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Robusta coffee (*Coffea canephora*) value chain in East Java, Indonesia¹

La cadena de valor del café Robusta (*Coffea canephora*) en el Este de Java, Indonesia

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ABSTRACT:

Introduction. Coffee plantations are one of the growing agriculture sub-sectors and a high coffee production should be based on proper processing and marketing. **Objective.** To analyze the updates of products, processes, functions, and upgrading of the robusta coffee value chain in East Java. **Materials and methods.** This study was conducted in the Robusta coffee plantations in the Bondowoso, Jember, Lumajang, Pasuruan, Malang, and Ngawi districts in East Java, Indonesia, between October 2019 and March 2020. The quota sampling technique was used, followed by surveys and interviews. The number of respondents was 120 people who were actors in the coffee value chain, such as farmers, coffee cherry collectors, coffee cherry grinders, green bean grinders, and consumers. **Results.** The results showed that product, function, and channel upgrading had a significant effect on the coffee value chain, but the upgrading process did not significantly affect it in several regions on East Java. **Conclusions.** There is a need for innovation to enhance the coffee value chain in order to deliver future benefits to all stakeholders in this market.

KEYWORDS: coffee bean, commodity value, farmers, upgrading, value chain.

RESUMEN:

Introducción. Subsectores de agricultura en crecimiento son las plantaciones de café y una alta producción de este cultivo debe basarse en adecuado procesamiento y comercialización. **Objetivo.** Analizar las actualizaciones de productos, procesos, funciones y canales de actualización de la cadena de valor del café robusta en Java Oriental. **Materiales y métodos.** Este estudio se realizó en los distritos de Bondowoso, Jember, Lumajang, Pasuruan, Malang y Ngawi, al este de Java, Indonesia, entre octubre de 2019 y marzo de 2020. Se utilizó la técnica de muestreo por cuotas, seguida por encuestas y entrevistas. El número de encuestados fue de las 120 personas actoras en la cadena de valor del café, como agricultores, recolectores, molinillos de cereza de café, molinillos de granos verdes y consumidores. **Resultados.** Los resultados mostraron que la mejora del producto, la función y el canal tuvieron un efecto significativo en la cadena de valor del café, pero el proceso de mejora no lo afectó significativamente en varias regiones de Java Oriental. **Conclusión.** Existe una necesidad de innovación para mejorar la cadena de valor del café a fin de brindar beneficios futuros a todas las partes interesadas en este mercado.

PALABRAS CLAVE: grano de café, valor de los productos básicos, agricultores, modernización, cadena de valor.

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INTRODUCTION

The agricultural sector is closely related to the industry (Puja Puspito et al., 2016). The link between the agricultural and industry needs to be directed towards the development the downstream and the reinforcement in the upstream of the value chain. One of the agriculture sub-sectors is coffee plantations. The development of the coffee commodity encourages farmers to be more active in cultivation to increase their yields. The high value of coffee production must be balanced with proper processing and marketing activities to maximize its value. Various roles have led to a supply chain pattern, which includes the product, information, and financial flow. However, there are several problems in coffee-producing areas, namely low yields, weak farmer organizations, and limited government support (Neilson et al., 2015). Farmers only receive around 3.4 % to the final price of coffee in Indonesia (Taufik et al., 2018), while exporters and roasters received around 29 % and 62.5 %, respectively. The difference in price at the farm and grinding facility shows the imbalance in the value chain.

Value chains in products are the activities from raw materials to after-sales, including between suppliers (supplier linkages) and consumers (consumer linkages). They are separate activities but very dependent on one another (Kaweera et al., 2019). A value chain consists of various roles (main producers, processors, traders, and service providers) in such a way as to maximize the value (Hober & Schaarschmidt, 2017). Meanwhile, the value chains implementation to smallholders will increase the benefits and support their rural community in an inclusive way (Briones, 2015). The underutilized value chain consists of upstream distributors, farmers, collectors, downstream distributors, traders, primary grinders, wholesalers, retailers, and consumers (Bandula et al., 2016). Value Chain Development (VCD) focuses on the relationship formed between all parties by ensuring a sustainable pathway (Donovan & Poole, 2013).

Value chain analysis is an activity to understand the series of businesses that create value of the product, by considering the contribution of the entire series' activities (Simatupang et al., 2017). One of which is the process of upgrade. It is an investment for a company to achieve a higher level of efficiency, product range, or reaching new markets and profits. Several upgrades can be done in some of the coffee value chain parts, like product, functional, process, and channel improvements.

The value chain is an activity that can provide additional benefits for each production process until the consumers receive the best product (Aimin & Shunxi, 2011). The additional value in a product is the difference between the product's value and the value of raw materials with other inputs without labor cost (Bille et al., 2013).

