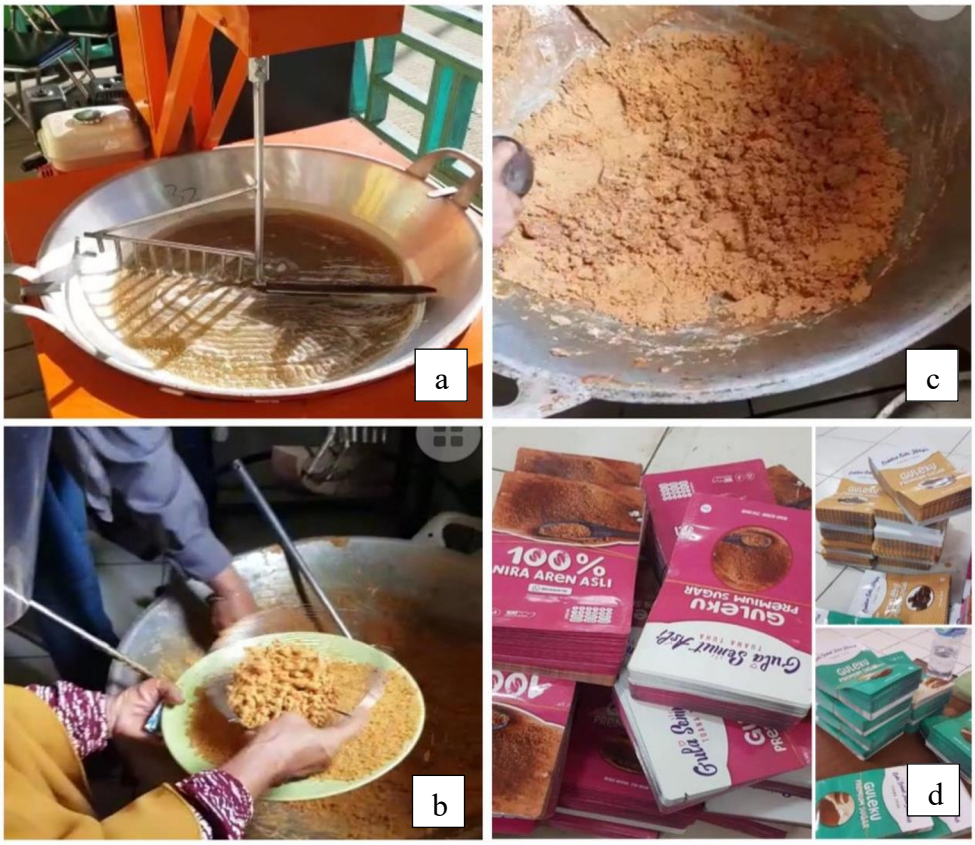
Before tapping palm sap, old palm blossoms called "mayang" are beaten – hit first regularly. In one day, two beating sessions were carried out. In one session, 10-18 strokes are carried out until evenly distributed. After a month of beating, the old "mayang" was propped up and then propped up using bamboo (**Fig.4**). According to respondents, the results of palm sap are suspected to be related to the season. When the river water rises, the sap yield is quite a lot, but the sap yield decreases when the river water season recedes. The sap leads flow into the bamboo installed under the "mayang." So that the palm sap does not sour immediately, the bamboo where the palm sap is distilled/smoked first for 5 minutes. In addition to bamboo, some respondents also used the pipe as an alternative.

The collected sap is cooked in a non-permanent kitchen near the palm plantation. The production cost of making thick palm sugar is quite cheap because the fuel for cooking sap for ± 7 hours uses firewood obtained from the nearest former industrial plantation forest. Using firewood obtained around the village certainly reduces the cost of palm sugar production. According to respondents, laban wood can produce very hot and durable fires. Laban wood is rare, so farmers must buy it for IDR 5,000/log to get it. Ten laban logs are needed or cost IDR 50,000 for fuel in one process of cooking palm sap.

