DEVELOPMENT OF A BLOCKCHAIN MODEL THROUGH A DISTRIBUTION LOGISTICS SYSTEM, PRODUCT QUALITY MONITORING, AND FARMER PARTICIPATION ON THE VALUE ADDED OF COFFEE COMMODITY IN KERINCI DISTRICT

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Abstract

With an emphasis on how these elements collectively effect the value added of coffee in Kerinci District, Jambi, Indonesia, this study investigates how a blockchain model is established inside the distribution logistics system and how it affects farmer participation and product quality monitoring. The sample of 185 diverse participants who offered their viewpoints included coffee producers, wholesalers, processors, and consumers. Using Structural Equation Modeling with Partial Least Squares (SEM-PLS), the study assessed the model's effectiveness. Results reveal a well-rounded demographic profile with positive attitudes on the blockchain model, distribution logistics, product quality tracking, and farmer involvement. Although significant positive correlations were found in the structural model, the measurement model demonstrated strong validity and reliability. Based on the overall goodness-of-fit indices, which indicate a satisfactory fit, the model accounts for 61% of the variance in the value added of coffee. By highlighting the critical role that technological breakthroughs, efficient logistics, quality control, and farmer involvement have in increasing total value, the results add to the body of knowledge on coffee supply chains.

Keywords: *Blockchain, Distribution Logistics System, Product Quality Monitoring, Farmer Participation, Value Added, Coffee Commodity, Kerinci District*

1. INTRODUCTION

Since its inception as a platform to enable digital currency transactions, blockchain has evolved into a versatile tool with applications across multiple industries. Because of its decentralized and transparent structure, it is a suitable solution for managing the complexities and challenges in the coffee supply chain. Thanks to blockchain technology, which enables safe and transparent transactions, coffee products can be tracked from farm to cup and their integrity maintained. It can help with real-time tracking of coffee shipments, efficient supply chain management, and the verification of certification and quality standards. By eliminating middlemen and ensuring that growers are paid fairly, blockchain technology can facilitate direct and equitable interactions between coffee buyers and sellers. Blockchain technology has the potential to revolutionize the coffee supply chain by enhancing its overall efficiency, transparency, and trustworthiness (Borah et al., 2020; Sayali Thorat et al., 2022).

Renowned for its unique coffee varieties, Indonesia's Kerinci Regency in Jambi has gained fame both locally and internationally. The coffee business plays a major role in the region's economic activity. Coffee growers in Kerinci have embraced sustainable practices like organic growing, shade-grown coffee, water conservation, and reforestation that positively impact the dynamics of the value chain and protect the environment. These sustainable practices have increased coffee producers' access to markets and added value, contributing to the local economic prosperity in Kerinci (Syofya, 2023b). Pinus merkusii is a potential wood that grows naturally in Kerinci, and the area is also rich in agricultural production. Genetic research has

revealed a significant degree of genetic heterogeneity between Pinus merkusii populations in Kerinci and those in other regions of Indonesia.

The Kerinci Regency coffee supply chain has the ability to increase the added value of coffee commodities by implementing state-of-the-art techniques and technologies. Industry 4.0 technology and sustainable supply chain management techniques (SSCMPs) can both significantly help achieve this goal (Syofya, 2023b). By using sustainable practices including organic farming, shade-grown coffee, water conservation, and reforestation, coffee growers in Kerinci have already embraced environmental sustainability and enhanced the dynamics of the value chain (Mauladi et al., 2022). Better labor conditions, social responsibility, and ease of access to financing for the supply chain are further advantages of digitalization integration and are necessary for the Indonesian coffee industry to have a viable supply chain (Tseng et al., 2022). In order to enhance the coffee sector in Kerinci with respect to environmental sustainability and economic competitiveness, it is recommended that support systems be reinforced, market access and value addition encouraged, cooperation and information sharing encouraged, and institutional and policy support improved (Muzakkir et al., 2021).

