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Analysis Of Food Security Determinants In Sumatra Island 2019-2023

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Abstract

This study analyzes the determinants of food security in Sumatra Island from 2019 to 2023, focusing on three main variables: percentage of poor population, per capita expenditure on food, and agricultural productivity. The research results show that agricultural productivity and per capita expenditure have significant and positive effects on food security. A 1% increase in agricultural productivity raises the Food Security Index (FSI) by 0.61 points, while a 1% increase in per capita expenditure raises the FSI by 11.7 points. In contrast, the percentage of poor population has a negative but statistically insignificant effect on food security, indicating that government social programs and resilience in the agricultural sector may mitigate the direct impact of poverty. Despite the theoretical relationship between poverty and food security, this study emphasizes the importance of integrated interventions, such as social safety nets and sustainable agricultural practices, to strengthen food security in Sumatra. This research contributes to policy formulation by highlighting holistic strategies that encompass economic and agricultural aspects to achieve long-term food security.

Keywords: Food Security, Poverty, Agricultural Productivity, Per Capita Expenditure.

INTRODUCTION

Indonesia's development history demonstrates that food security has close relationships with economic stability (particularly inflation), aggregate production costs in the economy (such as living costs), and national political stability. Thus, food security is a fundamental prerequisite for the implementation of national development (Sudjana,

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2013). Food security has become a crucial and strategic aspect. Based on the experience of various countries, no nation can implement optimal development without first ensuring its food security.

Food security is a fundamental aspect of national development, especially in Indonesia as a country with high population growth. According to BPS projections, Indonesia's population is estimated to reach 329 million people by 2050, increasing pressure on food availability (BPS, 2025). Sumatra, as one of the islands with significant contributions to national food production, faces challenges such as land conversion, poverty, and fluctuations in agricultural productivity.

The Food Security Index (FSI) of Sumatra shows an increase from an average of 65.98 (2019) to 73.69 (2023), although it experienced a decline in 2022. The gap in values between provinces is quite substantial, with differences of up to 20 points. West Sumatra consistently leads with the highest values, while provinces with the lowest values vary. The Bangka Belitung Islands recorded the highest annual growth (3.78 points), while the Riau Islands had the lowest (1.46 points). Although performance gaps still exist, the differences between provinces are decreasing each year, indicating improvements in food security across the Sumatra region.

The poverty rate in Sumatra decreased from 9.44% (2019) to 8.99% (2023), although it temporarily increased to 9.82% in 2020. Aceh consistently recorded the highest percentage of poor population (14.45% in 2023), while the Bangka Belitung Islands remained the lowest (always below 5%). The majority of provinces successfully reduced poverty rates, with Lampung recording the largest decrease (-0.30% per year), followed by South Sumatra and Bengkulu. Some provinces such as Jambi and the Bangka Belitung Islands showed slight increases in poverty, albeit in very small numbers.

Poverty is closely linked to food security, as poverty conditions limit individuals' economic access to food. The inability to economically access food is a major indicator of failure to achieve food security. Therefore, efforts to strengthen food security have become a government priority to ensure food availability at national, regional, and household or family levels. (Simanjuntak et al., 2020).

Per capita expenditure in Sumatra showed an increasing trend from 2019-2023 in almost all provinces. The Riau Islands recorded the highest average (Rp 825,488 thousand) with a maximum value of Rp 863,530 thousand in 2023, while Lampung was the lowest (average of Rp 546,458 thousand). Jambi recorded the largest increase (Rp 160,408 thousand) from 2019-2023, followed by Riau and South Sumatra. Despite having the highest expenditure, the Riau Islands actually showed the smallest growth (Rp 74,473

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thousand). Provinces in southern Sumatra generally showed higher growth compared to northern or island regions, indicating more rapid economic development in certain areas.

The share of food expenditure is a key indicator in assessing household food security. This indicator is calculated through the proportion of spending on food relative to total monthly household expenditure. Food insecurity at the household level is often triggered by poverty. Additionally, low public awareness and weak food security institutions at the local level further exacerbate households' inability to meet their food needs. (Praza & Shamadiyah, 2020).

Agricultural productivity in Sumatra from 2019-2023 shows varied trends across provinces. Most provinces experienced increases, with South Sumatra recording the highest increase (48.27 to 56.19). The Bangka Belitung Islands showed significant improvement (28.56 to 43.49) despite remaining the lowest. The majority of provinces experienced fluctuations but tended to remain stable or increase. The Riau Islands became the only province that experienced a decline in productivity (32.3 to 28.11), indicating the need for special attention. In general, agricultural productivity in Sumatra shows positive development, with several provinces standing out in their achievements.

