TAKING A DEEPER LOOKAT THE PRIORITY OF AGRICULTURAL INDUSTRY EFFICIENCY THROUGH THE USE OF DATA ENVELOPMENT APPROACH

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ABSTRACT

The research aims to analyze the technical efficiency of the chocolate industry, which has outstanding performance in producing chocolate products in East Java, Indonesia. The research sample includes all small and large-scale chocolate industries in East Java, with 42 Decision Making Units (DMUs). Efficiency research uses Data Envelopment

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Analysis (DEA), which is usually used in agricultural production research. However, in this research, DEA was used to analyze the efficiency of the chocolate industry making this concept as an empirical novelty. The analysis results show that there are industries operating at the Constant Returns to Scale (CRS) level (0.971), with a percentage of 66.67%, consisting of 28 DMUs, and the Variable Returns to Scale (VRS) level (0.992), with a percentage of 85.71%, which is represented by 36 DMUs. The Technical Efficiency (TE) is categorized as full technical efficiency at 85.72%, with a high category at 14.28%, and no DMUs fall under the moderate and low categories. This indicates that the allocation of inputs in each DMU is significantly different. Six DMUs require improvement in the distribution of industrial capital and raw materials input to achieve full efficiency category by making decisions based on the DMU's recommendations as a reference (benchmarks). This article concludes that industrial efficiency is a priority for the establishment of a business to achieve its goals easily. When the industry can control the quality and quantity of its products, it can be highly beneficial. The policy implications required for this case research to maintain and improve the efficiency of the chocolate industry in East Java, Indonesia, are for industries to prioritize joint management, increase the scale of operations, increase production frequency, expand innovative chocolate processing technology, prioritize product quality, and be able to penetrate export markets.
Keywords: chocolate industry, Decision Making Unit, industrial efficiency, Data Envelopment Analysis, DEA, East Java, Indonesia

RESUMEN

El objetivo de la investigación fue analizar la eficiencia técnica de la industria chocolatera, que destaca por su rendimiento en la producción de productos de chocolate en Java Oriental (Indonesia). La muestra utilizada incluye todas las industrias de chocolate a pequeña y gran escala en Java Oriental, con 42 Unidades de Toma de Decisiones (DMU). La investigación sobre la eficiencia utiliza el Análisis Envolvente de Datos (DEA), que suele emplearse en la investigación sobre la producción agrícola. Sin embargo, en este caso el DEA se utiliza para analizar la eficiencia de la industria del chocolate, haciendo de este concepto una novedad empírica. Los resultados del análisis muestran que existen industrias que operan en el nivel de Rendimientos Constantes a Escala–CRS (0,971), representadas por 66,67%, formado por 28 DMUs, mientras que el nivel de Rendimientos Variables a Escala (VRS) (0,992), con un porcentaje del 85,71%, está representado por 36 DMUs. La Eficiencia Técnica (ET) se clasifica como de plena eficiencia técnica, con un 85,72%, con una categoría alta del 14,28%,en tanto que ninguna de las DMU entra en las categorías moderada y baja. Esto último indica que la asignación de insumos en cada DMU es significativamente diferente. Seis DMU necesitan mejorar la distribución de los insumos de capital industrial y materias primas para alcanzar la categoría de eficiencia plena, tomando decisiones basadas en las recomendaciones de la DMU de referencia (*benchmarks*). Se concluye que la eficiencia industrial es una prioridad para el establecimiento de una empresa para alcanzar fácilmente sus objetivos. Cuando la industria puede controlar la calidad y la cantidad de sus productos, puede resultar muy beneficioso para ella. Las implicaciones políticas que requiere esta investigación de caso para mantener y mejorar la eficiencia de la industria del chocolate en Java Oriental (Indonesia) son que las industrias den prioridad a la gestión conjunta, aumenten la escala de las operaciones, incrementen la frecuencia de producción, amplíen la tecnología innovadora de elaboración del chocolate, den prioridad a la calidad del producto y sean capaces de penetrar en los mercados de exportación.
Palabras clave: industria del chocolate, Unidad de Toma de Decisiones, DMU, eficiencia industrial, Análisis Envolvente de Datos, DEA, Java Oriental, Indonesia

