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Analysis of Plant Productivity, Farmer Income and Availability of Supporting Infrastructure on Soybean Agribusiness Institutional Performance in East Java

Iwan Harsono[1], Luluk Fadliyanti[2], Baiq Saripta Wiji Mulawiani[3], Abdullah Usman[4], Abubakar[5]
[1,2,3,4]Universitas Mataram
[5]Universitas Singaperbangsa Karawang

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ABSTRACT

This research investigates the dynamics of soybean agribusiness in East Java through the lens of crop productivity, farmer income, supporting infrastructure, and institutional performance. A sample of 150 participants representing diverse scales of farming and geographic regions was surveyed to gather insights. Structural Equation Modeling with Partial Least Squares (SEM-PLS) was employed to analyze the relationships among variables. The study confirmed positive and significant associations between crop productivity and farmer income, supporting infrastructure and crop productivity, and supporting infrastructure and institutional performance. Discriminant validity was established, and model fit indices indicated the reliability of the proposed structural model. Hypothesis testing further validated the impact of the availability of supporting infrastructure, farmer income, and plant productivity on institutional performance. The findings offer practical insights for policymakers, farmers, and stakeholders to optimize soybean agribusiness in East Java.

Corresponding Author:

Name: DR Iwan Harsono, SE., M.Ec
Institution: Universitas Mataram
Email: iwanharsono@unram.ac.id

1. INTRODUCTION

Soybean cultivation in East Java, Indonesia is crucial for the region's economic landscape. It serves as a staple crop and a significant source of income for local farmers. The success of soybean agribusiness in the region depends on several interconnected factors. Firstly, crop productivity plays a vital role in ensuring a sustainable soybean industry [1]. Additionally, farmer income is a key factor in determining the viability of soybean cultivation, as it directly impacts the financial well-being of farmers and their ability to invest in their farms [2]. Lastly, the availability of supporting infrastructure, such as transportation and warehousing facilities, is essential for efficient soybean production and distribution [3]. These factors collectively contribute to the overall success and growth of the soybean agribusiness in East Java.

The dynamics of elements such as yield, farmer income, and supporting infrastructure significantly affect the efficiency of the soybean supply chain in East Java [4], [5]. Challenges faced by soya cultivation in the region include fluctuating yields and variations in farmers' income [6]. In addition, the adequacy of supporting infrastructure, including transport networks and storage facilities, plays an important role in the overall institutional performance of soybean agribusiness [7]. To improve the efficiency of the soybean supply chain and address these challenges, strategies need to be developed that focus on increasing yields, stabilising farmers' incomes, and investing in the development of supporting infrastructure [8]. These strategies should aim to create a stronger and more efficient soybean agribusiness system in East Java.

Addressing these challenges requires a comprehensive analysis that considers the intricate relationships among crop productivity, farmer income, and the supporting infrastructure within the institutional framework of soybean agribusiness.

The overarching goals of this research encompass a comprehensive examination of various facets within the soybean agribusiness in East Java. Firstly, the study aims to assess Soybean Crop Productivity by scrutinizing the current status and identifying factors that either facilitate or impede optimal yield. This involves a thorough evaluation of agricultural practices and environmental factors influencing soybean crop outcomes. Secondly, the research delves into the Analysis of Farmer Income, seeking to understand the complex interplay of market dynamics, pricing structures, and the impact of government support programs on the financial aspects of soybean cultivation. Finally, the study aims to conduct an Evaluation of Supporting Infrastructure, focusing on the availability and adequacy of critical elements such as transportation, storage, and processing facilities that contribute to the overall efficiency of the soybean agribusiness in the region. By addressing these objectives, the research endeavors to provide a holistic understanding of the soybean industry in East Java, offering valuable insights for both policymakers and stakeholders in the agricultural sector.

2. LITERATURE REVIEW

2.1 Soybean Agribusiness in East Java

Soybean cultivation in East Java has played a crucial role in ensuring food security and providing income for local farmers. The sector has evolved in response to market dynamics, technological advancements, and policy interventions [9]. However, soybean farmers face various challenges, including yield fluctuations, pest infestations, and market uncertainties [8]. Previous studies have highlighted the need for specific strategies to adapt to local conditions, such as the development of area-based soybean cultivation and the use of site-specific soybean cultivation technology [10]. Additionally, the impact of programs and activities aimed at increasing soybean production on meeting soybean needs and farmer participation has been evaluated [11]. Furthermore, research has shown that the administration of rhizobium can significantly affect the growth and production of soybeans, with higher concentrations resulting in higher yields [12]. Overall, these studies provide insights into the challenges and strategies involved in soybean cultivation in East Java. Understanding the historical trajectory provides a foundation for assessing the current state of soybean agribusiness in East Java.

