

LEAN AND GREEN SUPPLY CHAIN MANAGEMENT IN IMPROVING OPERATIONAL PERFORMANCE IN SUGAR INDUSTRY

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Abstract: The purpose of this study is to understand supply chain management practices, Lean & Green management, and the integration of Lean & Green Supply Chain Management in PG. Krebet Baru - PG. Rajawali I in improving operational performance in supplier and manufacturing chains. The method used is case study qualitative research through interviews, observation, documentation, document review & corporate websites that produce data analysis. The results of this research data analysis produced the first proposition related to supply chain management practices, namely coordination in the flow of material, information, and finance that is being increased by PG Krebet efforts in maintaining better cooperative relations with farmer groups as suppliers. The second proposition relates to lean management practices, namely the efficiency of human resources and natural resources, reduction of lead time, and reduction of inventory is an activity that can increase added value to the company. The third proposition is related to green management practices, namely environmentally-friendly innovation in the operating system is a strategy to improve the application of environmental management. The synergy between the practice of lean and green supply chain in improving operational performance also results in a fourth proposition, namely the commitment of suppliers (farmer groups) to PG. Krebet will improve company efficiency and environmental performance which may improve product quality and flexibility and reduce costs. Suggestions for further research, which in this case study, can be continued in the entire supply chain from suppliers to consumers to better understand lean and green management practices in all sugar industry supply chain members.

Keywords: Lean Management, Green Management, Supply Chain Management

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The sugar industry in Indonesia is currently unable to fulfill the basic needs of the community due to the inefficiency of sugar mills, decreasing production capacity,

and the decreasing area of sugar cane plantations. Indonesia's national sugar industry has been managed by state-owned enterprises (BUMN) and the private sector, but in practice, the performance of BUMN is far behind compared to the private sector because it is inefficient and produces low-quality

ity sugar with small capacity, old equipment, a large number of employees and operates only 150 days a year. Unlike the case with the growth of the sugar industry which is managed by the private sector, it is currently increasing by prioritizing the concept of environmentally friendly or green technology so that it can strengthen national sugar production. Private sugar mills have an integrated management system from the process of planting, cutting, transporting, to processing. But state-owned sugar mills do not have their land so the supply of sugar cane depends on the sugar cane farmers. Management on land that is separate from milling management makes these sugar mills are not easy to integrate activities: planting, cutting, transporting, and grinding so that the emergence of problems at one point will have a long impact on the next supply chain points. According to Subiyono (2017), the key competitiveness of the national sugar industry is in three things: efficiency, diversification, and optimization (EDO). Improved supply chain management that is currently being developed today is Lean and Green Supply Chain Management (Lucila et al., 2016; Folinasa et al., 2013; Dües et al., 2013; Carvalho et al., 2017; Ugarte et al., 2015). The system approach aims to improve better value for all members of the supply chain through the quality of products and services at the same time by reducing wasteful production and reducing waste that can pollute the environment (Deif, 2011). Some things that distinguish this research from previous research is that there is no consistency of results in the same study between Lean, Green, and Supply Chain Management integration practices when applied together because there are studies that are consistent with the theory and some are not so that this research is interesting to do because the application of an efficient and environmentally friendly supply chain is still not widely practiced in developing countries, especially in Indonesia.

LITERATURE REVIEW

The Lean and Green supply chain are two different paradigms. The difference lies in the goal, where lean practices maximize profits through cost reduction and focus on increasing flexibility through

