



Agricultural Financing and Food Security in Sumatra: The Role of Islamic and Conventional Banks in a Dual Banking System

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ABSTRACT

Food security is a key target of the Sustainable Development Goals (SDGs), aiming to end hunger and promote sustainable agriculture by 2030. This study examines the role of agricultural financing under a dual banking system comprising Islamic and conventional banks in enhancing food security across 10 provinces in Sumatra from 2019 to 2023. Using panel regression analysis, the results indicated that agricultural financing from both Islamic and conventional banks has a significant, positive impact on food security in the region, highlighting the importance of bank-based financing in supporting agricultural productivity and food availability. In addition, agricultural labor, the Human Development Index (HDI), and the Farmer Exchange Rate (FER) significantly contribute to improving food security across Sumatra. These findings suggest that expanding and strengthening agricultural financing portfolios within both Islamic and conventional banking systems can effectively support government efforts to enhance national food security and promote sustainable agricultural development. Overall, this study provides policy-relevant evidence on the importance of an inclusive agricultural financing framework in strengthening food security across Sumatra.

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INTRODUCTION

Food security is a key Sustainable Development Goal (SDG), especially Goal 2, which aims to end hunger and promote sustainable agriculture by 2030 (Abduh, 2019). This goal depends on strong agriculture, which is vital to the food supply and rural livelihoods. Therefore, building a productive, inclusive, and sustainable agricultural system is essential for maintaining national food security.

The agricultural sector has faced growing challenges. Widespread conversion of farmland to non-agricultural uses reduces productive land and threatens food production (Rondhi et al., 2019; Adam et al., 2018). Agriculture's declining appeal as an income source accelerates rural-to-urban migration (Abduh, 2019; Osabohien et al., 2020), weakening productivity and increasing reliance on imports and supply risks. Moreover, slow farmer regeneration is a key concern. An aging farming population, limited access to resources, and high risks make farming less attractive to youth (Leavy & Hossain, 2014; Ma'rufah et al., 2022; Mardiyanti et al., 2023; Dalmiyatun et al., 2024). If unchecked, these trends endanger national food security amid global uncertainties. Global instability from conflicts, COVID-19, and rising health and climate risks creates a VUCA (Volatility, Uncertainty, Complexity, Ambiguity) environment for food systems (Sharif & Irani, 2017; Kotur et al., 2024). This uncertainty can limit agricultural investment, threatening food availability and use. The financial sector, especially banks, has become more important in supporting food security through steady agricultural financing.

A growing body of empirical literature has examined the relationship between agricultural financing and agricultural productivity as well as food security, particularly in developing countries. In Nigeria, Osabohien, Adeleye, and Tyron (2020) found that financing boosts productivity. Similarly, Osabohien et al. (2020), employing propensity score matching (PSM) on data from 4,210 farming households in Nigeria, demonstrated that households with access to agricultural financing achieved significantly higher crop yields than those without such access. Supporting evidence from Osabohien, Afolabi, and Godwin (2018) and Egwu (2016) further confirms that bank credit and agricultural credit guarantee schemes play a significant role in enhancing agricultural output, promoting economic growth, and reducing poverty. Conversely, Adetiloye (2012) showed that the weak performance of agricultural credit schemes contributed to low levels of food security in Nigeria.

Beyond Nigeria, research highlights the role of Islamic finance and other factors in food security. Basyariah (2022) and Abduh (2019) highlighted the potential of Islamic finance—including agricultural financing and Islamic social finance instruments—in advancing SDG-related food security objectives. Meanwhile, Srinita (2018) found that food availability, access, and use are crucial to regional food security and farmer welfare. Demand for Sharia-based financing is rising, supporting the broader economy (Trimulato *et al.*, 2026). Despite these contributions, existing studies remain largely fragmented, focusing either on a single financial system or on specific country contexts most notably Nigeria. Empirical research that simultaneously examines and compares the roles of Islamic and conventional banking within a dual banking system framework in relation to food security remains scarce, particularly at the regional level in Indonesia. Addressing this gap, the present study contributes to the literature by empirically analyzing the role of agricultural financing provided by both Islamic and conventional banks in enhancing food security across ten provinces in Sumatra. By employing panel data analysis, this study offers policy-relevant evidence on how an inclusive agricultural financing framework within a dual banking system can strengthen regional and national food security in Indonesia.