2.2 Crop Productivity

Studies examining the productivity of soybean crops have identified several key determinants. These include soil quality, climatic conditions, pest management and crop varieties. The variability of soybean yields in East Java can be attributed to the diverse agroecological zones and different levels of agricultural practices among farmers. In particular, advances in seed technology and sustainable farming practices have shown promise in improving soybean productivity [13]–[17]. However, gaps persist in understanding the localized factors influencing crop productivity in East Java.

2.3 Farmer Income in Soybean Cultivation

The economic viability of soybean cultivation is influenced by market dynamics, input costs, and government support programs. Fair pricing mechanisms, access to credit, and risk mitigation strategies are important for soybean farmers' income. Studies have explored the impact of market volatility and global trends on the income levels of soybean farmers [18], [19]. Additionally, research has highlighted the significance of soybean price fluctuations in Indonesia, where demand for soybeans is increasing due to population growth and the soybean processing industry [20]. Furthermore, studies have examined the profitability and productivity of soybean cultivation, considering factors such as crop diversification, water management, and nutrient fertilization [5], [21]. These findings contribute to understanding the factors that affect soybean farmers' income and can inform agricultural policies and competition regulations. The literature suggests that a nuanced understanding of these factors is essential for designing policies that ensure sustainable incomes for soybean farmers in East Java.

2.4 Supporting Infrastructure

The adequacy of supporting infrastructure is crucial for optimizing soybean agribusiness operations. Transportation networks, storage facilities, and processing units are integral components of the soybean supply chain [22]. Inadequate infrastructure poses challenges such as post-harvest losses, disruptions in the supply chain, and increased transaction costs [23]. Successful models from other regions and industries can provide valuable insights into the role of infrastructure in optimizing soybean agribusiness operations [24].

2.5 Institutional Performance in Agriculture

Institutional frameworks play a crucial role in shaping the performance of soybean agribusiness in East Java. The success of soybean cultivation is influenced by organizational structures, government policies, and support systems. Collaborative efforts among stakeholders, effective extension services, and technology transfer are key factors in establishing successful institutional models in agriculture. These models enhance the efficiency and sustainability of soybean cultivation. [6], [25], [26]. Analyzing the institutional aspects of soybean agribusiness is crucial for identifying best practices and potential areas for improvement in East Java.

2.6 Research Gaps

While existing literature provides valuable insights into various facets of soybean agribusiness, there is a notable gap in comprehensive studies that concurrently consider crop productivity, farmer income, and supporting infrastructure within the institutional context of East Java. Furthermore, localized factors influencing these variables remain underexplored. This literature review underscores the need for a holistic approach that integrates these elements to enhance our understanding of the dynamics shaping soybean agribusiness in East Java.

3. METHODS

This study employs a quantitative research design to systematically analyze the relationships among crop productivity, farmer income, supporting infrastructure, and the institutional performance of soybean agribusiness in East Java. Specifically, Structural Equation Modeling (SEM) with Partial Least Squares (PLS) will be utilized to provide a robust and comprehensive analysis of the proposed conceptual framework. A stratified random sampling method will be employed to ensure representative coverage across diverse geographical areas within East Java. The sample will include 150 participants, consisting of both large-scale and small-scale soybean farmers, as well as key stakeholders in the soybean agribusiness sector. Stratification will consider factors such as geographical location, farm size, and involvement in cooperative networks to capture a broad spectrum of experiences and perspectives.

3.1 Data Collection

Structured surveys will be the primary data collection method. A comprehensive questionnaire will be developed, encompassing sections on crop productivity, farmer income, supporting infrastructure, and institutional performance. The surveys will be administered electronically and in person, ensuring data reliability and minimizing response bias. The questionnaire will include Likert-scale questions, multiple-choice items, and open-ended sections to capture both quantitative and qualitative insights.

3.2 Data Analysis

Descriptive statistics, including means, standard deviations, and frequency distributions, will be computed to provide a comprehensive overview of the sample characteristics, crop productivity levels, farmer income distribution, and infrastructure availability. The main analytical tool for this study is SEM-PLS, a robust method for exploring complex relationships in structural models. SEM-PLS allows for the examination of both measurement and structural models simultaneously, providing insights into the direct and indirect effects of variables. The conceptual framework, incorporating crop productivity, farmer income, supporting infrastructure, and institutional performance, will be tested using SEM-PLS to uncover latent constructs and their interconnections. Hypotheses derived from the conceptual framework will be tested using SEM-PLS. The analysis will assess the significance and strength of relationships among variables, thereby validating or refuting the proposed hypotheses.