RÉSUMÉ

L'objectif de la recherche était d'analyser l'efficacité technique de l'industrie du chocolat, qui se distingue par ses performances dans la production de produits chocolatés dans l'Est de Java (Indonésie). L'échantillon utilisé comprend toutes les petites et grandes industries chocolatières de l'Est de Java, avec 42 unités de prise de décision (DMU). La recherche sur l'efficacité utilise l'analyse d'enveloppement des données (DEA), qui est souvent utilisée dans la recherche sur la production agricole. Cependant, dans ce cas, la DEA est utilisée pour analyser l'efficacité de l'industrie du chocolat, ce qui fait de ce concept une nouveauté empirique. Les résultats de l'analyse montrent qu'il existe des industries qui fonctionnent au niveau des rendements d'échelle constants - CRS (0,971), représentés par 66,67%, composés de 28 DMU, tandis que le niveau des rendements d'échelle variables (VRS) (0,992), avec un

pourcentage de 85,71%, est représenté par 36 DMU. L'efficacité technique (TE) est classée comme efficacité technique totale, avec 85,72 %, avec une catégorie élevée de 14,28 %, alors qu'aucune des DMU n'entre dans les catégories modérée et faible. Ce dernier indique que l'allocation des intrants dans chaque DMU est significativement différente. Six DMU doivent améliorer la répartition des intrants de capital industriel et des matières premières pour atteindre la pleine catégorie d'efficacité, en prenant des décisions basées sur les recommandations de la DMU de référence (benchmarks). On en conclut que l'efficacité industrielle est une priorité pour la création d'une entreprise afin d'atteindre facilement ses objectifs. Lorsque l'industrie peut contrôler la qualité et la quantité de ses produits, cela peut lui être très bénéfique. Les implications politiques nécessaires à cette étude de cas pour maintenir et améliorer l'efficacité de l'industrie du chocolat dans l'est de Java (Indonésie) sont que les industries donnent la priorité à la gestion conjointe, augmentent l'échelle des opérations, augmentent la fréquence de production, développent les technologies innovantes de fabrication du chocolat, donner la priorité à la qualité des produits et être en mesure de pénétrer les marchés d'exportation.
Mots-clés : industrie du chocolat, unité de prise de décision, DMU, efficacité industrielle, analyse par enveloppement des données, DEA, East Java, Indonésie

RESUMO

O objetivo da pesquisa foi analisar a eficiência técnica da indústria de chocolate, que se destaca por seu desempenho na produção de produtos de chocolate em Java Oriental (Indonésia). A amostra utilizada inclui todas as indústrias de chocolate de pequena e grande escala em Java Oriental, com 42 unidades de tomada de decisão (DMUs). A pesquisa de eficiência utiliza a Análise de Envoltória de Dados (DEA), que é frequentemente usada em pesquisas de produção agrícola. No entanto, neste caso, a DEA é usada para analisar a eficiência do setor de chocolate, o que torna esse conceito uma novidade empírica. Os resultados da análise mostram que há indústrias que operam no nível de Retorno Constante de Escala (CRS) (0,971), representado por 66,67%, composto por 28 DMUs, enquanto o nível de Retorno Variável de Escala (VRS) (0,992), com um percentual de 85,71%, é representado por 36 DMUs. A Eficiência Técnica (ET) é classificada como eficiência técnica total em 85,72%, com uma categoria alta de 14,28%, enquanto nenhuma das DMUs se enquadra nas categorias moderada e baixa. Esse último indica que a alocação de insumos em cada DMU é significativamente diferente. Seis DMUs precisam melhorar a distribuição do capital industrial e dos insumos de matéria-prima para atingir a categoria de eficiência total, tomando decisões com base nas recomendações da DMU de referência (benchmarks). Conclui-se que a eficiência industrial é uma prioridade para que o estabelecimento de uma empresa atinja facilmente seus objetivos. Quando o setor pode controlar a qualidade e a quantidade de seus produtos, isso pode ser muito benéfico para o setor. As implicações de política exigidas por essa pesquisa de estudo de caso para manter e melhorar a eficiência do setor de chocolate em Java Oriental (Indonésia) são que os setores priorizem a gestão conjunta, aumentem a escala das operações, aumentem a frequência da produção, expandam a tecnologia inovadora de processamento de chocolate, priorizem a qualidade do produto e consigam penetrar nos mercados de exportação.
Palavras-chave: indústria do chocolate, Unidade de Tomada de Decisão, DMU, eficiência industrial, Análise Envoltória de Dados, DEA, Java Oriental, Indonésia