METHOD, DATA, AND ANALYSIS

Given data availability, this study employed a sample of 10 provinces on Sumatra Island for the period 2019–2023, namely Aceh, Bengkulu, Jambi, Bangka Belitung Islands, Riau Islands, Lampung, Riau, West Sumatra, South Sumatra, and North Sumatra. The selection of this region was motivated by Sumatra’s strategic role as one of Indonesia’s major national food production centers and by the availability of consistent provincial-level data across the study period.

The study primarily used secondary data aggregated from relevant government institutions. Data on the Food Security Index are obtained from official publications of the National Food Agency (Badan Pangan Nasional, Bapanas). Meanwhile, data on agricultural financing provided by Islamic banks and agricultural credit disbursed by conventional banks are sourced from provincial-level statistical reports published by the Financial Services Authority (Otoritas Jasa Keuangan, OJK). Data for control variables—including the Farmer

Exchange Rate, agricultural labor, the Human Development Index (HDI), and natural disasters—are obtained from Statistics Indonesia (Badan Pusat Statistik, BPS) for each province on Sumatra Island. The variables employed in this study consisted of a dependent variable, key independent variables, and a set of control variables. A summary of the variables and their corresponding measurements is presented in Table 1.

Table 1. Research Variables and Measurement

Type of Variable	Variable	Proxy / Measurement	Data Source
Dependent Variable	Food Security	Food Security Index based on three dimensions: food availability, food access, and food utilization	National Food Agency (Badan Pangan Nasional, Bapanas)
Independent Variable	Agricultural Financing (Islamic Banks)	Total Islamic banking financing allocated to the agricultural sector at the provincial level	Islamic Banking Statistics (Statistik Perbankan Syariah, SPS) – Financial Services Authority (OJK)
	Agricultural Lending (Conventional Banks)	Total conventional banking credit allocated to the agricultural sector at the provincial level	Indonesian Banking Statistics (Statistik Perbankan Indonesia, SPI) – Financial Services Authority (OJK)
Control Variables	Farmer Exchange Rate (FER)	Farmer Exchange Rate by province	Statistics Indonesia (BPS)
	Natural Disasters	Natural Disasters	Statistics Indonesia (BPS)
	Agricultural Labor	Percentage of labor force employed in the agricultural sector	Statistics Indonesia (BPS)
	Human Development Index (HDI)	Human Development Index (HDI)	Statistics Indonesia (BPS)

Source: Author's compilation (2026)

The Food Security Index was measured using an indicator-weighting method as published by the Deputy for Food Insecurity and Nutrition (2023). Each indicator was first standardized using a combination of z-scores and distance-to-scale methods, producing values ranging from 0 to 100. Subsequently, the standardized indicator values were multiplied by

their respective weights and aggregated to obtain the composite Food Security Index score. Formally, the Food Security Index is expressed as follows:

$$Y_j = \sum_{i=1}^9 a_i X_{ij}$$

Where i denotes indicators 1 through 9, j represents the region (province), Y_j denotes the Food Security Index, a_i represents the weight assigned to indicator- i , and X_{ij} denotes the standardized value of indicator i in region j . The indicators and weights of the Food Security Index employed in this study are presented in Table 2.

Table 2. Food Security Indicators based on the National Food Agency

No.	Indicator	Weight
Food Availability Dimension		
1	Ratio of normative consumption to net production of rice, maize, sweet potato, cassava, and sago, including regional government rice reserves	0.30
Food Accessibility Dimension		
2	Percentage of population living below the poverty line	0.15
3	Percentage of households with food expenditure exceeding 65% of total household expenditure	0.075
4	Percentage of households without access to electricity	0.075
Food Utilization Dimension		
5	Average years of schooling of females aged over 15 years	0.05
6	Percentage of households without access to clean water	0.15
7	Population-to-health-worker ratio	0.05
8	Percentage of stunted children under five years old	0.05
9	Life expectancy at birth	0.10

Source: Author's compilation (2026)

The Food Security Index is measured using an indicator-weighting method as published by the Deputy for Food Insecurity and Nutrition (2023). Each indicator is first standardized using a combination of z-scores and distance-to-scale methods, producing values ranging from 0 to 100. Subsequently, the standardized indicator values are multiplied by their respective weights and aggregated to obtain the composite Food Security Index score.