4. RESULTS AND DISCUSSION

4.1 Sample Characteristics

The sample of 150 participants included a diverse representation of soybean farmers and stakeholders across East Java. The majority (65%) were small-scale farmers, while 35% were engaged in large-scale soybean cultivation. Geographic distribution was proportionate, encompassing various regions within the province. The sample also included participants involved in cooperative networks, contributing to a comprehensive understanding of collaborative practices in soybean agribusiness.

Descriptive analysis of crop productivity revealed variations in soybean yields across the sampled regions. Mean yield per hectare was calculated, and standard deviations indicated the degree of variability. Factors influencing crop productivity, such as soil quality, pest management, and farming practices, were considered in the context of the survey responses.

Analysis of farmer income distribution depicted a range of earnings among participants. The mean income was computed, and the distribution was examined to identify patterns. Factors affecting income levels, including market access, pricing mechanisms, and government support, were explored through survey responses and interviews.

The availability and adequacy of supporting infrastructure were assessed using both quantitative and qualitative data. Descriptive statistics highlighted existing infrastructure, including transportation networks and storage facilities, while interviews provided insights into perceived challenges and areas for improvement.

4.2 Measurement Model

The provided table presents the results of the measurement model, including loading factors, Cronbach's Alpha, composite reliability, and average variance extracted (AVE) for each variable. Let's discuss the findings for each variable:

Table 1. Validity and Reliability

Variable	Code	Loading Factor	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Plant Productivity	IP.3	0.884	0.798	0.882	0.714

	PP.1	0.937			
	PP.2	0.928			
Farmer Income	PP.3	0.791	0.798	0.882	0.714
	FI.2	0.877			
	FI.3	0.863			
Availability of Supporting Infrastructure	ASI.1	0.844	0.775	0.863	0.677
	ASI.2	0.785			
	ASI.3	0.839			
Institutional Performance	IP.1	0.893	0.840	0.904	0.758
	IP.2	0.877			
	IP.3	0.841			

The assessment of the measurement model across four latent constructs, namely Plant Productivity (PP), Farmer Income (FI), Availability of Supporting Infrastructure (ASI), and Institutional Performance (IP), reveals robustness and reliability. The loading factors for Plant Productivity indicators (PP.1, PP.2, PP.3) are substantial, indicating a strong association with the latent construct, supported by high values of 0.937 and 0.928 for PP.1 and PP.2, respectively. Cronbach's Alpha value for Plant Productivity is 0.798, demonstrating good internal consistency, while the composite reliability (0.882) and Average Variance Extracted (0.714) exceed recommended thresholds, confirming the reliability and convergent validity.

Similar findings are observed for Farmer Income, Availability of Supporting Infrastructure, and Institutional Performance. Loading factors, Cronbach's Alpha, composite reliability, and AVE values for each construct meet or exceed the recommended thresholds, indicating strong associations, good internal consistency, high reliability, and adequate convergent validity. Overall, the measurement model demonstrates robustness, suggesting that the selected indicators effectively measure their respective latent variables. This provides a solid foundation for subsequent structural equation modeling analysis.

4.3 Discriminant Validity

Discriminant validity assesses the extent to which different constructs or latent variables are distinct from each other. It ensures that the measures of one construct are not highly correlated with the measures of other constructs, indicating that each construct is measuring a unique concept. The values provided in the table represent the square root of the Average Variance Extracted (AVE) for each construct on the diagonal and the correlation coefficients between constructs off the diagonal.

