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Article

Mini Review: The Efficiency of Sugar Mills in East Java Province

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Abstract

East Java Province is recognized as one of Indonesia's main producers of the white sugar (plantation white sugar/*gula kristal putih*). However, The closure of these sugar mills raises an important question about the mills efficiency. The urgency of this study lies in the need to develop a comprehensive literature review that synthesizes existing findings on the production efficiency of East Java's sugar mills. The research was conducted in April 2025, using the literature review method. The results shows that the efficiency of sugar mills in East Java Province remains below the optimal threshold, both technically and economically. This inefficiency is caused by several factors, including inconsistent sugarcane supply, outdated factory machinery, and socio-economic challenges such as price policy and the low welfare of farmers. Inefficiency has become one of the key reasons behind the closure of several sugar mills in East Java, particularly those owned by PTPN X and PTPN XI.

Keywords: literature review, sugar mills, white sugar.

1. Introduction

East Java Province is recognized as one of Indonesia's main producers of the white sugar (plantation white sugar/*gula kristal putih*). With a long-standing history in the sugar industry dating back to the colonial era, the province is home to numerous sugar mills that have been operating for decades. Despite its historical significance, many of East Java's sugar mills are now aging facilities grappling with various operational challenges; ranging from outdated technology and declining production efficiency to the rising costs of maintaining old machinery. Furthermore, recent data reveal that several of these mills have ceased operations, due to either an inability to compete in the market or internal management issues [1]–[8].

The closure of these sugar mills raises an important question: what is the current state of efficiency in East Java's sugar industry? Efficiency

plays a critical role in ensuring the sustainability of this sector. Poor efficiency not only results in reduced production capacity, but also affects the livelihoods of sugarcane farmers, who serve as key partners to the mills; and has broader implications for national food security, given that sugar remains one of Indonesia's strategic commodities [4], [5], [8]–[14].

Numerous studies have attempted to examine the efficiency of sugar mills in East Java. However, most of these investigations are limited in scope, focusing on specific mills or isolated case studies. As a result, they fall short of offering a comprehensive understanding of sugar production efficiency across the province. This signals a gap in the literature that must be addressed; a lack of holistic, province-wide analysis of sugar mill performance [5], [9], [10], [15]–[17].

The urgency of this study lies in the need to develop a comprehensive literature review that synthesizes existing findings on the production efficiency of East Java's sugar mills. Filling this research gap is critical, as policy decisions for the development of the sugar industry should not be based solely on individual studies or fragmented case analyses. This review aims not only to provide a broader overview of the current conditions in the sugar industry but also to serve as a vital foundation for formulating more targeted and effective policy recommendations.

This study is guided by three key research questions. First, what does the existing literature reveal about the efficiency of sugar mills in East Java Province? Second Is the inefficiency primarily caused by technical factors, especially by old machines that are no longer optimal? Third, has production inefficiency been a primary cause of the recent wave of sugar mill closures in the region? By clearly articulating these questions, the study is designed to ensure a focused and well-directed discussion.

The novelty of this research lies in its comprehensive literature review approach to understanding sugar mill efficiency in East Java Province. Unlike previous studies that tend to concentrate on individual cases, this study seeks to collect and map all relevant findings to construct a broader, more integrated picture of the white sugar industry's performance in the province.

2. Material and Method

This research was conducted in April 2025, using the literature review method. This method is used to synthesize and connecting numerous thematic empirical research. Furthermore, it is instrumental in identifying sugar factory production efficiency in East Java. The detailed method in this research is outlined below:

1. Identify search keywords for literature searches.
   Key words in this research include keywords in Indonesian:
   a. "*Efisiensi pabrik gula Jawa Timur*", with additional keyword: "*produksi*", "*teknis*", "e*konomi*" and "*biaya*"
   b. "*Operasional pabrik gula Jawa Timur*", with additional keyword: "*penutupan pabrik*", "*mesin*", "*teknologi*", "*revitalisasi*"
2. Identify literature databases and criteria.
   Identify the literature database used, and identify criteria for selecting relevant literature with inclusion and exclusion criteria:
   a. Database: Dimensions
   b. Type of literature: articles in scientific journals
   c. Publication period: 2000 – 2024
3. Extraction and synthesis
   Data and information were extracted using Dimensions data base; leveraging specified keywords, databases, and criteria. Focusing on the top 15 articles for each keyword based on their relevance; with total 42 different articles as materials for this research. Following this, a synthesis of crucial data and information was conducted in alignment with the research objectives (ignore unrelated information and/or literature).