Formally, the Food Security Index is expressed as follows:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \varepsilon_{it}$$

Where Y_{it} denotes the dependent variable (food security) in province i at time t , X_{it} represents the independent variables, β_0 is the intercept, β_n denotes the regression

coefficients, and ε_{it} is the error term. Based on Equation (2), the empirical models employed in this study are specified as follows:

Model 1: Islamic Banking Agricultural Financing

$$\text{FoodSecurity}_{it} = \beta_0 + \beta_1 \text{AgriculturalFinancing}_{it} + \beta_2 \text{ControlVariables}_{it} + \varepsilon_{it}$$

Model 2: Conventional Banking Agricultural Credit

$$\text{FoodSecurity}_{it} = \beta_0 + \beta_1 \text{AgriculturalLending}_{it} + \beta_2 \text{ControlVariables}_{it} + \varepsilon_{it}$$

Under the FEM and REM approaches, the key distinction lies in whether the individual effects (λ_i) and time effects (μ_t) are correlated with the explanatory variables. To determine the most appropriate estimation model, this study applied the Chow test (PLS vs. FEM), the Lagrange Multiplier (LM) test (PLS vs. REM), and the Hausman test (REM vs. FEM), as illustrated in Figure 1.

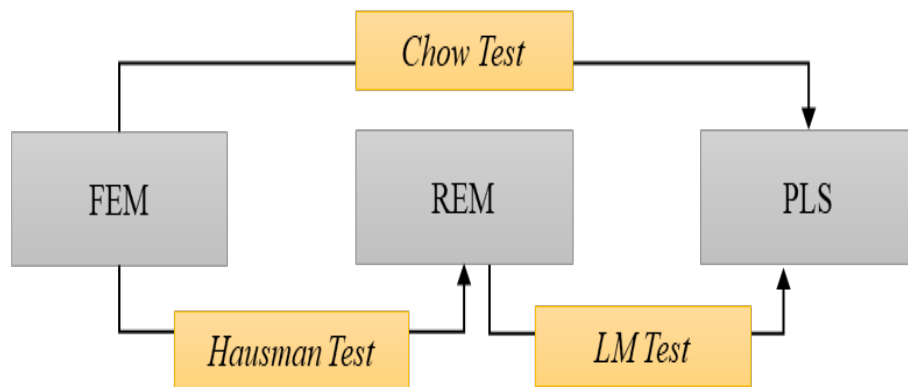


Figure 1. Illustration of the Model Selection Process

Source: Gujarati and Porter (2012a, 2012b)

RESULTS AND DISCUSSION

Table 3 presents the descriptive statistics for all variables utilized in this study, namely mean, standard deviation, minimum, and maximum values. These statistics provide a comprehensive summary of food security characteristics and their determinants across the ten provinces of Sumatra Island during the study period.

Table 3. Descriptive Statistics

Variabel	Mean	Std. Dev.	Min.	Max.
KP	70.4378	5.6023	56.0300	83.2200
IAF	5.7032	1.4067	1.3100	8.1600
CAL	8.6508	1.4999	4.8900	10.8200
NTP	112.9198	14.7315	94.7300	152.9300
TKP	81.7778	7.1730	66.7800	91.9900
BA	4.2086	0.9028	2.2000	5.6300
IPM	72.3262	1.6643	69.5700	77.1100

Note: KP = Food Security; IAF = Islamic Agricultural Financing; CAL = Conventional Agricultural Lending; NTP = Farmer Exchange Rate; TKP = Farmer Labor Force; BA = Natural Disasters; HDI = Human Development Index

Table 4 shows the correlation matrix between the independent and dependent variables in the panel regression model. This matrix identifies potential multicollinearity in the model. The pairwise correlations among independent variables are all below 0.80. According to Gujarati (2003), multicollinearity is a concern when coefficients exceed 0.80. Thus, there is no multicollinearity, and the regression estimates remain robust.

Table 4. Correlation Matrix

Variabel	KP	IAF	CAL	NTP	TKP	BA	IPM
KP	1						
IAF	0.3698	1					
CAL	0.4661	0.7189	1				
NTP	-0.0075	0.3428	0.0385	1			
TKP	0.4884	-0.1199	0.0385	-0.3336	1		
BA	0.3702	0.5848	0.3505	0.0901	0.0872	1	
IPM	0.1442	-0.3149	-0.5210	0.2603	-0.2697	0.0165	1

Note: KP = Food Security; IAF = Islamic Agricultural Financing; CAL = Conventional Agricultural Lending; NTP = Farmer's Exchange Rate; TKP = Farmer Labor Force; BA = Natural Disasters; HDI = Human Development Index

The empirical analysis in this study employed panel data regression using three main approaches: Pooled Least Squares (PLS), Fixed Effects Model (FEM), and Random Effects Model (REM). The selection of the most appropriate model was conducted through a series of specification tests, including the Chow Test, Breusch–Pagan Lagrange Multiplier (LM) Test, and Hausman Test. The test results indicate that both the Chow Test and the LM Test are statistically significant, while the Hausman Test probability value exceeds 0.05. These findings suggest that the Random Effects Model (REM) is the most suitable specification for estimating

the relationship between Islamic Agricultural Financing and food security in Sumatra. The REM is preferred because it captures cross-provincial variation while maintaining estimation efficiency, assuming that individual effects are not correlated with the explanatory variables.