Provinces with high agricultural productivity tend to have more stable food supplies and more affordable prices, which can encourage increased protein consumption. Conversely, increased protein consumption can also be an indicator of improved community welfare, which in turn can drive increased investment and innovation in the agricultural sector (Suryana & Kariyasa, 2008).

Based on the data summary above, it is evident that provinces in Sumatra show complex dynamics in aspects of food security, poverty levels, per capita expenditure, and agricultural productivity during the 2019-2023 period, with some regions recording significant progress while others still face challenges. Therefore, directed and sustainable development strategies are needed to address inter-regional disparities and improve community welfare throughout Sumatra Island.

METHODS

Types and Sources of Data

This research falls into the category of quantitative research that aims to provide explanations for events or problems by analyzing and synthesizing data from various sources (Neuman, 2003). Sugiyono (2018) defines quantitative data as research data in the form of numbers that will be measured using statistics as a calculation testing tool, based on positivistic (concrete) data (Sugiyono, 2018). This study uses secondary

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information sources and employs quantitative descriptive research, drawing data from relevant institutions, in this case the national food agency and the central statistics agency. The data used is in the form of panel data for Sumatra Island over the period 2019-2023.

Research Limitations

Three independent variables are covered in this research: poor population, per capita expenditure, and agricultural productivity. This study uses the food security index as its dependent variable. The variable limitations are as follows:

Table 1. Research Limitations

Variable	Symbol	Unit	Data Source
Food security	Y	Points	National Food Agency
Percentage of poor population	X1	Percent	Central Statistics Agency
Per capita expenditure	X2	Thousand	Central Statistics Agency
Agricultural productivity	X3	Percent	Central Statistics Agency

Source: *Researcher, Processed Data (2025)*

Data Analysis Method

To fully define whether there is a relationship between independent variables and the dependent variable, this research uses quantitative descriptive data analysis that mostly relies on secondary data. This study employs panel data regression and uses Stata 15 as its analytical tool. Panel data is obtained by observing a group of individuals over a specific time period, often referred to as *cross-sectional units*.

Specifically, this estimation approach uses the *Common Effect Model* (CEM), *Fixed Effect Model* (FEM), and *Random Effect Model* (REM). Widarjono (2018) states that one can use the Chow test, Hausman test, and Lagrange Multiplier (LM) test to find the best model for understanding the relationship between dependent and independent variables.

$$IKP_{it} = \beta_0 + \beta_1 PM_{it} + \beta_2 PPK_{it} + \beta_3 PP_{it} + \varepsilon_{it}$$

Legend:
IKP = Food Security Index (Points)
PM = Poor Population (Percent)
PPK = Per Capita Expenditure (Thousand)

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PP = Agricultural Productivity (Percent)
ε = Error term
β0 = Constant
β1,β2, β3 = Slope or gradient coefficients

Classical Assumption Testing

To ensure that regression equations are unbiased, estimates are accurate, and models are consistent, classical assumption tests must be conducted before further data analysis can be performed. If you want your regression model to pass the BLUE (Best Linear Unbiased Estimator) test, then you must conduct classical assumption tests. By performing classical assumption tests when examining multicollinearity, heteroscedasticity, autocorrelation, and normally distributed residuals, one can demonstrate that the BLUE criteria have been met (Gujarati, 2006).

Hypothesis Testing

The purpose of the t-statistical test, according to Widarjono (2018), is to determine how much influence one independent variable has on the dependent variable, while considering all other independent variables as constant. The degree of freedom (df) = (n-k) is used to assess the importance of each parameter at three different confidence levels: 99%, 95%, and 90%, (Zulkarnain & Murwiati, 2023). The following are the hypotheses being tested:

H0 : ßa = 0 (has no influence)
H0 : ßa ≠ 0 (has influence)
H0 : ßa > 0 (positive)
H0 : ßa < 0 (negative
The hypotheses used are as follows:

Coefficient of Determination

As a measure of model quality, the coefficient of determination seeks to ensure the extent to which independent variables adequately explain fluctuations in the dependent variable. The coefficient of determination ranges from 0 to 1, with higher numbers indicating stronger explanation of the dependent variable by the independent variables. If all dependent variables can be adequately explained by the independent variables in the model, then the coefficient of determination is 1, (Widarjono, 2018).

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RESULTS AND DISCUSSION

Descriptive statistics explain the average or mean value, the lowest or minimum value, and the largest or maximum value of the analyzed data. Analysis of these values consists of estimates of the dependent variable food security index, as well as independent variables in the form of poor population, per capita expenditure, protein consumption, and agricultural productivity.