3. Results and Discussion

3.1. The Efficiency of Sugar Mills in East Java

Empirical literature consistently highlights the untapped production potential of sugar mills in East Java. As one of Indonesia's leading centers for white sugar production, the province is home to numerous sugar mills, many of which have been in operation for decades, or even centuries. Most of these mills are owned by state enterprises such as PTPN X, PTPN XI, and PT. Rajawali

Nusantara Indonesia (RNI), while the rest are managed by private companies. However, numerous studies underscore that the installed capacity of these mills has not been fully utilized [6]–[8], [18].

Sugar production in East Java can be significantly increased, approaching optimal levels, through both technical and managerial improvements. Among the most cited areas for improvement are the suboptimal use of farmers' sugarcane land and outdated factory equipment, which reduces both milling capacity and sugar yield [10], [12]–[14], [16], [17], [19].

Currently, the production of white sugar in East Java's mills falls short of efficient benchmarks. Research findings show that average technical and production efficiency in most mills remain below 90%, indicating a substantial margin for improvement. Nevertheless, this does not suggest a complete inefficiency—several mills still manage to perform reasonably well under limited conditions. Efficiency analyses using methods such as Data Envelopment Analysis (DEA) reveal that while a few mills operate near the efficiency frontier, the majority lag behind due to various technical and non-technical constraints [10], [12]–[14], [16], [17], [19], [20].

A major bottleneck to achieving optimal technical and production efficiency is the insufficient availability of sugarcane. Many mills rely heavily on smallholder farmers whose supply is inconsistent in both quantity and quality. Moreover, the majority of milling equipment is over 50 years old and has never undergone comprehensive revitalization. Frequent machinery breakdowns result in prolonged downtime, significantly affecting both daily and seasonal production levels. These intertwined issues prevent factories from achieving the productivity levels their infrastructure is technically capable of [5], [7], [12]–[14], [16], [21]–[33].

This inefficiency directly impacts economic, or cost efficiency. When production processes are suboptimal, the cost per unit of sugar increases, as fixed costs are spread over a lower output volume. Consequently, the cost of producing a kilogram of white sugar rises, reducing the net income of the mill. In addition, the high maintenance costs of aging machinery and other operational expenditures further erode profit margins [5], [7], [10], [12]–[14], [16], [23], [29].

Several strategic interventions are necessary to improve sugar mill efficiency in East Java. First, revitalizing machinery should be prioritized to increase production capacity and reduce downtime. Second, the adoption of high-yield, disease-resistant sugarcane varieties should be expanded to optimize supply. Third, encouraging the planting of new ratoon crops would help ensure a sustainable supply of raw materials for the mills. Finally, strengthening partnerships with smallholder farmers is crucial to create mutually beneficial relationships and establish a more resilient and efficient sugar agribusiness system [5], [7], [12], [14], [23], [24], [26]–[31], [34]–[38].

3.2. Factors Affecting Sugar Mills Efficiency

Multiple factors explain why technical and production efficiency in East Java's sugar mills remain suboptimal. The most critical issue is the availability of inputs, particularly sugarcane. The supply often falls short of the mill's crushing capacity, due to not only harvest fluctuations but also the shrinking area of smallholder sugarcane plantations. This mismatch between supply and capacity means that equipment is underutilized, leading to lower production efficiency [5], [7], [10], [12], [13], [16], [23], [29], [39].

Another key issue is the aged condition of the machinery. Many machines are long overdue for replacement or major repair, but due to limited funding, these actions have not been taken. Most sugar mills in East Java still operate using equipment that has exceeded its optimal service life. The lack of investment, both private and public, has hindered comprehensive modernization. These outdated machines operate inefficiently, require more maintenance, and often suffer from energy and fuel leakage, all of which directly reduce productivity and increase operational costs [5]–[7], [12], [14], [23], [29].