continuous or not value-added waste elimination throughout the supply chain. Green aims to reduce risks and environmental impacts while increasing the ecological efficiency of organizations and partners (Carvalho & Cruz-Machado (2009); Zhu et al. (2008), and focusing on developing sustainable and ecological impact reduction through the elimination of resource waste and pollution (Carvalho & Cruz-Machado, (2009)). Supplier and consumer relations lean focuses on long-term relationships that are close, collaborative, reciprocal, win-win with selected suppliers (Hines et al., 2004; Carvalho & Cruz-Machado, 2009) and build shared understanding and learning about waste reduction and operational efficiency. The green difference is more about the collaboration between organizations that involves the transfer and/or dissemination of environmentally friendly knowledge to partners, consumer cooperation, and the distribution of environmental risks. Lean product design maximizes performance and minimizes costs while green is more about environmentally friendly designs and life cycle assessments to evaluate ecological risks and impacts (Zhu et al., 2008). The acquisition of sources of raw materials in lean is more concerned with the attributes of suppliers with low costs and high quality, while the green attention to purchases in an environmentally friendly manner (Zhu et al., 2008; Cox, 1999). Reducing costs for lean inventory management is done by minimizing inventory throughout the supply chain and producing high turnover, while green minimizes inventory by reducing redundant materials and using reusable/reproducible parts (Srivastava, 2007). Lean waste reduction techniques focus on eliminating waste in all operational processes arising from excess production, transportation, waiting, excessive processing, defects, and unnecessary inventory and movement while reducing green waste by redesigning products and processes, substitution, prolonged use, demolition, remanufacturing, reduction, internal consumption of by-products, waste separation, and recycling.

METHOD

The method used in this study is a qualitative method with a single-case strategy. This type of

research is a case study research that is based on phenomena that exist in real life. The research process involves collecting data, reducing data, presenting data, interpreting data, and inferring (Yin, 2011). The selection of research locations was purposive in the sugar processing industry, namely PG. Rajawali I - PG. Kabet Baru, located on Jl. Bululawang No. 10, Kabet, Malang Regency, East Java. Information is obtained by conducting interviews and observations that result in the existence of supply chain

practices in PG. Kabet Baru starts from the procurement of sugar cane raw materials to finished products GKP (White Crystal Sugar) based on ISO 9001 certification and environmentally friendly certification from the Environmental Agency, Blue PROPER. The determination of key informants in this study is based on informants who have knowledge in the fields of supply chain management, lean and green management in the PG Kabet Baru.

Table 1. Description of Informant

No	Name and codeInformant	Positon	Considerations / Conditions
1.	Mrs. Arin (A)	Plant Staff (Bina Sarana Tani)	knowing the management and planning, and supervising all activities and processes in the sugar cane plantation unit
2	Mr. Sofyan (S)	Quality Control (On-farm)	Knowing and being responsible for the quality of raw materials received from farmers
3	Mrs. Farah (F)	Quality Control (Off-farm)	Analyzing raw materials until finished products are in the production process
4	Mr. Deni (D)	Manufacturing Staff (KB 1)	Knowing the course of the production process and being responsible for increasing production efficiency and planning programs (KB1 & KB 2)
5	Mr. Bayu (B)	Manufacturing Staff (KB 2)	
6	Mr. Nanda (N)	Financial Management Staff	Knowing the planning and task of coordinating financial activities related to suppliers & distributors
7	Mr. Purnomo (P)	Pure farmer group coordinator	Coordinating sugar cane farmers around the factory to supply PG. Krebs
8	Mr. Warno (W)	Semi-supplier farmer group coordinator	As a PG Kabet supplier who owns the land and has built farmers
9	Mr. Hasan (H)	Supplier farmer group coordinator	As a PG Kabet supplier that does not have their land and only as sugar cane collectors from several farmers

In qualitative research testing the validity of the data to obtain valid, reliable, and objective data using test data credibility for the level of trust in the results of data from qualitative research. According to Sugiyono (2014), there are six ways to test the credibility of the data by extending observations, increasing perseverance, triangulating sources, con-

ducting analysis, using reference materials, and holding a member check. Besides, there is a confirmability test, which is to consult with the supervisor and informant so that the data obtained is relevant. In this study, the researcher used source triangulation and method triangulation. Source triangulation is used by interviewing techniques with

different sources both from farmer groups and sugar factory employees. Then the similarity of informant data is compared with one another and can be used to conclude. Whereas for the method triangulation, namely data collection by interview, observation, and documentation. This is done to obtain information that is consistent with the research objectives.