Table 2 Statistics descriptive analysis

		IKP	PM	PPK	PER
Mean		70.619	9.3726	662739.7	45.624
Minimum		56.03	4.5	484800	28.11
Maximum		83.22	15.53	881622.4	56.19
Std. Dev.		5.638791	3.64954	102722.5	7.987084
Percentiles		70.62	8.06	646316.1	47.925
Variance		31.79597	13.31914	1.06e+10	63.79351
Observation		50	50	50	50

Source: *Researcher, Processed Data (2025)*

Descriptive analysis of 50 observation data points in Sumatra from 2019-2023 shows: the food security index has an average of 70.619 points with the highest value in West Sumatra in 2023 (83.22 points) and the lowest in Bangka Belitung Islands in 2019 (56.03 points); the percentage of poor population averages 9.3726% with the highest in Aceh in 2021 (15.53%) and the lowest in Bangka Belitung Islands in 2019 (4.5%); average per capita expenditure is Rp 662,739 with the highest in Bangka Belitung Islands in 2022 (Rp 881,622) and the lowest in Lampung in 2019 (Rp 484,000); and agricultural productivity averages 45.62% with the highest value in South Sumatra in 2023 (56.19%) and the lowest in Riau Islands in 2023 (28.11%).

Random Effect Model (REM) Regression

This regression model assumes that the error term affects both the intercept and constant in the estimated research data. This model is more appropriate when sampling is done randomly from a specific population (Kuncoro M., 1997).

Table 3 Random Effect Model (REM) Regression Test

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Variabel	Coef	Std. Err	z	[95% Conf	Interval]
cons	-111.2117	69.40616	-1.60	-247.2453	24.82187
PM	-.3498703	.4068618	-0.86	-1.147305	.4475642
lPPK	11.71363	5.143808	2.28	1.631949	21.79531
PER	.6188386	.1271361	4.87	.3696564	.8680209

Source: *Researcher, Processed Data (2025)*

Based on the estimation results, the following equation model is formed:

$$IKP_{it} = -111.2117 - .3498703PM_{it} + 11.71363PPK_{it} + 6188386PER_{it} + \varepsilon_{it}$$

The analysis results show that the poor population has a negative effect on the food security index with a coefficient of -0.3498703, where each 1% increase in poor population decreases the food security index by 0.34 points. Meanwhile, per capita expenditure has a significant positive influence with a coefficient of 11.71363, where each 1% increase in per capita expenditure increases the food security index by 11.7 points. Agricultural productivity also has a positive effect with a coefficient of 0.6188386, where each 1% increase in agricultural productivity increases the food security index by 0.61 points..

t-Statistic Test

The t-statistic test or partial test is applied to measure the influence of independent variables on the dependent variable. To determine the significance of regression coefficients partially, the t-statistic test is used.

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Table 4. t-Statistic Test

Variable	Coef	z	P > | z |	conclusion
PM	-.3498703	-0.86	0.390	accepted H0
lPPK	11.71363	2.28	0.023	Rejected H0
PER	.6188386	4.87	0.000	rejected H0

Source: *Researcher, Processed Data (2025)*

The t-test results show that the poor population variable (PM) with a coefficient of -0.3498703 and probability of 0.390 > 0.05 does not significantly affect the food security index in Sumatra during 2019-2023 (H0 accepted). Meanwhile, the per capita expenditure variable (lPPK) with a coefficient of 11.71363 and probability of 0.023 < 0.05 significantly affects the food security index (H0 rejected). Similarly, the agricultural productivity variable (PER) with a coefficient of 0.6188386 and probability of 0.000 < 0.05 significantly affects the food security index in Sumatra during 2019-2023 (H0 rejected).

Coefficient of Determination Test

The coefficient of determination, which can be identified by looking at the R-square value, aims to assess the extent to which independent variables can provide explanation for the dependent variable. The range of the coefficient of determination value is between zero and one, where the lower the R-square value, the more limited the ability of independent variables to explain the dependent variable, and vice versa.

Table 5. Coefficient of Determination Test

Model Terpilih	R-sq: within	R-sq: between	R-sq: overall
Random Effect	0.4614	0.4960	0.4824

Source: *Researcher, Processed Data (2025)*

Based on the regression results in table 4.12, an R-Squared value of 0.4824 was obtained, indicating that 48.2% of the variation in the food security index variable can be explained by the variables of poor population, per capita expenditure, and agricultural productivity. Meanwhile, the remaining 51.08% represents other variations outside the panel data regression model.

Gujarati et al. (2013) stated that the R^2 value, which is a measure of goodness of fit in least square linear regression, does not play a major role in the quality of regression

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analysis. Thus, a high R^2 value does not always indicate that the regression model is of good quality in terms of results, and a low R^2 value does not always indicate that the model is of poor quality in terms of results.

ANALYSIS DISCUSSION

Effect of Poor Population on Food Security in Sumatra from 2019-2023

The research results show that during the period from 2019 to 2023, the poor population does not have a significant influence and has a negative relationship with food security in Sumatra. This indication appears because the significance level of 0.390 is greater than the alpha significance level of 0.05. Therefore, H0 is accepted and Ha is rejected. In other words, the poor population variable does not significantly affect the food security index in Sumatra, so H0 is accepted..

