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Analysis of Determinants of Food Security in the Provinces of Java and Sumatra Islands 2019-2022

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ABSTRACT

Food has always been a strategic topic in development at both the global and national levels, because fulfilling food is a right for every citizen whose quantity and quality must be guaranteed in a safe and nutritious manner. The main problem in realizing food security in Indonesia today is related to the growth in demand for food which is faster than the growth in supply. This research aims to find out the influence of food security determinants in the provinces of Java and Sumatra Islands in 2019-2022. By using secondary data and panel regression, Fixed Effect Model is the best model chosen to be used in this research. Partially, rice land productivity, population and agricultural labor have a significant effect on food security in the provinces of Java and Sumatra Islands. Together or simultaneously the variables of rice land productivity, population and agricultural labor have an influence on food security. There is a need for efforts and an active role from the government and society in optimizing the implementation of policies related to the protection of agriculture and human resources in order to maintain sustainable food security.

Keywords: Agricultural Labor, Food Security, Population, Rice Land Productivity

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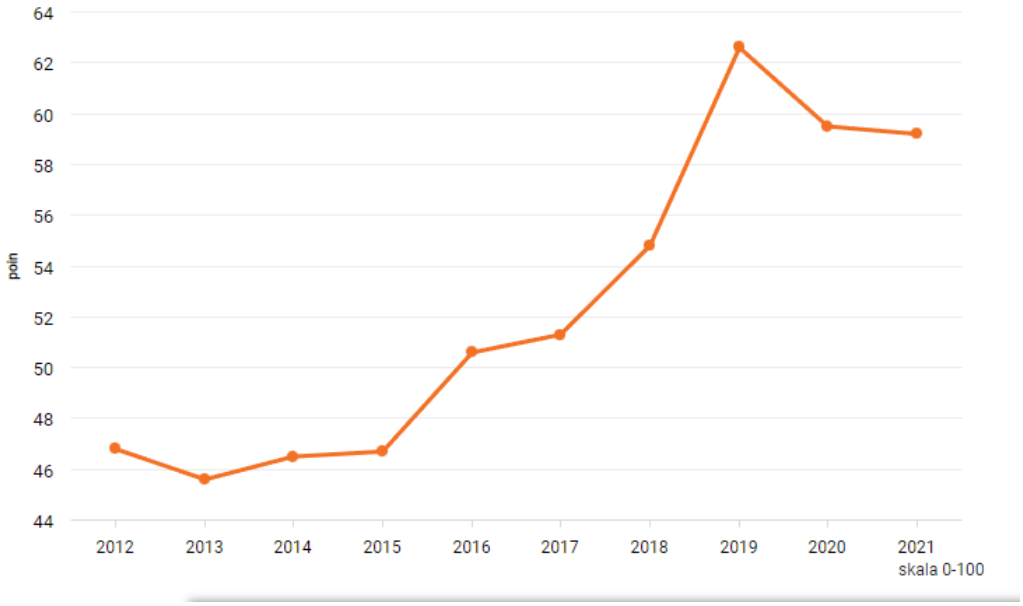
INTRODUCTION

Being an agricultural nation, Indonesia has an abundance of resources derived from nature, but rural populations are unable to utilize them to the fullest extent possible for their management. Agriculture is therefore anticipated to be a source of support for the welfare of those who live in rural regions (Ernawatiningsih, Budhi, Marhaeni, & Yuliarmi, 2023).

Food security is one of the main pillars in realizing national resilience. Food security is very important, especially for countries with very large and increasing populations like Indonesia. Because everyone's access to food is a human right, the quantity and quality of which must be guaranteed in a healthy and safe manner, food has always been an important topic in development, both nationally and internationally.

Figure 1. Indonesian Food Security Index According to the Global Food Security Index (2012-2021)



Source: Databoks, 2022.