1. INTRODUCTION

The expansion of the impact of the COVID-19 pandemic on cocoa commodities depends on several factors: (i) the demand profile of chocolate in the near future; (ii) the expansion of the pandemic's impact in Ivory Coast and Ghana, which are responsible for about 60% of global cocoa production; (iii) the expansion of economic disruptions to the production and distribution chain; and (iv) changes in the purchasing power of chocolate consumers and its derivatives (CBI, 2020).The point of view (Neilson, 2008) about ten years ago and still relevant today is referred to the dynamics of the specific demand side of the global cocoa industry, which have led to the close involvement of multinational cocoa companies, which have become the main competitors of

local companies (Thomas, 2011).Thus, it is widely accepted that the cocoa industry is highly centralized in the global context, with around 10 multinational companies dominating 70% of the world's cocoa processing industry. Cargill, ADM, and Barry Callebaut are the world's three largest cocoa processors. Evidence that such interconnection occurs is that most large cocoa processing industries are also involved in international cocoa trade.

Taking a closer look at the condition of the processed cocoa agro-industry in the country, most industry players rely on local markets or raw materials with technology that depends on foreign countries. On the other hand, behind the grim impact of the COVID-19 pandemic, it has launched new challenges for the food production chain with cost-saving innovative processes, offering products that are acceptable and economically competitive. An adjustment to this new way of life is in stark contrast to the development of processed cocoa agro-industry in East Java. As stated in the background of the research, long before the pandemic, the issuance of Law No. 18 of 2000 concerning VAT on Primary Commodities, in fact, resulted in the *flop performance* of the processed cocoa agro-industry in international trade, results in relatively small export values.

The alternative strategy to introduce technological innovation into the operations of the processed cocoa industry business is a technology-based strategy that is more practical and requires technological innovation to compete and gain a competitive advantage (Escandon-Barbosa, Rialp-Criado, Fuerst, Rodriguez-Orejuela & Castro-Aristizabal, 2019; Fawole & Ozkan, 2018; Ortigueira-Sánchez, Welsh & Stein, 2022). According to Fahriyah, Hanani & Koestiono (2018) improving technical efficiency also needs to be done through increasing the scale of operations so that input expenditures become more efficient. This argument is consistent with the perspective of industrial efficiency (Campos-García, Muñoz-Bullón, Sanchez-Bueno & Zúñiga-Vicente2020; Nyam, Bahta, Oduniyi &Matthews,2022; Sueyoshi & Goto, 2012). Furthermore, exporting companies are more efficient than others, as companies that have engaged in export activities in their business are able to face greater global market competition (Jekanyika & Freeman, 2009; Mengistae & Pattillo, 2004; Wagner, Phu, Azomahou & Wehrmeyer, 2002). The increase in the utilization of available resources will be able to drive the *industrial competitiveness*, which will improve the commercial activities of companies towards industrial efficiency. The problem of efficiency performance in small and medium-sized industries in East Java, Indonesia, is related to suboptimal machinery and equipment, as their utilization capacity reached its lowest point of 54% in 2019. They should be able to maximize their installed capacity. This case may be caused by other problems that lead to the suboptimal utilization of the factory's capacity.

This research is based on the concept that efficiency in production can be analyzed operationally and technically. The results of this research can answer the hypothesis argument that the chocolate industry in East Java is either efficient or inefficient and the formulation of policy recommendations as the right decision-making to improve efficiency. The problem-solving is analyzed using *Data Envelopment Analysis* (DEA) which characterizes the performance of Decision Making Unit (DMU) through the inputs used and the outputs generated and evaluates qualitatively and quantitatively at the level of DMUs to make the right decision. This concept is a novelty of previous empirical research, so the findings of the study are to analyze technical efficiency in chocolate products in East Java, Indonesia, and formulate chocolate industry policies as suppliers of world chocolate.