The process of making ant sugar is almost the same as the process of making thick palm sugar; it is just that ant sugar is cooked to a small amount of moisture content so that it is in powder form. The process of cooking ant sugar is slightly longer compared to making thick palm sugar. The process of making ant sugar can be seen in **Fig. 5**. Ant sugar can be sold for IDR 40,000 per kg. Tuana Toha ant sugar products have made several kinds of product diversification. Among them are original ant sugar, ginger ant sugar, and coconut sugar.

Source: Tuana Toha's local government

Fig.4. Palm Sugar-Making Process: a) the process of distilling bamboo and pipe sap water containers b) installation of sap containers c) sap harvesting d) the process of cooking sap into brown sugar with a thick texture e) the palm sugar moulding process.



Source: Tuana Toha's local government

Fig.5. Ant Sugar Making Process: a) the process of cooking palm sap with an automatic stirrer, b) palm sugar with low moisture content so that it is in powder form, c) and sugar sieving process, d) and sugar packaging.

3.3 Stage 2- Distribution

This stage focuses on designing an effective distribution network that ensures the smooth and timely flow of palm sugar products. At present, the marketing of new ant sugar can meet local needs. The promotion has been pursued through social media and the provision of testers to companies, cafes, and exhibitions. Currently, some have been sold through online applications. However, the marketing scope of ant sugar still needs to compete with the price of ant sugar on the island of Java, which can be lower than Tuana Toha ant sugar. The local government is still looking for a Tuana Toha ant sugar market.

Many farmers also use sap water to ferment vinegar and "tuak." The tuak is sold directly to consumers and stalls around the village. One liter of tuak is priced at IDR 5,000 per liter. Farmers who use palm sap for palm juice are only about 4-5 people and only about 10% of the total sap production. Sour palm sap can also be processed for food vinegar. So far,

processing into new vinegar is limited to its own needs, and a small part is sold to the nearest stall. While palm fruit, kolang-kaling, is only used during the fasting month. Apart from Ramadan, kolang-kaling fruit is rarely used due to a lack of market demand. The village government has planned to use kolang-kaling in canned fruit that is more durable. However, this is undoubtedly constrained by the market and processing plants.

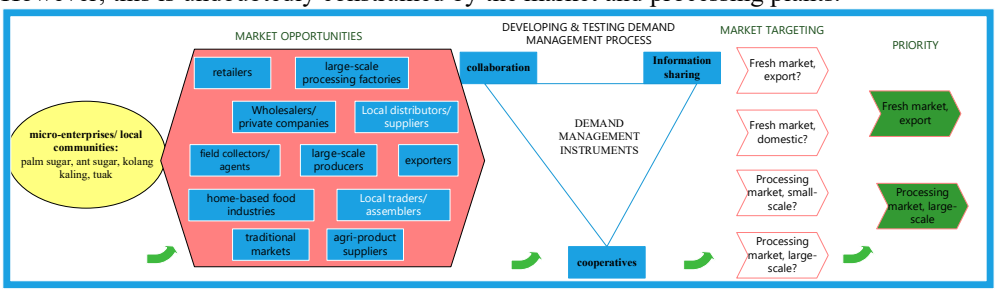


Fig 6. Distribution channels of Palm Sugar

3.4 Stage 3- Diagnosis

The stage involves analyzing the palm sugar supply chain to identify bottlenecks, inefficiencies, and areas of improvement. Several factors influence the productivity of making palm sugar. The first factor is the cooking time of palm sap is done. A small number of farmers cook palm sap daily, but most do not routinely cook palm sap because, in general, this palm sugar business is not the main livelihood of palm crops farmers. Second, each palm farmer's expertise varies, affecting how much palm sugar is produced using the same palm sap and the quality of palm sugar produced. Knowledge related to techniques in stirring sap when cooked, techniques for regulating the temperature of the combustion fire in the cooking process, and techniques for regulating the viscosity of palm sugar has been taught for generations. So that each palm crop farmer produces a variety of palm sugar quantity and quality, an average of 5 liters of sap water can be used as 1 kg of palm sugar.