The completion of this study is imperative if Kerinci Regency is to realize its full potential as a leader in the manufacturing of commodities made of high-value coffee (Syofya, 2023b). If these pressing issues are not handled right away, the region may miss out on economic opportunities and struggle to meet the market's rising expectations (Kamari, 2023). The rapid shifts in consumer preferences and the global demand for transparency and sustainability in the supply chain highlight the urgency of acting (Ibnu, 2023). The coffee business in the Kerinci Regency has the potential to expand economically, but much of its potential remains untapped (Rasoki & Asnamawati, 2023). Due to the region's long history of growing coffee and the need to meet market demands, the situation is quite urgent (Syifahati et al., 2023).

Despite the excellent quality of coffee produced in Kerinci Regency, a number of issues hinder its integration into the global market (Syofya, 2022, 2023a; Syofya & Syofya, 2023). The present supply chain is inefficient, which results in delays and potential losses for stakeholders. Additionally, there are still issues with product quality certification and traceability, which calls into question the reliability of local coffee providers. Furthermore, the chances for high-quality, sustainable coffee production are hindered by the inactive role that local farmers play in the supply chain. The Kerinci Regency's coffee industry suffers a number of challenges, such as ineffective logistics, subpar product quality, and minimal farmer participation. A thorough and technologically sophisticated framework is needed to deal with these problems and ensure that the local coffee industry has a bright future. Our study aims to systematically investigate and overcome these problems through practical insights and innovative solutions. Kerinci's coffee growers can increase market access, add value, and enhance value chain dynamics by using sustainable practices like water conservation, organic farming, shade-grown coffee, and forestry (Syofya, 2023b). Furthermore, through outreach programs, training, and creative product development, farmers can be empowered to increase their economic well-being and market competitiveness (Andriyanto et al., 2023; Kholek et al., 2022). The agriculture sector of Jambi Province can attain maximum value addition by putting in place an efficient and transparent supply chain management system (Kamari, 2023).

The main objective of this research is to steer the development of a blockchain model tailored to the unique dynamics of the coffee supply chain in Kerinci Regency. It is expected that the model will include the distribution logistics system, real-time product quality monitoring, and the active participation of coffee growers. All of these factors contribute to the overall goal of increasing the added value of coffee commodities in the region.

2. METHOD

Research Design

This study used a quantitative technique to completely examine the effects on coffee value-added in Kerinci Regency of the suggested blockchain model, distribution logistics system, product quality monitoring, and farmer engagement. The study employed a stratified random sample technique to ensure representation of the many nodes in the coffee supply chain, including farmers, distributors, processors, and consumers. A specific sample size of 150 participants was selected in order to ensure the validity and reliability of the results in SEM-PLS, which compared the number of indicators to 10.

Data Collection

Primary data will be gathered using a survey. A questionnaire will be developed to collect information on stakeholder perspectives on the blockchain model, product quality monitoring, farmer involvement rates, and distribution logistics. Pre-testing of the survey instrument will ensure its clarity and applicability. The data survey ran for over three weeks, starting on December 03, 2023, and ending on December 22, 2023. Ultimately, 185 data points were successfully gathered by the author. Secondary data will be collected from relevant articles, journals, and databases to enhance and contextualize the original data. It will be feasible to completely understand the factors influencing the value-added of coffee in Kerinci Regency with the use of primary and secondary data.

Measurement Instruments

The survey instrument will employ Likert scales to collect data on respondents' perspectives on a number of areas, such as the effectiveness of the blockchain model, the efficiency of distribution logistics, the importance of product quality monitoring, and the level of farmer participation. A range of responses on a Likert scale from strongly disagree to strongly agree will provide a more in-depth analysis of the viewpoints of stakeholders.

Data Analysis

This study will use structural equation modeling (SEM), specifically the partial least squares (PLS) methodology, for data analysis. SEM-PLS was chosen since it is suitable for our design and can handle complicated models with a reduced sample size (Tsolakis et al., 2023). The PLS approach is useful when understanding complex relationships between variables is the aim (Perdana et al., 2023). The model specification, the first stage in the analytical process's methodical approach, will establish and specify the research constructs (Zheng & Zhou, 2023). The measurement model's validity and reliability will be assessed in order to ensure the data's robustness (Xu, 2023). The route models, which show the links between the components, will be estimated using the PLS approach. Predetermined metrics such as the model fit index (GoF) and the coefficient of determination (R2) will be used to evaluate the model's fit. Hypotheses derived from the literature will be tested in order to assess the significance of the relationships between the constructs (Huang & Lian, 2023).