2. METHODS

The sample selection for this study used multistage sampling in East Java province, with a total of 42 industries. This study used a non-parametric frontier approach with the Data Envelopment Analysis model (DEAP Version 2.1 program) to measure company efficiency. There are two model assumptions generated from the DEAP program for comparison, namely the CRS (Constant Returns to Scale) model and the VRS (Variable Returns to Scale) model. This study uses the assumption of the VRS scale because it produces a higher

efficiency rating (Banker, Charnes & Cooper, 1984),but also uses the CRS scale as a comparison. The VRS model also assumes that the industry does not operate optimally. Linear programming problems for CRS cases using linear programming are as follows:

$$\begin{aligned} &\text{Min } \theta, \lambda\ \theta, \\ &\text{St } -qi + Q\lambda \geq 0, \\ &\theta xi - X\lambda \geq 0, \\ &\lambda \geq 0 \end{aligned}$$

Where θ is a scalar and λ is a constant vector with size $i \times 1$. θ is the efficiency value for the Chocolate Industry (DMU) to «*i*», and the result will satisfy $\theta \leq 1$. A value of *1* indicates that the DMU is the frontier so it is said to be technically efficient.

The VRS approach is by modifying the convexity constraint into the VRS equation. The convexity constraint ($I1'\lambda = 1$) guarantees that the inefficiency level of the DMU is only a reference for the DMU of the same scale. So that the estimated point of a DMU on the DEA frontier is a convex combination of the studied DMUs and the mathematical equation becomes:

$$\begin{aligned} &\text{Min } \theta,\lambda\ \theta, \\ &\text{St } -qi + Q\lambda \geq 0, \\ &\theta xi - X\lambda \geq 0, \\ &I1'\lambda = 1 \\ &\lambda \geq 0 \end{aligned}$$

Where *I1* is a vector with size $I \times 1$, *I* is the number of DMUs of the Chocolate Industry. The VRS approach produces a technical efficiency score that is greater than or equal to the CRS model. The minimization above is technical efficiency (VRS), the efficiency value is always less or equal to 1. A DMU that has an efficiency value of ≤ 1 means that the DMU is inefficient while a value of = 1 is a DMU that has technical efficiency.

Banker *et al.* (1984) and Coelli, Rao, O'Donnell & Battese (2005) suggest adjusting the CRS DEA model by calculating VRS. The use of the CRS model when not all DMUs are operating at their optimal scale will produce a Technical Efficiency (TE) value that reflects their efficiency scale. The use of the VRS model will enable the calculation (TE) which eliminates the effect of the efficiency scale (Rosihan, 2017).

The results of the DEA analysis can show which DMU is the most efficient. An inefficient DMU can improve its efficiency by using table of peer units DMU. Peers are a group of best practices that become benchmarks for inefficient DMUs that are relatively the same size. Inefficient DMUs can improve their performance by reducing or increasing the amount of slack movement (SM) and radial movement (RM) inputs regularly and proportionally recommended from the results of efficient DMU peers to achieve project value full efficiency.

3. RESULT AND DISCUSSSION

The Central Statistics Agency of East Java Province reported the Food and Beverage Industry data based on Constant Prices by Field of Business in East Java Province (in billion rupiah) in 2018 amounted to 153,219.55 and increased to 182,156.35 two years later[7], and continued to increase in 2021 to 190,726.33. This indicates that over time the existence of the processing industry in East Java has developed after the post-COVID-19 period, particularly the efficiency of the chocolate industry, which plays an important role as a source of income and survival for the community, job creation, and source of income for the region or area.

3. 1. THE TECHNICAL EFFICIENCY INDUSTRY

The analysis results show the level of efficiency in each chocolate industry in East Java. Based on Figure Nº 1, the percentage of technical efficiency on the CRS and VRS scales has an average value of 0.971 and 0.992, respectively.