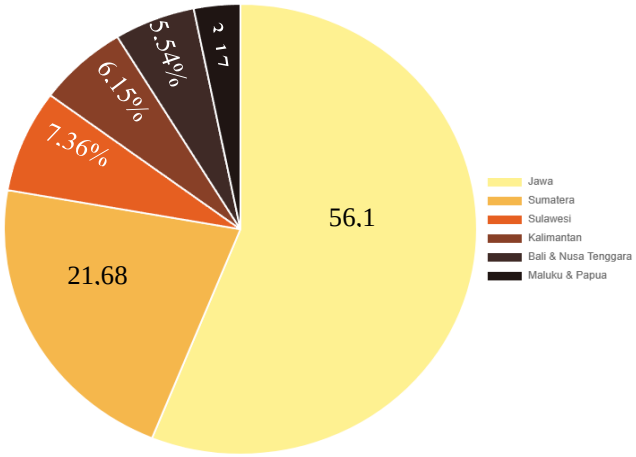
According to data Global Food Security Index (GFSI), Indonesia's food security in 2021 will experience a decline compared to the previous year. Global Food Security Index (GFSI) estimates that Indonesia's food security index score was 59.5 in 2020, but dropped to 59.2 in 2021, placing Indonesia 69th out of 113 countries.

It will cost a lot to develop food crops and guarantee food security in the future, thus it needs to be planned for in advance. Because it keeps being used for non-agricultural purposes like highways, industry, trade, and towns, the state of agricultural land, particularly rice fields, has become extremely concerning. In addition to macro-level (national and regional) food production, distribution, and provision, the food security and nutrition system also addresses micro-level factors, such as family and individual food access and nutritional status of household members. In order to ensure that the small details are not overlooked, appropriate tactics are employed in the national effort to meet food needs (Rusdiana & Maesya, 2017).

The main problem in realizing food security in Indonesia today is related to the growth in demand for food which is faster than the growth in supply. There are two sources of challenges in maintaining food security, namely from the demand side/demand and supply side/supply. Challenges on the demand side are caused by many factors, such as increasing demand from the increasing population, increasing people's purchasing power, increasing intensity of mass activities such as conferences, seminars, celebrating holidays, and increasing the number of tourist visits, especially in tourist areas.

Global population is expected to reach 9.7 billion by 2050 if current conditions continue, with an annual growth rate of about 1.1%. Despite the fundamental ambiguity in population projections, which has led to recent overestimations of population growth, it is 95% certain that the global population will be between 9.4 and 10.1 billion by that year (Molotoks, Smith, & Dawson, 2020). Indonesia, as the fourth most populous country in the world, has its own complexities. Population equality is something that must be done by issuing several regulations and policies.

Figure 2. Distribution of Indonesian Population by Island/Area



Source: Data goodstats, 2023.

The Central Statistics Agency (BPS) released 2020 Population Census data which describes the distribution of population in Indonesia based on islands/areas. Java Island, which is the center of Indonesia's economic activity, has the largest population percentage at 56.1%. Sumatra Island is in second place with 21.68% of the total population. This data shows that Java and Sumatra are the regions with the largest population distribution in Indonesia.

The second challenge comes from the supply side, in this case food production. The decline in agricultural land area, land and labor productivity, as well as the inadequate use of technology and the uneven development of infrastructure to distribute food are real challenges in providing food supplies. The main problem in the field of food availability is food production capacity which is decreasing and increasingly limited.

Based on the problems above, researchers are encouraged to conduct further research by formulating the problem of the influence of Rice Land Productivity, Population and Agricultural Labor on Food Security in the provinces of Java and Sumatra in 2019-2022, and with the aim of knowing and analyzing the influence each of these variables.