Production activities not only transform input into an output but also create additional values. It is important to understand the added value to make the production activities efficient. The existence of diverse products is a form of agricultural commodity transformation.

Process upgrading can be done by improving the performance of product distribution to consumers. The upgrade can be done in all production activities, such as coffee cultivation, coffee plant maintenance, coffee cherry plantations, coffee cherry grinding, green bean grinding, roasting, grinding, packaging, and marketing. It is expected to obtain the complete quality standard with an efficient cost.

The existence of globalization has led to the modernization and the creation of a single market all over the world (Stellarosa & Ikhsano, 2015). Furthermore, the digitalization of a product will impact its resilience and adding benefits (Gan et al., 2015; Centerholt et al., 2019). The orientation in business processes is not only local but also global nowadays. The global value chain approach consists of design, production, marketing, distribution, and service to the final customer, which allow this approach to gain more integrative advantages in the transaction cost theory (Rousseau et al., 2015; Șerbănel, 2015). In its implementation, all the involved parties must prepare a strategy to compete in the global market.

In preparing a proper strategy, value chain analysis provides several advantages to help in decision-making. After the civet coffee agro-industry evaluation in Lampung Province, it showed that the coffee agro-industry

is profitable and feasible to be developed (Noviantari et al., 2015). The partnerships with various parties are more profitable for coffee farmers when compared to farmers without partners (Permatasari et al., 2017). Furthermore, value chain analysis could have different characteristics on the specific time, commodity, and region. It will be beneficial to find the specific value that a company needs to confront the different customers. A study of the Robusta coffee (*Coffea canephora*) value chain is necessary to analyze how product, functional, process, and channel upgrading factors influence the coffee value chain in East Java.

The objective of this research was to analyze the updating of products, processes, functions, and channels upgrading of the Robusta coffee value chain in East Java.

MATERIALS AND METHODS

This research was done in the Robusta coffee plantation (*Coffea canephora*) in six districts of East Java, Indonesia (Bondowoso, Jember, Lumajang, Malang, Pasuruan, and Ngawi) from October 2019 until March 2020. Besides, if the selected area had a coffee grinding industry managed by their own agriculture groups, it becomes another important consideration for selection. A descriptive-quantitative method by observation, survey, and interview was used in this study. The total respondents were 120 people, 20 from each district. The interviewed respondents were selected by a quota-sampling technique according to their skill and competency in coffee cultivation, grinding, marketing, and consumer. The interviews aimed to collect the management process and challenges in the Robusta coffee value chain.

The dependent variable was the improvement strategy (Y). While the independent variables were: a) product upgrading (X1), which consisted of X11 (productivity enhancement through the use of superior seeds), X12 (quality improvement in plant maintenance), and X13 (quality improvement of the processed products through proper roasting method); b) process upgrading (X2), which consisted of X21 (quality enhancement of human resources), X22 (quality improvement by red coffee bean selection), and X23 (quality improvement of coffee beans by limiting impurities to 4 % per kg); c) functional upgrading (X3) that was indicated by X31 (value-added improvement); and d) upgrading channel (X4), which consisted of X41 (entering the local market), X42 (regional market), and X43 (national market).

It has previously been hypothesized that product, functional, process, and channel upgrading factors are necessary to be analyzed for the coffee value chain on Robusta coffee plantation in East Java. The hypothesis was ignored (null (H0) accepted) if the $p\text{-value} \geq \alpha=0.05$, while H1 (product upgrading), H2 (functional upgrading), H3 (process upgrading), and H4 (channel upgrading) hypotheses were accepted if each of them had $p\text{-value} \leq \alpha=0.05$.

The obtained data were analyzed by Warp-PLS 6.0 version, that is software created by Ned Kock to answer the research goal using a reflective construct based on convergent validity, discriminatory validity, and composite reliability test (Kock, 2013). The evaluation had a model fit test, path coefficient, and R2. The model fit test was carried out before testing the significance of the path coefficient and R2. This model fit test was used to determine whether a model had a match with the data. There are 3 test indices in the model fit test, namely average path coefficient (APC), average R-squared (ARS), and average variance factor (AVIF). APC and ARS were accepted if $p\text{-value} < 0.05$, while AVIF were accepted if $p\text{-value} < 5$. The results of the path coefficient and R2 could be seen in the direct effect of the data processing results. The path coefficient was used to find how big the path coefficient value was. R2 could be used to determine how strong the independent variable affected the dependent variable.

Product upgrading

The additional value is the increase in the commodities' raw materials value due to the additional input or further processing in the production flow. Besides, the concept of additional value in the supply chain is a series of activities. The relationship of each role is determined by its value to the customer (Asrol, 2018).