[7] [Editor's note] It hiked from approximatelyUS$10.53 to 12.52 billion, at the official exchange (12/31/2018) of 14,553 IDR/USD. Source: Bank Indonesia (https://www.bi.go.id/en/statistik/informasi-kurs/transaksi-bi/default.aspx)

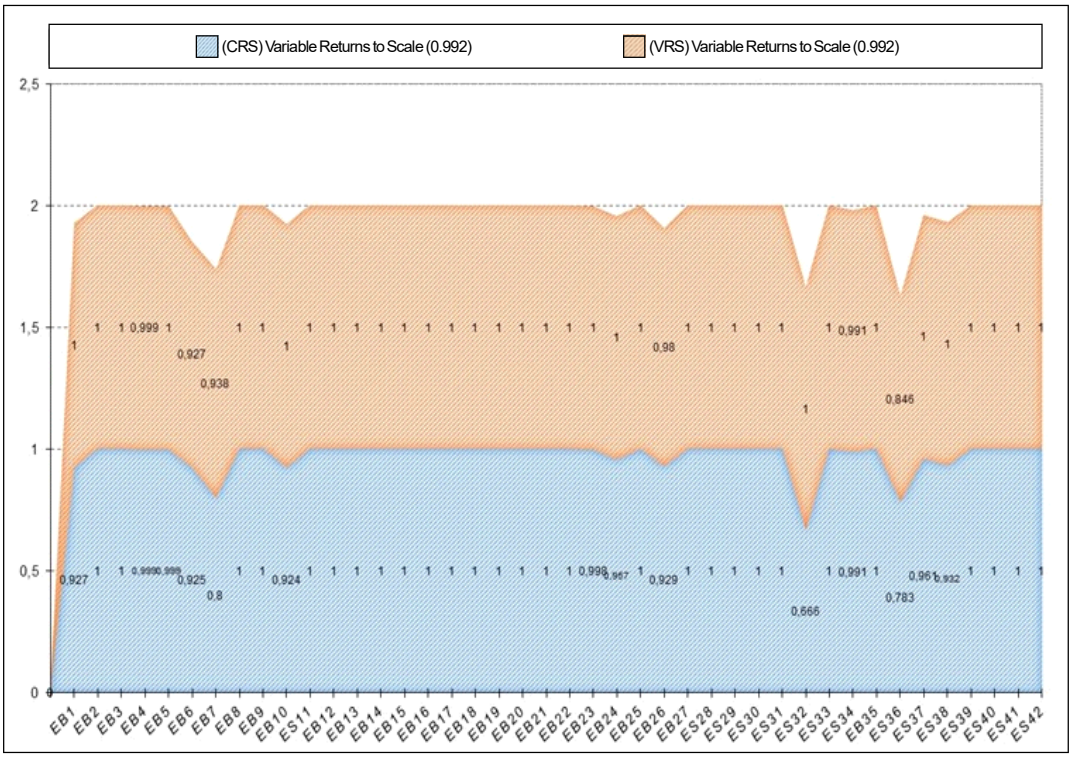

*Figure 1.*Comparison of Technical Efficiency Values using CRS and VRS Approaches

DMUs that are technically efficient in the VRS model are more numerous, accounting for 85.71% of the 36 DMUs, while the VRS model is 66.67% efficient in the 28 DMUs. The range of these results shows that the allocation of inputs used differs in each DMU and there are still many DMUs that obtain the same production results from the addition of input amounts. This condition describes that the performance of the chocolate industry in East Java, Indonesia still needs improvement.

3.2. THE IMPROVEMENT OF THE INDUSTRY TARGET

Some DMUs need to adjust the reduction and addition of chocolate production inputs as shown in Table Nº 1, which indicate the results of Radial Movement (RM) and Slack Movement (SM) values.

Based on the analysis shown in Table Nº1, the general fact obtained is that the most dominant factor in maximizing efficiency in the chocolate industry is reducing labor and capital costs in chocolate production. The greater the inputs of raw materials, labor costs, and capital used, the greater the output of chocolate products produced. Therefore, increasing the use of inputs for production must be balanced, and technological innovation is needed to improve efficiency in the chocolate industry.