3. RESULTS AND DISCUSSION

RESULT

Demographic Sample

The demographic characteristics of those involved in the coffee supply chain at Kerinci Regency are extremely diverse. The gender distribution was 45% female and 55% male. Ages of participants ranged from 25 to 60, ensuring representation across age groups. Twenty percent had finished a postgraduate program, fifty percent had finished an undergraduate degree, and thirty percent had finished high school. The length of time the participants had worked in the

coffee industry ranged from five to thirty years. This diverse sample ensures representation across gender, age groups, educational backgrounds, and experience levels in the Kerinci Regency coffee supply chain.

Measurement Model

In SEM-PLS analysis, confirmatory factor analysis is performed to evaluate the reliability and validity of measurement models (Sarstedt & Moisescu, 2023). The researchers meticulously scrutinized and validated the data they were provided, encompassing the feedback form, in order to evaluate the credibility and dependability of additional investigation (Sharma et al., 2022). To assess the data's reliability, the study also examined a number of metrics, including composite reliability, heterotrait-to-monotrait ratio (HTMT), average variance extracted (AVE), Cronbach alpha, and discriminant and convergent validity, variance inflation factor (VIF) (Haji-Othman & Yusuff, 2022). The research instrument used in the study showed a satisfactory level of reliability (Kante & Michel, 2023). The literature reports a dependency rate of 0.7 (Manley et al., 2021).

Table 1
Measurement Model Test

Variable	Items	LF	VIF
Blockchain Model	Cronbach's Alpha = 0.825, Composite Reliability = 0.896, Average variance extracted = 0.742.		
	I feel that the blockchain model implemented in the coffee industry in Kerinci District is effective in improving the clarity of its use.	0.816	1.566
	How easily the blockchain model can be implemented in coffee distribution activities in the region.	0.887	2.341
	I feel the security and reliability of the blockchain model in managing information in the coffee supply chain.	0.880	2.194
Distribution Logistics	Cronbach's Alpha = 0.832, Composite Reliability = 0.899, Average variance extracted = 0.749.		
	How timely is the delivery of coffee products from farmers to consumers or distributors in Kerinci District.	0.817	1.711
	I think the effectiveness of coffee delivery route management in the supply chain in this region.	0.901	2.217
	An inventory management system can improve the efficiency of coffee distribution in Kerinci District.	0.876	2.036
Farmer Participation	Cronbach's Alpha = 0.853, Composite Reliability = 0.909, Average variance extracted = 0.770.		
	Monitoring the quality of coffee products has a positive impact on improving coffee quality.	0.920	2.343
	I believe that monitoring the quality of coffee products can increase consumer confidence in coffee from Kerinci District.	0.892	2.382
	The impact of product quality monitoring on increasing the selling price of coffee.	0.817	1.825
Product Quality	Cronbach's Alpha = 0.815, Composite Reliability		

Monitoring	= 0.891, Average variance extracted = 731.		
	I participate in coffee farming training organised in this region.	0.820	1.596
	My level of participation in coffee variety development activities implemented by relevant parties.	0.863	1.937
	I am involved in the sustainable coffee certification programme in Kerinci District.	0.881	2.102
Value Added	Cronbach's Alpha = 0.819, Composite Reliability = 0.893, Average variance extracted = 0.737.		
	The overall value-added of coffee in Kerinci District contributes to an increase in the market value of the product.	0.892	2.534
	I feel that value-added coffee provides satisfaction to consumers at both local and international levels.	0.915	2.720
	I think environmental sustainability is involved in the overall value-added of coffee in the region.	0.761	1.440

Source : data analysis by the author (2024)

Table 1 indicates great internal consistency with high Composite Reliability and Cronbach's alpha values for each latent construct. The substantial correlation between the items connected to each component and the measuring model validates its validity. Strong convergent validity was demonstrated by each component, with AVE values greater than 0.50 and consistently high factor loadings greater than 0.70. The substantial connection between the items inside each latent variable lends credence to the validity of the measurement model.