The relationship between the poor population and the food security index has an opposite direction with a coefficient of -.3498703. This means that each 1% increase in the poor population will impact a decrease in the food security index of about -0.34 points, while maintaining the assumption that other variables do not change (ceteris paribus). In this context, an increase in the percentage of poor population potentially results in a decrease in the food security index in Sumatra.

There are several factors that can explain why the poor population does not have a significant influence on food security in Sumatra. Although poverty theoretically can reduce food security due to limited access to quality and diverse food, in Sumatra, social assistance and food programs from the government have played an important role in reducing the impact of poverty on food security. Programs such as Cash Social Assistance (BST), Non-Cash Food Assistance (BPNT), and the Family Hope Program (PKH) have helped poor households meet basic food needs. So even though the percentage of poor population increases, its impact on food security is not significant. In addition, many poor households that depend on subsistence agriculture are still able to produce food for their own consumption, despite their low income. This reduces their dependence on formal food markets, so that food price fluctuations during the pandemic did not significantly affect their food security (Refnaldo et al., 2018).

Effect of Per Capita Expenditure on Food Security in Sumatra from 2019-2023

The research results show that during the period from 2019 to 2023, per capita expenditure has a significant influence and a positive relationship with food security in Sumatra. This indication appears because the significance level of 0.023 is smaller than

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the alpha significance level of 0.05. Therefore, H0 is rejected and Ha is accepted. In other words, the per capita expenditure variable significantly affects the food security index in Sumatra, so Ha is accepted.

The relationship between per capita expenditure and the food security index shows a significant positive relationship with a coefficient of 11.71363. This means that each 1% increase in per capita expenditure will impact an increase in the food security index of about 11.7 points, while maintaining the assumption that other variables do not change (ceteris paribus). In this context, an increase in per capita expenditure potentially increases the food security index in Sumatra.

The people of Sumatra, especially in rural areas, still heavily depend on the agricultural and plantation sectors as their main source of income. However, uneven income and fluctuations in agricultural commodity prices often make it difficult for some households to meet quality food needs (Nur Ainun Nisa, 2024).

The increase in food expenditure per capita, especially among middle to upper-income households, allows better access to diverse and nutritious foods, such as animal protein, vegetables, and fruits. This is important to meet family nutritional needs and reduce the risk of food insecurity. However, for low-income households, the increase in food expenditure is often only used to meet basic caloric needs, such as rice, so the impact on overall food security becomes limited. During the COVID-19 pandemic, many households in Sumatra experienced a decrease in income due to disrupted economic activities, so expenditure for food became more limited and the main priority was only on staple foods (Badan Pangan Nasional, 2025).

Effect of Agricultural Productivity on Food Security in Sumatra from 2019-2023

The research results show that during the period from 2019 to 2023, agricultural productivity has a significant influence and a positive relationship with food security in Sumatra. This indication appears because the significance level of 0.000 is smaller than the alpha significance level of 0.05. Therefore, H0 is rejected and Ha is accepted. In other words, the agricultural productivity variable significantly affects the food security index in Sumatra, so Ha is accepted..

The relationship between agricultural productivity and the food security index shows a significant positive relationship with a coefficient of .6188386. This means that each 1% increase in agricultural productivity will impact an increase in the food security index of about 0.61 points, while maintaining the assumption that other variables do not change (ceteris paribus). In this context, an increase in agricultural productivity potentially

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increases the food security index in Sumatra. Increased agricultural productivity, especially in food commodities such as rice, corn, and vegetables directly increases food availability at local and regional levels.

During the pandemic and recovery period, the agricultural sector proved to be one of the most resilient sectors, where agricultural activities continued to run despite many other sectors being hampered. This helped maintain food supply and prevent a more severe food crisis. The government also continues to boost assistance programs such as fertilizers, superior seeds, and modern agricultural training to continue encouraging increased productivity in the agricultural sector (Praza Riyandhi et al, 2020). For example, in North Sumatra and South Sumatra Provinces, the use of agricultural technologies such as more efficient irrigation systems and superior rice varieties has significantly increased crop yields.

CONCLUSION

The research results show that the poor population has a negative but not significant effect on food security in Sumatra during the 2019-2023 period, indicating that social assistance programs and government interventions play a role in mitigating the impact of poverty. Meanwhile, per capita expenditure has a positive and significant effect because it allows access to more diverse and quality food. Similarly, agricultural productivity has a positive and significant effect on food security in Sumatra, showing that increased crop yields, crop diversification, and adoption of agricultural technologies directly contribute to improving food availability, access, and stability, while increasing farmers' income.

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