3.3. POLICY RECOMMENDATIONS FOR IMPROVING INEFFICIENT INDUSTRIES

The peer-to-peer analysis in the table above provides a comparison of technical efficiency for each DMU, with those in the full efficiency category serving as a reference/benchmark for other DMUs that are not yet efficient using lambda weights for input distribution improvement, as seen in the example of DMU-eb26 in Figure Nº2.

DMU-eb26 used four peer DMUs as a reference, namely DMU (eb-35, eb-19, es-31, and es-39). The RM value resulting from the input of raw materials and industry capital is -20.9. The SM value can be found in the DEA

Table 1
DMU Chocolate Industry Improvement Target

DMU	Chocolate product		Export product		Cocoa Bean		Labor costs		Capital	
	RM	SM	RM	SM	RM	SM	SM	RM	RM	SM
eb1	0	0	0	0	0	0		0	0	0
eb2	0	0	0	0	0	0		0	0	0
eb3	0	0	0	0	0	0		0	0	0
eb4	0	0	0	0	-25.2	0		-2.7	-55.3	0
eb5	0	0	0	0	0	0		0	0	0
eb6	0	0	0	0	-228	0		-409	-609	-210
eb7	0	0	0	0	-290	-372		-327	-608	-147
eb8	0	0	0	0	0	0		0	0	0
eb9	0	0	0	0	0	0		0	0	0
eb10	0	0	0	0	0	0		0	0	0
es11	0	0	0	0	0	0		0	0	0
eb12	0	0	0	0	0	0		0	0	0
eb13	0	0	0	0	0	0		0	0	0
eb14	0	0	0	0	0	0		0	0	0
eb15	0	0	0	0	0	0		0	0	0
eb16	0	0	0	0	0	0		0	0	0
eb17	0	0	0	0	0	0		0	0	0
eb18	0	0	0	0	0	0		0	0	0
eb19	0	0	0	0	0	0		0	0	0
eb20	0	0	0	0	0	0		0	0	0
eb21	0	0	0	0	0	0	0	0	0	0
eb22	0	0	0	0	0	0	0	0	0	0
eb23	0	0	0	0	0	0	0	0	0	0
eb24	0	0	0	0	0	0	0	0	0	0
eb25	0	0	0	0	0	0	0	0	0	0
eb26	0	0	0	110.7	-20.9	0	-3.17	-17.6	-22.6	-514
eb27	0	0	0	0	0	0	0	0	0	0
es28	0	0	0	0	0	0	0	0	0	0
es29	0	0	0	0	0	0	0	0	0	0
es30	0	0	0	0	0	0	0	0	0	0
es31	0	0	0	0	0	0	0	0	0	0
es32	0	0	0	0	0	0	0	0	0	0
es33	0	0	0	0	0	0	0	0	0	0
es34	0	0	0	128.8	-1.36	0	-0.62	-0.73	-1.92	0
es35	0	0	0	0	0	0	0	0	0	0
es36	0	0	0	0	-28.5	-21.6	-11.8	0	-64.6	0
es37	0	0	0	0	0	0	0	0	0	0
es38	0	0	0	0	0	0	0	0	0	0
es39	0	0	0	0	0	0	0	0	0	0
es40	0	0	0	0	0	0	0	0	0	0
es41	0	0	0	0	0	0	0	0	0	0
es42	0	0	0	0	0	0	0	0	0	0
∑1a+1b	0	0	0	239.5	-594	-393	-1.232	-757.3	-1.361	-871