Conducting thorough demand patterns and forecasting accuracy to identify gaps between forecasted and actual demand. Palm sugar sales carried out by palm crop farmers are diverse, but most palm farmers already have their customers. Some respondents must sell palm sugar to the nearest stall/shop/market. Some respondents wait for subscription buyers who come to their homes. Buyer demand for the quality of palm sugar also varies. Generally, buyers want palm sugar that is light brown. Nevertheless, some also prefer palm sugar which is dark brown-black. Dark brown-black palm sugar is more accessible from the palm farmer's side because it only requires a little palm sap water. Even slightly, sour palm sap produces dark brown palm sugar, which is textually softer than light brown palm sugar. However, the selling price of the two qualities of palm sugar is not much different, approximately IDR 20,000 – 23,000/ kg, because each has its market share.

Assessing the performance of supply chain partners, including techniques, farmer's expertise, and regulation, are to identify areas for collaboration and process improvement. Besides being processed into thick palm sugar, sap water is also into ant sugar. The local government initiated the diversification of ant sugar products. The local government has coordinated with palm crop farmers to sell palm crop products in sap water for IDR 3,000 – 4,000/liter. So those good quality standards are centralized in processing sap into ant sugar. However, unfortunately, this is not welcomed by palm crop farmers. Farmers prefer to preserve hereditary knowledge and local wisdom in making palm sugar as a family business. In addition, farmers already have customers who are still loyal to the production of their palm sugar business. Of course, this is a challenge in developing quality ant sugar

products for Tuana Toha's local government. This ant sugar business is still being pursued, as evidenced by efforts to make P-IRT (Pangan- Industri Rumah Tangga), Health Office permits, and halal logo certification for ant sugar products.

Utilizing data analytics and performance metrics to identify root causes of supply chain disruptions or inefficiencies. The sugar production of ants in Tuana Toha Village reaches 9 tons per month. Tuana Toha ant sugar products already have sufficient quality for export. However, unfortunately, this cannot be done because the requirement for export is a minimum capacity of 27 tons/month. In the future, the export market will be a challenge that must be pursued for the progress of the ant sugar business. Among others, one thing that should be done is establishing an ant sugar business center with quality that meets standards. Business centers can be carried out with the cooperation of several villages in Kutai Kartanegara Regency producing ant sugar.

3.5 Stage 4- Execution

The people of Tuana Toha village face several constraints in more accessibility for the supply chain to meet demand. Because of these points, here are some brief explanations of each execution to achieve better management of that palm sugar and ant sugar commodities. It focuses on instrument opportunities to stabilize the palm sugar supply chain.

3.5.1 Collaboration

Palm sugar production fluctuates wildly, and its supply is erratic in quantity. Collaboration enables better production plans and inventory strategies. Close collaboration with local governments can help build stronger relationships, resolve issues proactively, improve overall coordination, and foster a culture of open sustainability dialogue[11]. Local governments have the authority and opportunities to develop forecasting and inventory on commodities produced by palm plantations. Constructing a palm commodity management center from several villages in the Central Mahakam Region is possible. Although produced from different types of palms, product standardization, and certification can be done to ensure product quality.

Local governments can proactively plan for market fluctuation disruptions and implement measures to ensure the continuity of kolang-kaling and vinegar. Developing the potential of kolang-kaling and vinegar is by building a processing plant at the small and medium enterprises level. It will create order fulfillment processes, avoid stockouts, reduce excess waste, and enhance customer satisfaction for a packaging kolang-kaling and a sour palm sap for vinegar which the community has yet to widely process. Thus, palm crop products' diversification capabilities increase farmers' income and improve the regional economy[12].

3.5.2 Information sharing

The formation of palm sugar and ant sugar centers is constrained because palm crop farmers still maintain traditional manufacturing based on their knowledge. Palm sugar processing is still limited to a hereditary family business with local wisdom. Each farmer could be more diverse and consistent in the quality of palm sugar. So, it fosters the exchange of knowledge, best practices, and technical expertise among farmers and other supply chain partners[13]. It also allows them to have better visibility into each other's operations. This visibility enables traceability, which is crucial for ensuring consistent product quality and safety standards and verifying compliance with regulations throughout

the palm sugar supply chain[14]. In the long run, this shared knowledge helps in better planning, such as adjusting production levels, gathering market intelligence, consumer trends, and demand forecasts, aligning inventory levels, optimizing distribution routes, production methods, certifications, and quality standards, to meet the anticipated demand accurately.