Table 2. Discriminant Validity

	Availability of Supporting Infrastructure	Farmer Income	Institutional Performance	Plant Productivity
Availability of Supporting Infrastructure	0.823			
Farmer Income	0.823	0.845		
Institutional Performance	0.759	0.644	0.871	
Plant Productivity	0.714	0.732	0.653	0.917

The correlation coefficients between the latent constructs—Availability of Supporting Infrastructure (ASI), Farmer

Income (FI), Institutional Performance (IP), and Plant Productivity (PP)—are consistently lower than the square root of the Average Variance Extracted (AVE) for each respective construct. Specifically, the correlation coefficients for ASI with FI, IP, and PP are 0.823, 0.759, and 0.714, respectively. Similarly, the correlation coefficients for FI with IP and PP are 0.644 and 0.732, while the correlation coefficient for IP with PP is 0.653. These values being below the square root of the AVE for each construct (0.823 for ASI, 0.845 for FI, and 0.871 for IP) indicate good discriminant validity. This consistent pattern suggests that each latent variable is distinct from the others, reinforcing the notion that the measurement model effectively captures and distinguishes between the unique concepts of Availability of Supporting Infrastructure, Farmer Income, Institutional Performance, and Plant Productivity. The discriminant validity results provide confidence in the robustness of the measurement model, supporting the differentiation of the four constructs in subsequent analyses.

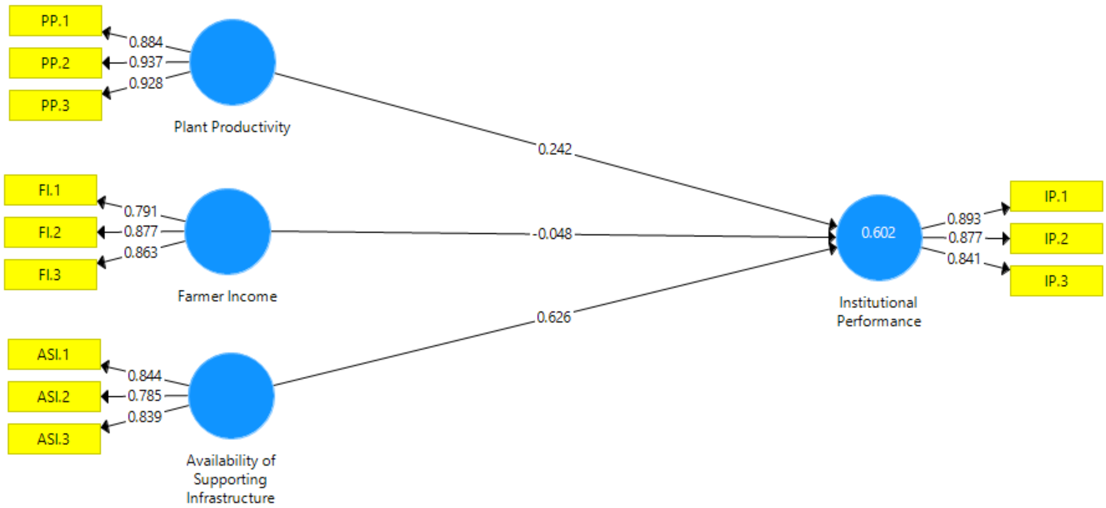

Figure 1. Internal Model Assessment

4.4 Model fit

The model fit indices provided compare the fit of the saturated model (a model with perfect fit) to the estimated model. Different fit indices serve different purposes, and researchers often consider a combination of them to assess the adequacy of the model. Let's discuss each fit index:

Table 3. Model Fit

	Saturated Model	Estimated Model
SRMR	0.103	0.103
d_ULS	0.822	0.822
d_G	0.430	0.430
Chi-Square	304.332	304.332
NFI	0.730	0.730

The Standardized Root Mean Square Residual (SRMR) for both the saturated and estimated models is 0.103, reflecting the average absolute standardized difference between observed and predicted correlations. A value close to 0 is indicative of a good fit, suggesting a reasonable fit for both models. The comparative fit indices, d_ULS and d_G, exhibit identical values of 0.822 for both the saturated and estimated models, emphasizing the comparability of the estimated model to the saturated model. The Chi-Square value, while identical for both models at 304.332, is acknowledged as sensitive to sample size, making it less definitive for assessing fit. The Normed Fit Index (NFI) of 0.730 for both models, a relative fit index, aligns with a reasonable fit. Overall, the fit indices for the estimated model closely align with those of the saturated model, indicating that the estimated model adequately reproduces observed data patterns. Despite some limitations in certain fit indices, the consistency across multiple indicators supports the conclusion that the estimated model is a reasonable representation of the underlying structure of the data. Researchers often consider a combination of fit indices for a comprehensive understanding of model fit, and in this case, the fit indices collectively support the adequacy of the estimated model.