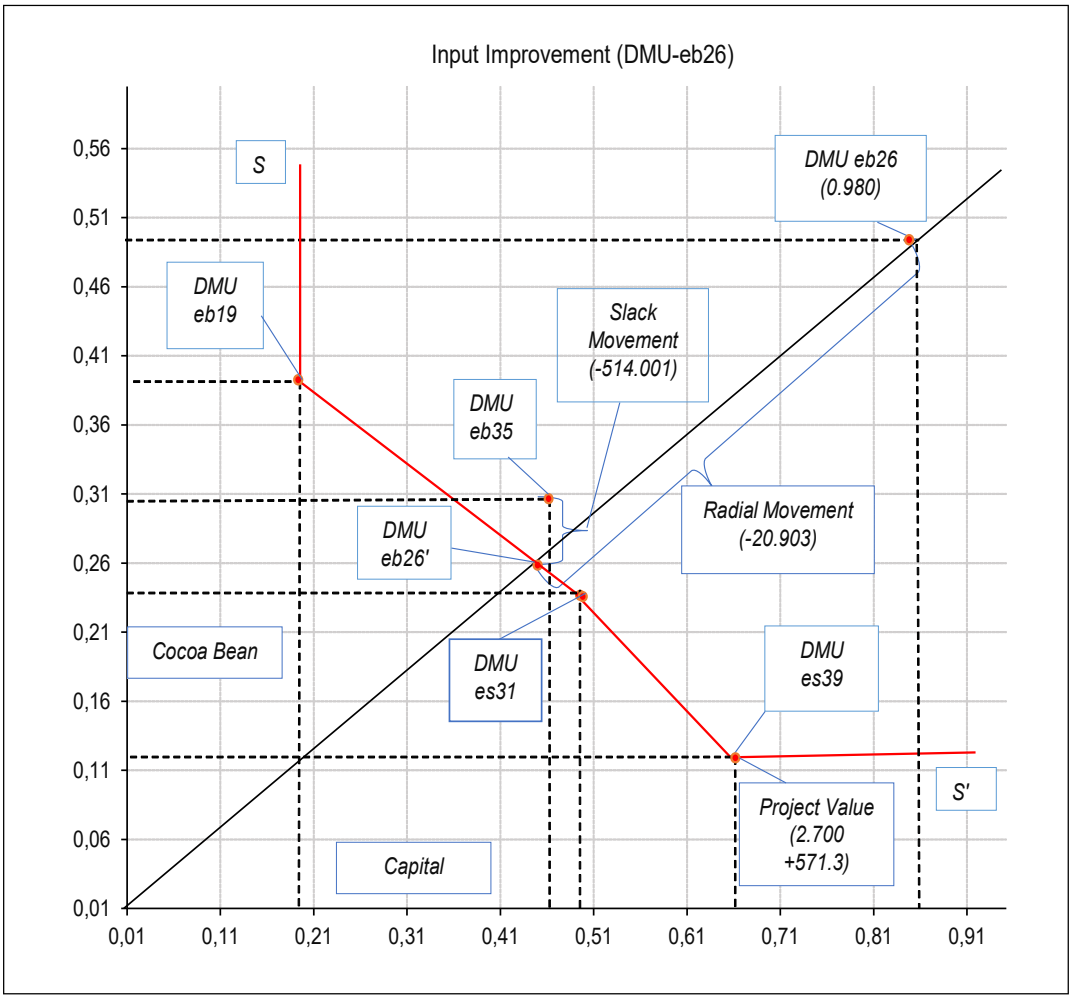

Figure 2. Peer simulation for DMU-eb26 improvement

CRS analysis for DMU-eb26, where there is a value of -514 in order to produce optimally approaching DMU peers with lambda weights (0.063, 0.011, 0.100, 0.825). Meanwhile, DMU-eb35 will form an S' isoquant curve and not intersect with the PV point of DMU-39 because it has the lowest *lambda weight* of 0.063.

DMU-es39 is the efficient benchmark DMU, which has the highest efficiency value towards all available factors, thus making it the most stable DMU in utilizing inputs to produce outputs. DMU es39 will remain relatively efficient in the future unless there are significant changes in inputs or other conditions, such as a significant increase in raw material prices that force suppliers to lower the quality of raw materials. This is one way to minimize input production costs based on the DEA efficiency principle. However, this step cannot be taken at the expense of quality. The hypothesis in DEA analysis has differences in the use of input data. Assumption that CRS has highly efficient *peers* with larger or unbalanced production scales compared to VRS assumption, is equivalent to what has been studied (Coelli *et al.*, 2005; Zhou, Tan, Li & Gao, 2021). This assumption may not

necessarily apply to other industries, considering that each industry uses different input and output variables.