Based on the REM estimation results, Islamic Agricultural Financing exhibits a positive and statistically significant effect on food security at the 10% significance level. Quantitatively, a 1% increase in agricultural financing disbursed by Islamic banks is associated with approximately a 1.15% increase in the Food Security Index. This finding indicates that Shariah-compliant agricultural financing plays a strategic role in enhancing agricultural production capacity and food availability in Sumatra. This is also in line with a previous study, which indicates that agricultural financing in Nigeria is essential in assisting farmers from the planting stage through the harvesting period (Doha, 2024).

In addition to the main explanatory variable, several control variables also demonstrate statistically significant effects. The Farmer Exchange Rate (FER) and Agricultural Labor (AL) show positive and significant relationships with food security at the 5% significance level. These results confirm that improvements in farmers' welfare and the availability of agricultural labor directly contribute to food security by enhancing purchasing power, food access, and agricultural productivity (Srnita, 2018).

From a conceptual perspective, these findings reinforce the argument that Islamic Agricultural Financing, grounded in principles of equity, sustainability, and social welfare, is effective in supporting food security in regions that are highly dependent on agriculture and natural resources, such as Sumatra Island. The results also align with prior studies that emphasize the critical role of agricultural financing in mitigating food insecurity (Osabohien et al., 2018; Osabohien et al., 2020; Egwu, 2016).

Table 5. Panel Regression Estimation Results of the Islamic Agricultural Financing Model on Food Security in Sumatra

Variable	Food Security in Sumatra		
	(1) PLS	(2) FEM	(3) REM
<i>IAF</i>	1.0213 [0.1561]	0.3635 [0.6328]	1.1567* [0.0558]
NTP	0.0442 [0.3947]	0.0832 [0.1330]	0.1014** [0.0379]
TKP	0.4043*** [0.0002]	0.1365 [0.5988]	0.3949** [0.0178]

Variable	Food Security in Sumatra		
	(1) PLS	(2) FEM	(3) REM
BA	1.0367 [0.2823]	0.1837 [0.8032]	0.6272 [0.3576]
IPM	-0.4053 [0.3947]	2.0772* [0.0568]	0.5296 [0.4151]
Constant	51.5159	-103.1968	-20.8454
R-Squared (R^2)	0.4465	0.8396	0.3963
Adj. R-Squared	0.3836	0.7755	0.3277
F/Wald Test	7.0983***	13.0887** *	5.7773***
Model Specification Test			
Chow Test			24.1129(0.000)
LM Test			9.5335(0.000)
Hausman Test			7.0700(0.2155)
Note: ***, **, and * are significant at the 1%, 5%, and 10% levels.			

The impact of Conventional Agricultural Lending on food security was also estimated using the PLS, FEM, and REM approaches. Based on statistically significant results from the Chow Test and Breusch–Pagan Lagrange Multiplier (LM) Test, along with an insignificant Hausman Test (p -value > 0.05), the Random Effects Model (REM) is once again selected as the most appropriate estimation model. The REM estimation results indicate that Conventional Agricultural Lending has a positive and statistically significant effect on food security at the 5% significance level. A 1% increase in agricultural credit disbursed by conventional banks is associated with an improvement in food security ranging from 1.29% to 2.18%. This finding underscores the crucial role of conventional banking in supporting agricultural financing, particularly by enhancing working capital, investment in production, and efficiency in regional food distribution.

Among the control variables, Agricultural Labor continues to exhibit a positive and significant effect on food security, indicating that the availability of agricultural labor remains a fundamental factor in sustaining food production. Meanwhile, the Human Development Index (HDI) shows a significant effect in the FEM specification, underscoring the importance of human capital quality in supporting long-term food security by improving education, health, and overall productivity. The relatively high values of the coefficient of determination (R^2) across all three models suggest that the independent variables included in the model adequately explain variations in food security across provinces on Sumatra Island. These findings are consistent with previous studies that emphasize the critical role of banking-sector

financing in strengthening agricultural performance and food security (Osabohien et al., 2018; Osabohien et al., 2020).