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LITERATURE REVIEW

Food Security

The term “food security” has many different definitions, but most people agree that what is meant is “access for all people at all times to sufficient food for a healthy life (secure access at all times to enough food for a healthy life)” as stated by the World Bank (1986) and Maxwell and Franken Berger (1992) (Suharyanto, 2011). Food security is a requirement for providing food for households in Indonesia as stated in Law no. 18 of 2012. This condition is reflected in: (1) the availability of sufficient food in both quantity and quality; (2) security; (3) equality; and (4) affordability (Fathi, Steven, Panggabean, & Tarina, 2022). With this concept, the following explanation of food security becomes more detailed:

Suryana (2008) investigates the role that dietary diversity and nutrition plays in bolstering the caliber of human capital. Agroecological factors, food production, availability, and distribution, variety of food, and promotion/advertisement are some of the external factors that affect the diversification of food consumption and nutrition. Individual factors that impact this diversity include income, preferences, beliefs (cultural and religious), and knowledge of nutrition (Yudita, Ashar, & Bintoro, 2021).

Fulfillment of food with sufficient availability conditions. This indicates that, in order to supply the body’s needs for carbohydrates, proteins, fats, vitamins, and minerals, as well as the compounds derived from these sources that are good for human health development, food availability in a wide sense encompasses food coming from plants, cattle, and fish. Second, fulfillment of food in safe conditions. This indicates that it is safe from religious regulations and devoid of biological, chemical, and other contaminants that could upset, hurt, or jeopardize human health. Third, fulfillment of food with even conditions. This means that food must be available at all times and evenly throughout the country. Fourth, fulfillment of food in affordable conditions. This means that food is easily obtained by households at affordable prices.

Food security is determined by a number of factors, according to the FAO (2014). These factors include food supply, access, stability, and usage. Availability, distribution, and consumption must all be considered when discussing food security. Food availability ensures that there is sufficient food to meet everyone’s needs in terms of quantity, quality, variety and safety. Distribution functions to create an effective and efficient distribution system to ensure that people can obtain food in sufficient quantities, sustainably, and at a reasonable cost. National food consumption patterns are directed by consumption factors to meet quality, diversity, nutritional content, safety and halal standards.

Large investments in the agri-food sector are needed as an enabling policy to realize these various initiatives, from infrastructure to the development and dissemination of technological innovations to expanding human resource capacity in agri-food. To increase food production capacity and facilitate food distribution between different times, places and income groups, it is also necessary to create strategic cooperation between the government and the private sector (BKP, 2021).

Rice Land Productivity

Productivity is the change in a product that results from the use of resources. According to Winardi, productivity is the number of results achieved by a person, namely units of other productivity factors within a certain period of time (Prabayanti, Sutrisno, & Antriyandarti, 2022). The decrease in the raw area of technically irrigated rice fields and other agricultural land is the issue facing efforts to enhance food production in Indonesia.

Land conversion, whereby agricultural land is transformed into homes or shopping malls, is the reason for the decline in agricultural land. The primary reason for the sale of vast tracts of agricultural land for use as residential and commercial real estate is the fact that farming produces a lower income than the industrial sector.

The productivity of rice land has an effect on increasing rice production, where when rice production increases it will reduce Indonesia's dependence on importing rice. The long-term standard of living of a nation depends on the nation's ability to achieve high and sustainable levels of productivity, this is used to achieve better product quality and higher efficiency in the production process. An economy that experiences productivity development will tend to have a high ability to compete, both in the form of price and quality of the products produced (Siringo & Daulay, 2014).

Population
Population is a group of people who reside, domicile or stay in a country's territory for a certain period of time and have fulfilled the requirements that apply in that country. The following explains the definition of population according to several experts:

Dr. Kartomo
Population refers to the total number of people living or occupying a particular area. Whether a citizen or not, a person can be considered a resident if he lives in a place inhabited by many people, and he chooses to remain there.

Jonny Purba
A resident or citizen is someone who defines himself as an individual, family member, citizen, or contributor to society and has a residence in a certain location, in a certain area, and at a certain time.