H₁: Upgrading product has an impact on the value chain.

Functional upgrading

There are many benefits from transforming agricultural commodities into certain products, such as form change (form utility), allowing longer storage (time utility), providing convenience in transportation, and maintaining the nutritional value in these commodities (Dewi & Susanto, 2013).

H₂: Functional upgrading has an impact on the value chain.

Process upgrading

The process upgrading must be carried out to increase the quality of the coffee. There are a variety of approaches to improve value chains, smallholder capacities, and challenges. Some challenges for coffee farmers are land ownership, credit guarantees, small scale, labor challenges, technological advances, cooperative action principles and practices, business skills, the environment, and the concept of social and economic sustainability (Donovan & Poole, 2014).

H₃: Process upgrading has an impact on the value chain.

Channel upgrading

Value creation can be done through collaboration in all value chain parts (Kähkönen & Lintukangas, 2012). Coffee supply chain characteristics consist of the cycle ratio of coffee availability, producer satisfaction, retail, or customer satisfaction (Horvat et al., 2015). The government can facilitate direct online sales for farmers (O'hara & Low, 2020), and the integrated management system implementation (Simon et al., 2012).

The existence of a standard and certification system can support the marketing activity (Millard, 2011). The value chain will be successful if it can be done in partnership with various parties (Simatupang et al., 2017).

H₄: Channel upgrading has an impact on the value chain.

RESULTS

Product upgrading

The results showed that product upgrading had a significant positive impact on the value chain (Y) with a track coefficient value of 0.355 (p-value = 0.001) (Table 1). Product upgrading includes the quantity, quality, and additional value improvement of the product from the raw material (coffee cherries) and its processed product, from green bean to powder.

TABLE 1

Results of the study of upgrading products, processes, functions, and channels of robusta coffee (*Coffea canephora*) value chain in the Bondowoso, Jember, Lumajang, Pasuruan, Malang, and Ngawi districts in East Java province based on data processing with WARP PLS 6.0. Faculty of Agriculture, Agribusiness Department, Universitas Pembangunan Nasional Veteran East Java Republic of Indonesia. October 2019 - March 2020.

Hypothesis	Path	Path Coefficient	P Values	Standard of Error for Path Coefficient	Effect Size For Path Coefficient	Significance
H1	Product →value chain	0.355	<0.001	0.091	0.216	p<0.05 Significant (H1 accepted)
H2	Functional upgrading →value chain	0.264	0.003	0,093	0.152	p<0.05 Significant (H2 accepted)
H3	Process upgrading →value chain	0.074	0.227	0.098	0.042	p>0.05 Non-Significant (H3 rejected)
H4	Channel upgrading →value chain	0.222	0.011	0.095	0.110	p<0.05 Significant (H4 accepted)

Cuadro 1. Resultados del estudio de la actualización de productos, procesos, funciones y canales de la cadena de valor del café robusta (*Coffea canephora*) en los distritos de Bondowoso, Jember, Lumajang, Pasuruan, Malang y Ngawi en la provincia de Java Oriental, basados en el procesamiento de datos con WARP PLS 6.0. Facultad de Agricultura, Departamento de Agronegocios, Universitas Pembangunan Nasional Veteran East Java, República de Indonesia. Octubre 2019 - marzo 2020.

Functional upgrading

According to the results, the functional upgrading positively impacted the value chain (Y) with a coefficient track value of 0.264 (p-value =0.003) (Table 1).

Process upgrading

The process upgrading did not affect value chain (Y) with a track coefficient value of 0.074 (p-value =0.227) (Table 1).

Channel upgrading

Lastly, channel upgrading positively impacted the value chain (Y) with a track coefficient value of 0.222 (p-value =0.011) (Table 1).

DISCUSSION

The results of the present research indicates that product upgrading can be done to increase the coffee quality and quantity through good maintenance, NPK (nitrogen, phosphorus, and potassium) fertilizer application, pest and disease control, and branch cutting. The coffee beans' quality can be increased further by semi-washed fermentation; hence, it could fulfill GMP (Good Manufacture Practice). The processing should be done in a condition with good hygiene and sanitation. The coffee pericarp waste could be used as animal feed. It is imperative to improve the quality of Robusta coffee products, particularly in roasting and packaging time. Also, it is important to better understand supply chain management as a quick solution and improving internal information sharing (Shakerian et al., 2016). The supply chain should compete with all competitors. This needs a larger and better systemic approach to reach sustainable entrepreneurship. Hence, all supplier chain members could contribute to a supply chain.