Frequent mechanical failures also disrupt factory operations, reducing overall productivity. Such technical breakdowns not only halt production temporarily but also cause downstream issues; delayed crushing schedules can degrade sugarcane quality and increase the presence of reducing sugars, which lowers sugar yield. Additionally, altered milling schedules disrupt the logistics of raw material delivery and may force mills to change processing locations. These complications add to operational costs and reduce economic efficiency [7], [12], [14], [23].

On the socio-economic side, there are also structural factors influencing sugar mill performance in East Java. These include low farmgate sugar prices, uncertain government pricing policies, and the generally poor welfare of sugarcane farmers. Many farmers are reluctant to grow sugarcane due to its declining profitability, directly affecting the raw material supply to mills. Furthermore, infrastructure issues such as poor roads, labor shortages, and unreliable energy supply further hinder smooth mill operations [10], [12], [16], [24], [30]–[32], [38], [40]–[42].

To enhance mill efficiency, several strategic actions should be implemented, as recommended by prior research. First, factory revitalization is urgently needed, along with farmer development programs to ensure raw material availability. Second, sugarcane intensification—through improved cultivation techniques, high-quality seed, proper fertilization, and better crop management—should be promoted to increase yields per hectare. Third, supportive government policies, such as stable sugar pricing and access to financing for farmers and factories, are critical for the sustainable development of the sector [5], [7], [31], [32], [36], [41], [42], [12], [14], [23], [26]–[30].

3.3. Impact of the Efficiency of Sugar Mills on Mills Operations in East Java

As previously discussed, sugar production in East Java has yet to reach optimal efficiency. While not entirely inefficient, many mills still operate below the production and technical efficiency frontier. This situation presents significant operational challenges, especially amid intensifying competition in both domestic and international sugar markets [5], [7], [10], [12], [13], [16], [23], [29], [39]..

Inefficiencies in production and machinery directly hinder mill operations. Frequent equipment breakdowns and inadequate raw material supply disrupt the production process and prevent output targets from being met. These interruptions lead to additional problems, such as delayed distribution, rising operational costs, and low equipment utilization rates [12], [13], [23].

Beyond operational setbacks, inefficiency also negatively affects cost efficiency. When output fails to match fixed costs, the cost per unit of sugar increases, narrowing profit margins and, in some cases, leading to losses. These challenges are compounded by volatile sugar prices, making it even more difficult for mills to maintain stable income streams [10], [12]–[14].

Over time, persistent inefficiencies have contributed to the closure of several sugar mills in East Java, particularly those owned by PTPN X and PTPN XI. As key actors in the national sugar industry, both companies have had to implement budget efficiency measures, including shutting down unprofitable or non-competitive mills. These closures not only affect the companies themselves but also have serious socio-economic consequences for workers and farmers in surrounding communities [6], [7], [10], [16].

To safeguard the white sugar industry in East Java, urgent and strategic actions are needed. Based on earlier research findings, steps such as machinery revitalization, management restructuring, and the adoption of modern technologies could enhance production efficiency. In parallel, farmer-centered policies such as seed subsidies, technical assistance, and infrastructure improvements are vital. Strengthening the partnerships between mills and smallholder farmers is also essential to ensure the long-term viability of the sugar agribusiness in East Java [5], [7], [31], [32], [36], [41], [42], [12], [14], [23], [26]–[30].

4. Conclusions

The efficiency of sugar mills in East Java Province remains below the optimal threshold, both technically and economically. This inefficiency is caused by several factors, including inconsistent sugarcane supply, outdated factory machinery, and socio-economic challenges such as price policy and the low welfare of farmers. Inefficiency has become one of the key reasons behind the closure of several sugar mills in East Java, particularly those owned by PTPN X and PTPN XI.

Although some mills are still able to operate close to the efficiency frontier, there remains significant room for improvement. To promote the sustainability of the white sugar industry in East Java Province, a range of strategic steps must be urgently implemented. These strategies include revitalization of mills and the machinery, strengthening partnerships with farmers, intensifying sugarcane cultivation, and enacting

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supportive policies that reinforce the sugar industry.

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