P. N. H. Simanjuntak
A person currently living in a country or region is considered a resident.

Srijnti dan A. Rahman
Individuals who, regardless of nationality, reside in a region or country are referred to as residents.

Thomas Robert Malthus was the first person to put forward a theory about population which became known as the Malthusian Theory. Then many views emerged as the development of Malthus's theory. In its first edition Essay on Population In 1798 Malthus expressed two main opinions, namely: (1) Food is an important factor for human life; (2) Human lust cannot be restrained. Malthus also said that population growth was much faster than food. As a result, in the future there will be a large difference between population and living needs. The theory put forward by Malthus is that the population tends to increase geometrically (a geometric series), while real living needs can increase arithmetically (arithmetic series) (Nurjanah, 2018).

Karl Marx and Friedrich Engels (1834) were the generation after Malthus. Marxists do not agree with Malthus, because according to him Malthus's ideology is contrary to human conscience. The difference in views between Marx and Maltus is that natural resources cannot be developed or keep up with the speed of population growth. According to Marx, population pressure in a country is not population pressure on food, but pressure on employment opportunities. Marx also argued that the greater the number of people, the higher the product produced, so there is no need to limit population (Nurjanah, 2018).

Agricultural Labor

According to Law number 13 of 2003 concerning employment. Labor is every person who aims to meet their own needs and those of society by doing work to produce goods or services. The population aged 15-64 years or the entire population of a country who, if there is demand, is able to participate in producing goods and services is called the workforce (Sudirman & Ahmadi, 2014). According to BPS and the National Employment Service, workers are residents aged 15 years or more, capable of doing work to produce goods and services. The value of work depends on the skills and desire of the workforce to do their job well. The output the company wants from its workforce is productivity. Labor is important because it is able to convert other resources into high-value and more useful products.

A worker in the agricultural industry who is employed by another individual, employer, or organization and receives compensation in the form of wages or goods, either on a daily or wholesale basis, is considered agricultural labor. This can apply to both household and non-household businesses. Plantations, forestry, animal husbandry, fishing, hunting, and food crop cultivation are examples of agricultural enterprises. Agricultural services are also included in this category.

RESEARCH METHOD

This research is descriptive and quantitative, meaning it uses secondary data, journal articles, and research findings related to food security and the factors that influence it. The variables used in this research are food security, rice land productivity, population and agricultural sector workforce in the provinces of Java and Sumatra in 2019 - 2022 which are sourced from Food Security and Vulnerability Atlas – (FSVA) and the Central Statistics Agency (BPS). The analytical tool used is panel data regression using Eviews to determine the best model, carry out classical assumption tests and significance tests.

To analyze research variables, researchers used panel regression and descriptive statistics. Regression using panel data combines cross data (cross section) and time series data (time series). There are several benefits to using panel data in observations. First, data time series and cross section can provide more data, so the greater the degrees of freedom, the more productive it will be. Second, combine data time series and cross section can overcome problems that arise when eliminating variables (Widarjono, 2013). In accordance with the panel data model, the general model equation can be written as:

$$Y_{it}=\beta_0+\beta_i X_{it}+e_{it} \quad \text{.....(1)}$$

This research is about the influence of rice land productivity, population and agricultural labor on food security in the provinces of Java and Sumatra, using data time series 4 years represented by annual data from 2019-2022 and data cross section as many as 16 data in the provinces of Java and Sumatra. The relationship between variables in the food security index according to Cobb Douglas theory is not linear, whereas analysis using regression of the relationship between variables must be linear in parameters to meet the BLUE criteria (Gujarati, 2003:224). In this research, the panel data regression function for determining food security in the provinces of Java and Sumatra Islands is written as follows:

$$Y_{it} = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + e_{it} \quad \text{.....(2)}$$

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Information:
Y = Food Security
X_1 = Rice Land Productivity
X_3 = Population
X_3= Agricultural Labor
β_0 = Constant
β_1, β_2, β_3, = Regression Coefficient
e = Standard error

RESULTS

Analysis of Determinants of Food Security

Panel Data Model Selection Test Results

Table 1. Hausman Test Results

Effect Test	Statistic	Prob.	The Right Model
Cross-section random	9,382222	0,0246	Fixed Effect Model

The random cross-section probability value, as determined by the Hausman test, is 0.0246 < α = 0.05, which means H_0 rejected and H_a accepted. So, the test results show that the best model that can be used is Fixed Effect Model.