4. CONCLUSION

The concept of technical efficiency used as a reference in this research was introduced by Farrell in 1957, with a focus on the measurement of efficiency concept(Coelli *et al.*, 2005) by observing fixed input-output ratios and comparing them with other DMUs. This research is based on the theory of production, in which each economic agent seeks to maximize profits and/or minimize costs. This technique is very important to be used to measure industrial performance and as the basis for decision-making (Rosihan, 2017; Rosihan, Fahriyah & Hanani, 2017). Industrial efficiency can boost the export performance of the industry to take advantage of economies of scale in the global market. This article presents the results of technical efficiency analysis on various chocolate industries, but due to space limitations, the names and efficiency values of all companies are not displayed. Raw material factors, labor costs, and capital affect the technical efficiency of the chocolate industry. In the performance of the chocolate industry, the factor that greatly influences is the industrial capital.

The volume of processed cocoa imports in East Java has increased, which is due to the majority of DMUs not operating due to the inconsistency of cocoa upstream, resulting in a lack of raw material supply. This is caused by the impact of the global crisis due to the COVID-19 pandemic that hit the world in 2020-2022. On the other hand, the volume of processed cocoa exports from the province of East Java, Indonesia, decreased from 134,156.03 kg/US$ to 112,456.38 kg/US$ in 2021. However, the decline in export volume did not occur drastically, and processed cocoa exports from East Java were able to increase again in 2022 to 136,698.99 kg/US$. This statement is supported by the results of research conducted by [19] which stated that the increase in chocolate products produced was the result of strengthening the effectiveness of cocoa upstream empowerment which is a comparative advantage of East Java cocoa, based on the results of the calculation of competitiveness (RCA) of processed cocoa commodities with a value of > 1 which means that East Java chocolate products have competitiveness (Harya, 2020; Nurhadi, Hidayat, Indah, Widayanti & Harya, 2019). This case proves that an industry that produces efficiently will enable the company to survive in critical conditions due to the impact of the global crisis. This condition shows that the DMU in East Java is capable of export orientation.

The necessary policies to improve the efficiency of the chocolate industry in East Java, Indonesia, are joint management to increase the scale of the business, as well as increasing the frequency or production capacity, expanding innovative chocolate processing technology so that the resulting products are of high quality and able to meet the demand for foreign chocolate products. This statement is supported by the results of research conducted by Indah, Harya, Fatma, Pratiwi & Widayanti (2018), and Harya, Indah, Sudiyarto, Widayanti & Pratiwi (2018). Improved chocolate quality, higher export volumes, stable export prices, the creation of industry clusters, easier technology and access to capital, deregulatory policies, and infrastructure development are all necessary to increase the existence of the chocolate industry.

The research findings provide a concept of innovation, which is the use of Data Envelopment Analysis (DEA) in measuring efficiency, which is commonly used in agricultural business production research. However, in this research DEA is used to measure industrial efficiency. This research is supported by empirical research from Flórez *et al.* (2012), to demonstrate the importance of paying attention to inputs in order to improve the export results of products using the DEA model. Capital support can be utilized to measure the efficiency of the industry (Attipoe, Jianmin, Opoku-Kwanowaa & Ohene-Sefa, 2020). According to Campos-García, Muñoz-Bullón, Sanchez-Bueno & Zúñiga-Vicente (2020), this tests the impact of exports and the interaction effects of efficiency for each export that tends to streamline the company's workforce to achieve full industrial

efficiency, as well as the idea of Attipoe *et al.* (2020), and Moral-Pajares, Mozas-Moral, Bernal-Jurado & Medina-Viruel (2015), regarding labor is an appropriate factor for calculating efficiency. However, these results contradict the findings of previous research conducted by Goyal, Singh, Kaur & Singh (2017). In conclusion, industrial efficiency can be achieved by prioritizing total industrial production, export revenues, and gross domestic product (GDP). The results of this research indicate that maintaining industrial efficiency can be achieved by considering raw materials and capital, rather than solely focusing on the industrial production factor or the products produced. This research concludes that industrial performance efficiency plays a crucial role in the future sustainability of the chocolate industry. When the industry can maintain the quality and quantity of inputs and outputs, this study can serve as a basis for in-depth review of industry efficiency and resource management to improve industrial efficiency.

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