RESULTS AND DISCUSSION

The Practice of Supply Chain Management at PG. Kreet

Supply chain management practices that occur in PG. Kreet is a mutually beneficial partnership between farmers, PG. Kreet and distributor. Farmers act as suppliers providing raw materials for sugar cane, sugar mills as manufacturers that process sugar cane farmers into GKP (White Crystal Sugar) products, and distributors as determinants of auction prices and sugar buyers produced by PG. Kreet Baru. PG. Kreet Baru in carrying out its business cooperates with farmers around the factory area because around 99% of the raw materials of sugar mills are from sugar cane which is divided into two: the People's Sugar Cane Partnership and the Independent People's Sugar Cane. The farmers are incorporated into farmer groups which are divided into three farmer groups based on the total area of land registered, the number of assisted farmers, and the location of the registered land area. The farmer groups are pure, semi-supplier farmer groups, and supplier farmer groups.

Supply chain activity in PG. Kreet can occur because of coordination and commitment between farmer groups and PG. Kreet. The coordination can be in the form of information for the distribution of farmer groups based on the amount of land, the ability of the amount of sugar cane supply, and the number of farmers who are members of the group. This information is useful for both parties in determining the right contractual agreement, cultivation, and extension of sugarcane cultivation for farmers and scheduling of transporting cuttings. The coordination of the financial flow of the factory in the form of a credit to farmers based on the ability of the amount of sugar cane supply sent to PG. Kreet through a cooperative within one week's normal

credit disbursement. According to Maulidiah (2018), a partnership is a partnership of business which is a business strategy carried out between two or more parties with the principle of mutual need, mutual reinforcement, and mutual benefit accompanied by one development and guidance. The flow of sugar cane raw material from farmer groups to PG. Kreet also requires good coordination because it deals with quality that is following MBS requirements: Ripe, Clean, Fresh. The quality of raw materials must be maintained starting from post-harvest handling to shipping so that the yield produced is high and produces a quality product. If it is not following "RCF", sanctions will be imposed. **Ripe** means the age of sugar cane about 11 months with Brix stem for the initial milled period ($MA \geq 17$ and $BL \geq 15$) rising in stages according to potential. If there is young sugar cane it will be subject to 100% raffia (the sugar note and driver premium are forfeited, the truck is not allowed to send, and the driver card is revoked in the course of one roll). **Clean** means free from dirt. If there is *sogolan* (secondary sugar cane) raffaction of 15% and SPTA is revoked 3x, sugar cane shoots are 5%, shoot rope is 7% and SPTA is revoked 2x, *daduk* / root raffia is 5% and SPTA is revoked 1x, and land receipts are 100% and note the driver's sugar and premiums are forfeited, the truck is not allowed to send, and the driver's card is revoked in one milling period. **Fresh** means sugar cane is felled until it is ground ≤ 36 hours and does not burn. If there is burning sugar cane, then the sugar cane receipts are burnt selectively only for TRK (People's Sugar Cane Partnership) with a time limit of 2 days with an official report. Provisions for burning sugar cane recession burned 1 day, namely rendement reaction not valid but normative weight raffaction. If $> 1-2$ days, it is a reaction ration of 1 kg of farmer's part and a normative weight ratio. If > 2 days, sugar cane is rejected. The sugar cane requirements other than MBS, namely sugarcane, should not be enumerated, if there is a count, it is subject to a 10% raffaction and the SPTA is revoked 2x.

Obstacles to supply chain activities in PG. Kreet is related to coordination, supplier commitment, and waiting time. Financial or credit disburse-

ments to farmers still experience delays because they depend on the distributors who auction. The commitment of farmers who are still lacking in maintaining the quality of raw materials even though the sugar factory plants have made guidance efforts related to the quality standards of raw materials. The loyalty of farmer groups in PG. Kreet is currently also decreasing because the price of sugar cane is too cheap and the quality requirements are too tight, making farmer groups move to other sugar mills. Waiting time for sugarcane queue is also a barrier to the supply chain, namely when sugarcane enters the emplacement (raw material quality control post) because there is still damage to production equipment so that production processes are terminated. The longer the term of the production process, the higher the cost of transporting the cut (OTA). Based on this, Pujawan and Mahendrawathi (2010), reveals that Supply Chain Management seeks relationships and coordination between processes from other companies in the business chain, from suppliers to consumers. Supply chain success is highly dependent on information systems (Pujawan and Mahendrawathi, 2010; Chopra and Meindl, 2004) relating to inventory, transportation, facilities, and consumers throughout the supply chain. Information is potentially the biggest driver of supply chain performance. from the supply chain occurs when all levels from the supply chain work towards the goal of maximizing the total supply chain profits rather than working independently. According to Akbar (2013), good and mutually beneficial cooperation in Supply Chain Management can be done between producers and suppliers and is expected to create a commitment, mutual trust, and mutual openness that will benefit both parties Based on the findings and discussion, the propositions can be determined as follows:

Proposition I: *Coordination in the flow of material, information, and finance that is increasingly being improved are PG Kreet's efforts. in maintaining better cooperative relations with farmer groups as suppliers*

The Practice of Lean Management at PG. Kreet

Improving supply chain management systems by streamlining (lean supply chain) can increase effectiveness and efficiency together in supplier and manufacturing activities by identifying planning, lean management activities, and barriers that occur in PG. Kreet. PG. Kreet conducts the planning phase on improving human resources on manufacturing and improving quality management based on ISO 9001: 2015.

Efforts to achieve efficiency to reduce activities that do not provide added value and which are considered as 'waste' or activities that only lead to excessive costs are carried out by human resource efficiency in manufacturing by maximizing employee empowerment, reducing waiting times for each process (lead time) also by providing a more automated control system with the installation of displays in every part starting from sugar cane emplacement (sugarcane raw material controlling post) to the production section so that it makes it easier for management to make decisions when there is damage or the results of the aberrant analysis. The saving of energy and material usage in the manufacturing section and the absence of storage of sugar cane raw materials are included in the effort in the efficiency of PG Kreet.

The obstacles faced when PG. Kreet strives to do efficiency, among others: procurement of inventory of these tools requires high capital costs and the damage is still frequent due to human error so that it still requires alternative manual equipment to take measurements and analyze each process. Employee commitment is also still low due to a lack of discipline and excessive workload. There are still some employees who ignore SOPs in implementing operational systems. Downsizing in terms of labor will minimize employee wages, but in practice, some employees who are given additional assignments or concurrent positions feel the workload is excessive so companies need to provide motivation. Another obstacle when PG. Kreet is trying to make it efficient, that is, it has not been received by chemical additives produced by manufacturing because it produces quality that is not following SNI. Regarding

lean management practices, according to Ohno (1988), Lean is a production system that prioritizes flexibility and quality by identifying and eliminating non-value-added activities that can increase costs. According to Liker (2006), the addition of non-value activities is characterized by identifying seven non-value-added wastes that are overproduction, waiting for time, unnecessary transportation, processing excessive/inappropriate process overprocessing/incorrect processing, excess inventory, unnecessary movements (motion), and product or system defects. Based on the findings and discussion, then the proposition can be determined as follows:

Proposition II: *Efficiency of human resources and natural resources, reduction of lead time, and reduction of inventory are activities that can increase added value to the company.*

Green Management Practices at PG. Kribet I

Today's industry cannot rule out the existence of the surrounding environment so that a system is needed that can manage the sustainability of the company efficiently but still pay attention to environmental aspects and benefit the company. PG. Kribet has realized this by planning, implementing green management practices, and identifying obstacles that occur when using environmentally friendly systems.

PG Kribet's initial planning before deciding to use an environmentally friendly system was to increase employee knowledge by training and fostering employees about environmental management and forming an internal team that empowers employees in managing liquid, solid, and gas waste. At this stage, PG. Kribet also coordinates with farmer groups about the selection of sugarcane raw materials and post-harvest handling so that factory waste is not excessive.