Fixed Effect Model Estimation Results

Table 2. Fixed Effect Model Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-24.82688	22.27906	-1.114360	0.2710
X_1	0.528813	0.167551	3.156124	0.0029
X_2	2.570857	1.060695	2.423748	0.0194
X_3	0.461489	0.183343	2.517076	0.0155
	Effects Specification			
Cross-section Fixed (Dummy Variables)				
Root MSE	2.282035	R-squared		0.867589
Mean dependent var	72.91312	Adjusted R-squared		0.814625
S.D. dependent var	6.320922	S.E. of regression		2.721486
Akaike info criterion	5.081763	Sum squared resid		333.2919
Schwarz criterion	5.722681	Log likelihood		-143.6164
Hannan-Quinn criter.	5.334253	F-statistic		16.38064
Durbin-Watson stat	2.260269	Prob(F-statistic)		0.000000

Hypothesis Testing and Analysis

T Test

The df number is 40 where the t-table value with α = 5% (0.05) for the one-way test is 1.6706. The t test results show t-statistical results with t-tables for each variable as follows.

Rice Land Productivity

The results of the comparison between t-statistics and t-table for the rice land productivity variable are t-statistic 3.1561 > t-table 1.6706, meaning that rice land productivity has a significant influence on food security in the provinces of Java and Sumatra.

Population

The results of the comparison between the t-statistics and the t-table population variable are t-statistics 2.4237 > t-table 1.6706, indicating that the provinces of Java and Sumatra's food security is significantly impacted by population expansion.

Agricultural Labor

The results of the comparison between t-statistics and t-table of road infrastructure variables are t-statistics 2.5170 > t-table 1.6706, indicating that in the Java and Sumatra provinces, agricultural labor significantly affects food security.

F Test

According to the calculation results, we get the value of degree of freedom for numerator (dfn) = (k-1) = (4-1) = 3 and degree of freedom for denominator (dfd) = (n-k) = (64-4) = 60, then the F-table value is 2.75. Based on the regression output, the influence of rice land productivity, population and agricultural labor on food security with a significance of 5% (0.05) produces an F-statistic value of 16.3806, so that the F-statistic value (16.3806) > F- table (2.75). Furthermore, if we look at the F probability value of 0.0000, the F probability value is smaller than the significance level (0.05). Therefore, from the calculations it can be concluded that jointly or simultaneously the variables of fisheries production, rice land productivity, population and road infrastructure have an influence on food security.

Goodness of Fit (Coefficient of Determination)

The Adjusted R-squared value is 0.8146 or 81.46%. This indicates that changes in the independent variables of population, agricultural labor, and rice land productivity appropriately account for the impact on the dependent variable of food security. Put another way, changes in population, agricultural labor, and rice land productivity may account for 81.46% of the increase and fall in food security, whereas other factors not included in the model account for 18.54% of the fluctuation.

Classic Assumption Test

The Fixed Effect Model (FEM) was selected as the study model, and the multicollinearity and heteroscedasticity tests were employed as traditional assumption tests (Napitupulu et al., 2021).

Multicollinearity Test

Table 3. Multicollinearity Test Results

	X_1	X_2	X_3
X_1	1.000000	0.462147	0.296110
X_2	0.462147	1.000000	0.261028
X_3	0.296110	0.261028	1.000000

Source: Eviews data processing results.