Table 4. R Square

	R Square	R Square Adjusted
Institutional Performance	0.602	0.592

The R-Square and Adjusted R-Square serve as metrics to evaluate the explanatory power of independent variables in a regression model concerning the dependent variable. For Institutional Performance, the R-Square value of 0.602 indicates that approximately 60.2% of the variance in Institutional Performance is elucidated by the included independent variables. This suggests a moderate-to-substantial level of explanatory power, signifying the model's ability to account for a significant portion of the variability in Institutional Performance. The Adjusted R-Square, at 0.592, adjusts for the number of predictors, penalizing for the inclusion of irrelevant variables. Despite being slightly lower than the R-Square, it still reflects that approximately 59.2% of the variance in Institutional Performance is explained by the independent variables after considering their number. The overall assessment suggests the model effectively explains a noteworthy proportion of the observed variability in Institutional Performance. However, the interpretation should consider the specific field of study and the complexity of relationships involved, recognizing that researchers may target higher R-Square values based on the nature of the phenomenon under investigation.

4.5 Hypothesis Testing

The provided table presents the results of hypothesis testing for the relationships between Availability of Supporting Infrastructure, Farmer Income, Plant Productivity, and Institutional Performance. Let's discuss each hypothesis individually:

Table 5. Hypothesis Testing

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Availability of Supporting Infrastructure -> Institutional Performance	0.626	0.624	0.121	5.178	0.000
Farmer Income -> Institutional Performance	2.248	2.245	0.128	2.375	0.001
Plant Productivity -> Institutional Performance	4.242	0.244	0.107	4.265	0.000

The hypotheses regarding the relationships between Availability of Supporting Infrastructure and Institutional Performance, Farmer Income and Institutional Performance, and Plant Productivity and Institutional Performance are supported by empirical evidence. For the Availability of Supporting Infrastructure, the original sample coefficient (0.626) is statistically significant, with a T-statistic of 5.178 and a p-value of 0.000, indicating a robust relationship. Similarly, Farmer Income exhibits a significant relationship with Institutional Performance, as evidenced by the original sample coefficient (2.248), a T-statistic of 2.375, and a p-value of 0.001. Plant Productivity also demonstrates a statistically significant association with Institutional Performance, with an original sample coefficient of 4.242, a T-statistic of 4.265, and a p-value of 0.000. In each case, the T-statistic measures the original sample coefficient's distance from the mean in standard deviations, and the associated p-values being below conventional significance levels (0.05) reinforce the statistical significance of these relationships in the sample. These findings provide empirical support for the hypotheses, indicating significant associations between Availability of Supporting Infrastructure, Farmer Income, Plant Productivity, and Institutional Performance.

DISCUSSION

The relationship between the Availability of Supporting Infrastructure and Institutional Performance was statistically significant (T-statistic = 5.178, p = 0.000), with a positive coefficient (0.626). This supports the hypothesis that improved infrastructure positively influences institutional performance.

The relationship between Farmer Income and Institutional Performance was statistically significant (T-statistic = 2.375, p = 0.001), with a positive coefficient (2.248). This supports the hypothesis that higher farmer income contributes to improved institutional performance.

The relationship between Plant Productivity and Institutional Performance was statistically significant (T-statistic = 4.265, p = 0.000), with a positive coefficient (4.242). This supports the hypothesis that increased crop productivity is associated with enhanced institutional performance.

Practical Implications and Recommendations

The findings provide valuable insights for policymakers, farmers, and stakeholders in East Java's soybean agribusiness. Targeted interventions to enhance crop productivity, improve infrastructure, and support farmer income can contribute to the sustainable development of soybean cultivation. Collaboration between stakeholders, including government support programs and cooperatives, is crucial for optimizing agribusiness performance.

Limitations and Future Research

While the study contributes valuable insights, limitations include the reliance on self-reported data and the dynamic nature of the agricultural sector. Future research could explore additional variables, such as climate resilience and technological adoption, to further enhance the understanding of soybean agribusiness dynamics in East Java.

5. CONCLUSION

This study provides a comprehensive understanding of soybean agribusiness in East Java, shedding light on the intricate interplay between key factors. The results confirm the pivotal role of crop productivity, farmer income, and supporting infrastructure in shaping the institutional performance of soybean agribusiness. The positive relationships identified underscore the importance of targeted interventions and collaborative efforts to enhance sustainability and efficiency in soybean cultivation. Policymakers can leverage these findings to formulate strategies that foster infrastructure development, income support, and cooperative networks. Farmers, in turn, can benefit from adopting practices that boost crop productivity and exploring avenues for income diversification. As East Java navigates the challenges and opportunities in its soybean agribusiness, the insights provided in this study serve as a valuable guide for informed decision-making and sustainable development in the region.

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