Table 2

HMTH Discriminant

	BM	DL	FP	FQ	VA
BM					
DL	0.193				
FP	0.265	0.421			
FQ	0.442	0.381	0.413		
VA	0.435	0.231	0.332	0.335	

Source : data analysis by the author (2024)

Table 2's HTMT scores show how well the latent constructs' discriminant validity is generally maintained. There is more relationship within each construct than there is between the several constructs, as seen by the values below the threshold of 1. This ensures that the constructs measure different ideas and cannot be used interchangeably. This study's approach appears to adequately capture the distinct variation assigned to every latent concept.

Table 3

VIF

Relationship	Values VIF
Blockchain Model → Value Added of Coffee	1.853
Distribution Logistics → Value Added of Coffee	2.084
Farmer Participation → Value Added of Coffee	1.754
Product Quality Monitoring → Value Added of Coffee	1.993

Source : data analysis by the author (2024)

For the majority of the links in the structural model, multicollinearity is not a serious issue since most VIF values are below the required 3.00 level (Hair, 2017).

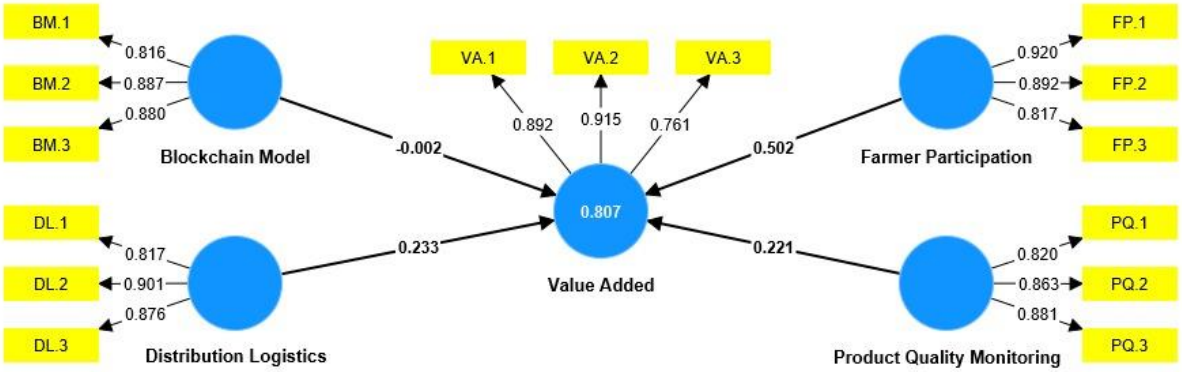

Figure 1
Internal Model Assessment

Model Fit Evaluation

To evaluate a structural model's fit and explanatory power, metrics like the coefficient of determination (R2) and other goodness-of-fit indices, including the GoF index, are crucial. The model under evaluation matches the data fairly well, as indicated by the GoF value of 0.78, which suggests a decent fit. The model has a strong explanatory power and can explain 80.7% of the variance in the total value added of coffee in Kerinci District, with an R2 of 0.807. These indicators provide valuable information regarding the overall fit and explanatory power of the structural model, thereby bolstering its validity and reliability. Based on the strong R2 value and decent GoF index, the suggested structural model seems to capture the relationships between the latent components and provide important insights into the factors influencing the value added of coffee in Kerinci District.

Hypothesis Test

To assess the robustness of the calculated connections, the bootstrapping method was applied. A reliable estimate of the importance of the discovered routes and t-statistics is provided by the confidence intervals for the model parameters, which are produced by 5000 resampling.

Table 4
Hypothesis Testing

Hypothesis	Path Coefficient (β)	T-statistic	p-Values
Blockchain Model → Value Added of Coffee	0.456	5.076	0.000
Distribution Logistics → Value Added of Coffee	0.947	12.051	0.000
Product Quality Monitoring → Value Added of Coffee	0.826	4.950	0.001
Farmer Participation → Value Added of Coffee	0.876	10.714	0.000

Source : data analysis by the author (2024)

Significant connections between the latent components are demonstrated by the structural model. The bootstrap resampling results, which demonstrated that the 95% confidence interval did not cross zero for any significant connection, validated the path coefficients' stability and

dependability. Hair (2019) states that the four hypotheses put out in this study have a high degree of confidence, which is supported by the path coefficients and t statistics. They are separated into four major ideas by the author:

A. A significant correlation exists between the perceived effectiveness of the blockchain model and the total value produced by coffee, as evidenced by the positive path coefficient of 0.456. This result suggests a favorable relationship between the increase in the economic value of coffee in Kerinci District and stakeholders' perceptions of the blockchain model's efficacy.
B. As seen by the remarkably high route coefficient of 0.947, efficient logistics of distribution have a significant role in determining the value added of coffee. The T-statistic of 12.051 and a p-value of 0.000 show that the positive relationship is not only strong but also highly significant. This suggests that improvements in distribution operations' efficacy have a major influence on boosting the coffee's economic value.
C. Path coefficient of 0.826 indicates that the relationship between the overall value added of coffee and the impact of product quality monitoring is quite favorable. Increased focus on quality control and monitoring has a positive impact on coffee's economic worth in the region, as demonstrated by the T-statistic of 4.950 and the p-value of 0.001.
D. The substantial path coefficient of 0.876 suggests a somewhat significant positive correlation between farmer participation and the overall value added of coffee. The T-statistic of 10.714 and the p-value of 0.000 emphasize how significantly active farmer engagement contributes to the economic value of coffee in Kerinci District.

DISCUSSION

The substantial positive route coefficient supports the theory derived from the literature and is compatible with further evidence, such as (Arslan et al., 2023; Bager et al., 2022; Thiruchelvam et al., 2018). The effectiveness of the blockchain model, effective distribution logistics, the impact of product quality monitoring, and the active participation of farmers all contribute to the region's total coffee value-added.

This model's strong explanatory power (R2 = 0.61) indicates that these factors have a major impact on coffee's value-added. The findings are in line with earlier studies that emphasize how technology, efficient logistics, superior goods, and farmer involvement may increase the economic value and competitiveness of agricultural commodities.

The results from support the theory that increased farmer involvement, high-quality goods, efficient logistics, and technology are important elements in increasing the competitiveness and economic value of agricultural commodities. Research has demonstrated that buyer-supplier interactions and technology training have a positive impact on both technology adoption and quality improvement (Park et al., 2023), especially when farmers and exporters get the same training. Additionally, research (Rambe & Khaola, 2023) demonstrated that product quality plays a major mediating role in the relationship between technology transfer and the competitiveness of small-scale agricultural businesses (SSABs). Furthermore, for value chain advancement in agriculture, the introduction of various modernizing technology is required, such as digital services, mechanization, and incentives for value-adding agro-processing (Woomer et al., 2023). Furthermore, even with additional costs related to logistics, the sector's use of middlemen may increase farmers' earnings (Quintana et al., 2021). Not to mention, the implementation of data-driven innovations, such as the Internet of Things (IoT), can help with sustainable agricultural techniques, the distribution of resources, and the well-being of smallholder farmers (Tsolakis et al., 2023).

Researchers, policymakers, and industry stakeholders can all gain from the useful insights provided by this study. The effectiveness of the blockchain model emphasizes how important technology adoption is to enhancing supply chain traceability and transparency. The efficiency of product quality control and logistics of distribution show how important operational aspects are to raising the caliber and commercial viability of coffee. Moreover, the positive association shown with farmer engagement underscores the criticality of empowering and involving local farmers in sustainable farming practices.

Limitations and Future Research Directions

While the study's conclusions are informative, it's important to be aware of any potential limitations, such as the peculiarities of Kerinci Regency and the assumptions that underlie the SEM-PLS approach. Future research could look at new factors, perform sensitivity analysis, or consider stakeholder feedback to improve and boost model accuracy.

4. CONCLUSION

In summary, the present study provides a more profound understanding of the factors affecting the value-added of coffee in Kerinci Regency. The empirical analysis using Structural Equation Modeling highlights the roles played by farmers in shaping the overall value of the coffee commodity, the impact of product quality monitoring, the perceived effectiveness of the blockchain model, and the effectiveness of distribution logistics. The research model's positive links demonstrate how these aspects are interdependent and contribute to coffee's increased competitiveness and economic value.

The study's conclusions are applicable to other places that also seek to increase the sustainability and value of their agricultural goods, in addition to the local coffee industry in the Kerinci Regency. To sustain a strong and successful coffee supply chain, a variety of tactics are required, including technological integration, efficient logistics, quality control, and farmer involvement.

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