Functional upgrades results showed its profit to increase benefits in value chain processes. The quality of green beans is the key to adding value as well as roasted coffee. Coffee quality can be expressed in the compositions, such as physical, biochemical, and organoleptic. Some of the antioxidant components were

slightly reduced during roasting (Sualeh et al., 2020). The company's task is to find the solutions that can provide additional value to customers because they are one of the parts with increasing value (Matzler et al., 2013).

In this study, the functional upgrade was carried out in the coffee grinding process. The improvement in the dry coffee bean into the ground coffee process can increase the product's additional value by 41.89 % (Olechno et al., 2021) and 42.97 % (Puspita, 2013). There will be challenges in the coffee trade system in the future, so constant innovations must be carried out to increase its value and ensuring the success in the coffee business. Some innovations could be in the form of processing into ground coffee, instant coffee, roasted coffee, mixed coffee, dipped coffee, various packaged coffee drinks, and other derivatives to compete in the market (Reswita, 2016). Improving the quality of green beans or cherries can be done by a semi-washed or dry process (both fermented and non-fermented) that meets a good quality standard, thereby increasing the farmers' bargaining power.

Channel upgrading is when companies try to enter one or more domestic, regional, and global end market with similar main products. It should be assisted by farmers for constant innovation and improve the management from upstream to downstream to enter the competitive international market. Therefore, good cooperation and design among public sector governance and institutions are needed.

In this case, the Department of Agriculture in six districts in East Java, coffee farmers, and the private sectors have to play a role in Robusta coffee handling so the process can run well. However, the farmers need more attention because they are the main actors in the coffee trade system. The concept of community empowerment, which is relevant to farmers, includes creating an atmosphere that allows the potential of the community to develop (enabling), strengthening the potential or the power of the community (empowering), and protecting it (Makmun, 2017). This empowerment effort is done by increasing the level of education, health, access to information, and technology while also the construction of physical infrastructure and training. The government's role is crucial to increasing farmers' welfare by increasing their productivity (Kolapo & Kolapo, 2021). Furthermore, the channel upgrading of other parties should be followed up and needs to be continuously developed.

Productivity and quality were chosen as process upgrading metrics. Productivity was not cited as one of the benefits of adopting the 4C standard (consumer wants and needs, cost of satisfying, convenience to buy, and communication) by any of the producers. This may emphasize the difficulties of focusing solely on the adoption of the 4C standard and its implications on productivity. According to the interviews, the 4C standard primarily relates to basic requirements for regulating and monitoring property resources. In general, the producers focused on cost reduction through pesticide purchasing, handling, and storage regulations. Better input management and property organization minimize expenses while also improving coffee bean quality (Humphrey & Schmitz, 2000; Souza Piao et al., 2019).

It's important to note that the company's green initiatives were designed to lessen environmental consequences both within and beyond its walls, namely at suppliers and consumers. Empirical evidence suggests that green strategies enable the firm to achieve economic benefits in terms of both its operations and market strategy – lowering production costs, improving competitive position, and entering new markets – and its value chain position – increasing bargaining power with value chain partners or entering new value chains. This data validates the global value chain framework's applicability in understanding the impact of green measures. Green strategies influenced value chain governance not just through encouraging players to deepen their relationships in order to produce green innovations, but also in Robusta coffee estates in East Java. Cooperation with upstream partners, in particular, appears as being crucial primarily for product upgrading, whereas process upgrading entails more downstream cooperation (Bandula et al., 2016; De Marchi et al., 2013).

This study has a limitation on the study area with only six out of the thirty-eight districts in East Java, so the results in this range may be different if it was carried out in another area. In addition, the different climates

in the Robusta coffee plantation area could change the quality of coffee beans so the product, functional, process, and channel upgrading strategy might be different from area to area.

CONCLUSION

Product, functional, and channel upgrading have a positive impact on the value chain of Robusta coffee in several areas in East Java. In contrast, the process upgrading does not have a significant impact. Robusta coffee has good prospects in line with the increasing demand in East Java. Therefore, it is necessary to have good handling from the upstream to downstream with a strategic approach to improve the product value -product upgrading and increasing the product's quality and quantity. Then, the process upgrading strategy improves the quality of human resources, picking, and grinding process. Besides, functional upgrading increases the additional value and the channel upgrading can expand the market.

These Robusta coffee growers often have older coffee plants; aside from being inadequate in plant maintenance, harvesting, and post-harvest handling. As a result, it is necessary to intensify socialization through counseling with the hope that coffee farmers would become more advanced in their understanding of coffee farming. In this scenario, certain places have the old coffee plantations with young plantations. Better variety, appropriate planting methods, regular and planned fertilization, pest and disease treatment is only performed when an assault arises, frequently trims branches and twigs, then harvests ripe red coffee cherries.

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NOTES

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