Environmental management activities in Kribet PG are carried out by applying the terms and conditions of PROPER B and obtaining a Blue rating which means that environmental management efforts are required following applicable regulations and 3R (Reuse, Recycle, Recovery) with assess-

ment criteria related to AMDAL, water, air, and LB3. The application of 3R is Reuse, Recycle, and Recovery in PG. Kribet is one form of innovation in improving environmental management by managing liquid, solid, and gas waste before going out to the factory area. The form of implementing this reuse is the reuse of bagasse from the mill for alternative boiler fuel and the rest supplied to KB2 for fuel. *Blotong* waste management has cooperated with cooperatives and farmers who use it as fertilizer and provided it free of charge. While the use of lime waste to repair roads around the factory area. Application of recycling in PG. Kribet is the reuse of *blotong* waste for charcoal (fire briquettes), reuse of ash waste for fertilizer and paving making. The efforts to recycle waste drops by third parties that will be reprocessed into other products such as soy sauce, MSG, alcohol. The rest of the Stroop additives were also purchased by third parties to be processed into other products (soy sauce, animal feed) so that they had a selling value that could increase revenue for PG. Kribet. The brownish-damaged sugar product when storing in the warehouse is also done by bleaching to be suitable for re-consumption. The recovery effort taken is to modify the unused equipment to be reused in production so that there is no need to procure the equipment again.

Barriers faced by PG. Kribet when conducting environmental management is that the costs incurred will be higher for the needs of CSR and the development of environmental systems that are more "zero waste", there are NGO provocations when environmental pollution is caused by human error during the production process, and supplier commitments that lack material quality so that factory waste can increase. The innovation of reprocessing waste from waste is more useful and has a high selling value that has not been received because of the lack of interest of farmers. Damage to the equipment to prevent air pollution with the installation of positive and negative air catchers on the boiler is still often damaged so that it still harms the community environment. Based on this, Melnyk and Smith (1996), revealed that green manufacturing is an industrial engineering method by minimizing resource consumption and its effect on the environment and

making synchronization with the economy and environmental excellence. Being an environmentally friendly industry can be interpreted as making products in industrial processes that require fewer resources and reduce the influence on the environment so that it becomes the focus of manufacturing companies in various countries (Li et al. 2010). The size of green management has a positive influence on product innovation or processes that are environmentally friendly in the future. The sustainable competitive advantage is well managed through management thinking that always responds and adapts to change, innovation in all aspects such as products offered, the technology used, or systems and structures, with the awareness of the importance of environmental management (greening business), the organization in achieving its goals become more directed, effective and efficient (Krisnanto, 2017). Based on the findings and discussion, the propositions can be determined as follows:

Proposition III: *Environmental friendly innovation in the operating system is a strategy to improve the application of environmental management.*

The Synergy of Lean & Green Supply Chain Management Practices at PG. Krebet Baru - PG. Rajawali I in Improving Operational Performance

Lean and green practices in PG. Krebet can occur synergy when carried out jointly and some don't. Synergy can occur when there is good coordination between suppliers and PG. Krebet in the flow of information, material and financial. The coordination is in the form of information about training and fostering the quality of sugar cane raw material desired by PG. Krebet is the productivity of sugar cane which is increasing every year and following the requirements of quality MBS (Ripe, Clean, Fresh). This is the main focus of PG. Krebet because the productivity and quality of raw materials for agro-industries such as sugar cane plants depend on weather and climate conditions, so training, guidance, and continuous evaluation are needed to be sustainable as a sugar industry. The increase in

yield is also a concern for PG. Krebet because the increase in sugarcane productivity only aims to meet production capacity in the milling period but does not necessarily get high yields or final product yields. The higher the rainfall, the higher the productivity of the land and the higher the weight because the water content in sugar cane is too much so that the yield (sugar content in sugar cane) will decrease and affect the quantity of the final product GKP (White Crystal Sugar) produced. Automatically the distribution of results with farmers is also not optimal because the basis for calculating profit sharing is the yield rate. These activities will also work in synergy with the application of green management to PG. Krebet because the higher commitment of the sugarcane supplier (farmer group) in maintaining the quality of raw materials will reduce the waste buried in PG. Krebet.