Establishing communication channels and mechanisms to facilitate real-time information-sharing could be in capacity building, empowering farmers with improved agricultural practices, processors with better production techniques, and other stakeholders with relevant skills, ultimately improving decision-making and optimizing supply chain operations[15]. However, data analytics, artificial intelligence, and other technology utilization can help gather targeted promotions and better data analysis, boost sales, improve customer satisfaction, and increase productivity and profitability.

3.5.3 Cooperatives

Palm plantations in Kutai Kartanegara Regency, East Kalimantan, are indicated to have comparative advantages in terms of industrial center potential, raw material availability, and buffer for the new state capital's logistical needs. Nevertheless, a fixed marketer or collector for palm sugar has yet to exist. Marketing is still local in scope, and prices have yet to be able to compete. Therefore, it needs an institutional mechanism that will not only meet the local needs but also intend to address industry challenges[16]. The form of institution that corresponds to this principle is a cooperative. Cooperatives are organizations formed by individuals or businesses who come together to achieve common goals and mutual benefits. In cooperatives' practice, the industrial center allows coordination of their activities more globally, such as adopting new technologies, business models, subscription-based services, or direct-to-consumer sales can help to disrupt traditional supply chain models and achieve greater customer satisfaction.

Farmers and supply chain partners can collectively identify resource allocation in cooperatives, such as diversifying sourcing locations or establishing alternative distribution channels. One of the critical principles of cooperatives is democratic member control, which means that decisions are made collectively, and each member has an equal say in the decision-making process. By pooling resources and cooperating, cooperatives can negotiate better deals and access resources that individual members might need help to obtain. Cooperatives can leverage their collective bargaining power to secure favorable terms for resource allocation, whether procuring raw materials, accessing financing, or obtaining services at reduced costs.

Palm sugar farmers' institution encourages exchanging ideas, innovations, and best practices among other partners. Farmers can drive continuous improvement for the export market by reengineering the cooperative. Farmers can communicate their harvest schedules closely to others, allowing them to plan their production processes accordingly. This synchronized effort hopefully reduces waste, optimizes production capacity, and minimizes inventory holding costs[17]. Moreover, by collectively addressing those issues, cooperatives can proactively plan to streamline transportation routes or share storage facilities, reduce fixed costs such as setup costs, enhance responsiveness to market dynamics, and change consumer preferences. It can promote sustainable farming practices, support smallholder farmers, and ensure fair trade principles to upheld throughout the supply chain[18].

4 Conclusions

Peatland Hydrological Unit has considerable palm plantation potential in several villages. Palm crops can be processed into commodity products such as palm sugar, ant sugar, kolang-kaling, and vinegar. Most palm crops are processed to sell palm sugar. The diverse quality of palm sugar leads to customer segments. Each palm farmer produces palm sugar distinctively and has its customers. It is an obstacle in developing palm sugar commodities to be used as industrial centers. Moreover, another diversification of palm products has yet to be developed optimally.

Following a comprehensive process improvement framework in the functioning of demand management, it integrates the definition stage, distribution stage, diagnosis stage, and execution stage. So, the palm sugar supply chain can adapt to changing demand patterns and stabilize this market demand. In summary, highlighting the importance of collaboration, information sharing, and cooperative interface playing a crucial role in such supply chains, here are some common reasons why these instruments are critical for optimal demand management. Collaboration establishes sustainability, innovation, and diversification that may arise during production capabilities. Information sharing contributes to quality control, visibility, and compliance to respond quickly to changing regulatory conditions. Cooperatives ultimately enable addressing industry challenges, resource allocation, and export considerations.

Acknowledgements. The highest appreciation is given to the PROPEAT project, Indonesia-Germany development cooperation; the Federal Republic of Germany supports the Government of Indonesia (Ministry of Environment and Forestry/MoEF) and related public or private actors in peatland rehabilitation and management in North and East Kalimantan. The research was funded by The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

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