Table 6. Panel Regression Estimation Results of the Conventional Agricultural Lending Model on Food Security in Sumatra

Variable	Food Security in Sumatra		
	(1) PLS	(2) FEM	(3) REM
CAL	1.2939** [0.0367]	1.6964 [0.4001]	2.1859** [0.0170]
NTP	0.0248 [0.6309]	0.0738 [0.1888]	0.0785 [0.1151]
TKP	0.3725*** [0.0003]	0.1617 [0.5342]	0.3842** [0.0157]
BA	1.2519 [0.1072]	0.1559 [0.8315]	0.5779 [0.3906]
IPM	-0.0752 [0.8821]	1.9932* [0.0534]	1.0898 [0.1037]
Constant	26.1482	-110.6231	-70.0117
R-Squared (R ²)	0.4756	0.8418	0.4192
Adj. R-Squared	0.416	0.7786	0.3532
F/Wald Test	7.9817***	13.3069***	6.3510***
Model Specification Test			
Chow Test			9.0049(0.000)
LM Test			19.7675(0.000)
Hausman Test			6.8691(0.2306)

Note: ***, **, and * are significant at the 1%, 5%, and 10% levels.

The results of this study indicate that agricultural financing, whether provided by Islamic or conventional banks, has a positive, statistically significant impact on food security in the Sumatra region. The selection of the Random Effects Model (REM) in both estimations strengthens the empirical evidence that agricultural financing within a dual banking system framework contributes meaningfully to improvements in the Food Security Index across all provinces on Sumatra Island. Quantitatively, a 1% increase in Islamic Agricultural Financing is associated with a 1.15% increase in food security, while a 1% increase in Conventional Agricultural Lending is associated with a 1.29% to 2.18% increase in food security. These findings underscore that access to agricultural financing is a key determinant of enhancing production capacity, stabilizing supply, and improving the overall sustainability of regional food systems.

The differences in financing between the two banking systems are reflected in their underlying principles and operational mechanisms. Islamic Agricultural Financing, grounded in principles of equity, sustainability, and social welfare (*maslahah*), has the potential to promote more inclusive agricultural development and improve farmers' well-being. In contrast, Conventional Agricultural Lending emphasizes economic efficiency and productivity enhancement through credit-based mechanisms. Despite these differing approaches, the empirical results demonstrate that both banking systems are complementary in supporting food security in Sumatra.

Beyond financing factors, socio-economic variables such as Agricultural Labor, the Farmer Exchange Rate, and the Human Development Index (HDI) also play significant roles in strengthening food security. This indicates that food security is not determined solely by capital availability, but also by farmers' welfare and the quality of human resources. Accordingly, strengthening food security in Sumatra requires an integrated policy approach that combines expanding agricultural financing, improving farmers' welfare, and sustained human development. This is consistent with previous studies emphasizing the importance of a policy hotspot framework, in which synergy among key stakeholders—regulators, Islamic financial institutions, and business actors—is essential for achieving sustainability (Kian *et al.*, 2026).

CONCLUSION AND SUGGESTIONS

This study concludes that agricultural financing within a dual banking system framework, encompassing both Islamic and conventional banks, plays a significant role in strengthening food security across Sumatra. Although food security levels remain uneven across provinces, agricultural financing from both banking systems empirically contributes positively and significantly to regional food security by enhancing production capacity, stabilizing supply, and improving access to agricultural resources. In addition to financing, socio-economic factors such as agricultural labor, the Farmer Exchange Rate, and the Human Development Index are also found to be critical determinants, underscoring that food security is shaped not solely by production factors but by the simultaneous interaction of financing access, farmers' welfare, and human capital quality. Future research is encouraged to adopt more granular measurements of agricultural financing—such as financing for sustainable

agriculture, region-based agro-industrial development, or high-value-added agricultural subsectors—and to employ more advanced methodological approaches, including dynamic panel models or spatial analysis, to better capture regional heterogeneity in food security outcomes.

From a policy perspective, Islamic and conventional banking institutions should expand agricultural financing and target underserved regions or subsectors with identified needs. They should also develop tailored financing products for smallholder farmers and support capacity-building initiatives. Meanwhile, government policies should include training programs to enhance farmers' technical and entrepreneurial skills, targeted interventions to improve the quality of agricultural labor, and mechanisms to stabilize and improve the Farmer Exchange Rate. Coordinated policies across the banking and government sectors should promote joint monitoring and evaluation frameworks to ensure integration among financing strategies, human capital development, and institutional strengthening, all aimed at achieving inclusive and sustainable food security throughout Sumatra.

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