Synergy in lean and green supply chain activities can also occur when there is a commitment of suppliers (farmer groups) in adhering to the scheduling of hauling with SPTA (Delivery Letter of Transport Cutting) to be on time in delivery and to precisely meet the amount of production capacity every day. Then the emplacement automation can speed up data analysis and minimize the lead time for each post. When this system is implemented properly, it will also have an impact on green management activities, because the higher the commitment the supplier adheres to the schedule of transport cut according to SPTA, then it will minimize the waste generated during the GKP processing. Corporate relations with suppliers is the strongest collaboration in the value chain or supply chain context (Kanter in Lesatri (2009). Lean and green supply chain management is a supply chain strategy that is based on minimizing costs and the time of the overall supply chain process to increase effectiveness. focusing on optimizing supply chain processes, simplifying and reducing waste and activities that do not provide added value, reducing environmental impacts without reducing quality, performance, or energy use efficiently (Duarte et al., 2011; Srivastava, 2007).

The lean activities and green management in PG. Krebet can run together but not directly related

to supplying chain activities, namely natural resource efficiency in line with the application of 3R. Fuel savings by reuse of pulp as an alternative fuel in generating electricity so that it can save on fuel energy costs such as petroleum. Based on this matter, PG. Kreet has carried out its commitment to implementing ISO 9001: 2015 and Blue PROPER. The benefits of implementing ISO 9001 can have an impact on internal benefits namely increasing continuous improvement and higher employee commitment, while external benefits are increasing potential sales profits because companies will continue to seek or improve certification better to improve competitive advantage. Increasing PROPER certification will also benefit the company to get a loan from the bank when it can implement operational management that is environmentally friendly. However, when the PROPER rating decreases (becomes a Red to Black rating), the company will be closed and cannot operate again. The practice of lean and green has the same obstacles, namely in terms of the cost and efficiency of automatic tools. The procurement of more automated tools and becoming a better environmentally friendly company also requires high costs. This is needed for the needs of "zero waste" internal development and external development such as the implementation of CSR (Corporate Social Responsibility). Lack of tool efficiency because there is still frequent damage to modern tools for analysis and ash catching devices on the chimney to minimize pollution of air coming out of the factory area. Dües et al. (2013), also revealed that determining the best Lean and Green integration by understanding the distinguishing attributes of both such as waste and waste reduction, engineering, human resources and organization, reduction of lead time and supply chain, then obtained results on the measurement of both performances, there are similarities in the tool and practice. The Lean and Green paradigm differences lie in: focus, what is considered as waste, consumers, product design and manufacturing strategies, product flow management, KPI, and dominant costs.

Carvalho et al. (2017), revealed that some management practices for green or lean profits have the opposite effect on the company's environmen-

tal and economic performance. Not all companies incorporated in the same supply chain can carry out lean or green. There must be a compromise in the behavior of individual companies so that the environmental and economic constraints of the supply chain are met. Based on the findings and discussion, the propositions can be determined as follows:

Proposition IV: *Supplier commitment (farmer group) at PG. Kreet will improve company efficiency and environmental performance to improve product quality and flexibility and reduce costs.*

CONCLUSIONS

Lean and Green Supply Chain are management innovations that focus on efficiency and environmental impact. Supply chain implementation in PG. Kreet requires good coordination starting from farmer groups as suppliers to PG. Kreet itself as manufacture. If you can implement this three management, operational performance can increase and you can have a sustainable competitive advantage.

IMPLICATIONS AND LIMITATIONS

This research has theoretical and practical implications. In theory, this research study produced concepts from lean and green supply chain management in improving operational performance found in the agro-industry manufacturing industry especially in the sugar industry to improve organizational performance. While the practical implications are that three things must be done by the sugar factory when the operational performance can run well, these three things include efficiency & effectiveness, all activities that do not add value in each supply chain flow must be reduced or even eliminated, environmentally friendly related to green management, and operations (implementers) related to operational performance.

This study certainly also has limitations, namely: The method used does not distinguish a hierarchy between senior employees or not, and does not get information from informants with Top Manager positions from each part of the organizational structure.

RECOMMENDATIONS

Suggestions for further research, which in this case study, can be continued in the entire supply chain from suppliers to consumers to better understand lean and green management practices in all sugar industry supply chain members.

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