In this work, the partial correlation approach using the rule of thumb (0.85) was utilized to test for multicollinearity. It is known that the values for the variables fisheries production, rice land productivity, road infrastructure, and population have values less than the Rule of Thumb (0.85). We may therefore infer that there are no issues with multicollinearity with the four independent variables employed in this study.

Heteroscedasticity Test

Tabel 4. Heteroscedasticity Test Results

Variabel	Prob.
X_1	0.5725
X_2	0.9498
X_3	0.4247

Source: Eviews data processing results.

The probability value of each variable in the Glejser test shows a value greater than α = 5% (0.05). This shows that the confounding variables in this research data have constant variance or are free from heteroscedasticity problems because all the probabilities of each variable are more than 0.05.

DISCUSSION

The Influence of Rice Land Productivity on Food Security

Rice Land Productivity influenced Food Security in the provinces of Java and Sumatra Islands in 2019-2022. The regression coefficient value for rice land productivity is 0.5288, indicating that, if all other factors remain constant, a one quintal/ha improvement in rice field productivity will have an impact on food security of 0.5288 points.

The higher the productivity of rice land, food security will improve as well. The findings of this study are consistent with those of Nubun and Yuliawati (2022), who found that productivity had an impact on food security. The productivity value is obtained from dividing the production amount by the harvested area. Therefore, when productivity is high, food security also increases.

The productivity of rice land will depend on the area or size of existing agricultural land. Indonesia's tourism sector is currently developing very rapidly, as a result of which there is a lot of conversion of agricultural land. The conversion of rice fields, apart from being used as a residence, is also influenced by the rapidly increasing need for tourism accommodation. Many of these tourist accommodations were built on former productive agricultural land. The choice to use this land is not without reason, one of which is the need for an attractive view or view. According to data reported by Bisnis.com on June 22 2022, the conversion of agricultural land to non-agricultural land is at 600 Ha and above. This condition can suppress the competitiveness of agricultural products in terms of quantity, because land area is an important factor in increasing production capacity which is of course related to productivity.

The Influence of Population on Food Security

The population size of the provinces of Java and Sumatra in 2019–2022 was found to have a substantial impact on food security, according to the findings of data analysis performed in a partial test (t test). The population regression coefficient value of 2.5708 indicates that for every million additional people added to the population, it will affect food security by 2.5708 points, assuming that other variables are constant.

The rate of population growth and the availability of land for agriculture are important factors that can influence food. The higher population increases, it can become a serious problem because it reduces the carrying capacity of the land. An increase in population will reduce the area of agricultural land used to produce food. Food security was often stronger in nations where population growth was predicted to slow down than in those where it was predicted to increase quickly (Molotoks, Smith, & Dawson, 2020).

According to the hypothesis proposed by Robert Malthus “The population growth rate is like a geometric series, and the food growth rate is like an arithmetic series”. Experiencing a natural resource crisis and scrambling to get food if the population growth rate is not suppressed. To avoid significant food shortages in the future, then, actions to mitigate the effects of projected population expansion are essential. These include narrowing the yield gap, improving maternal health care, and modifying trading patterns in addition to more equal access to food on a national scale.

The Influence of Agricultural Labor on Food Security

Agricultural labor has a significant influence on food security in the provinces of Java and Sumatra in 2019-2022. The regression coefficient value for agricultural labor is 0.4614, meaning that every time there is an increase in agricultural labor by one percent, it will affect food security by 0.4614 points, assuming that other variables are constant. According to research by Setiani, Pratiwi, and Fitrianto (2021), a farmer plays an important role in advancing a country. Without farmers, food needs will not be met properly because farmers are the main source of food providers. Indonesian farmers must pay attention so that Indonesia can continue to supply food obtained from the domestic agricultural sector. The success of agricultural production depends on several supporting factors, one of which is the good quality of human resources. If the supporting factors for farmers are met, they will produce good agricultural products and Indonesia’s food needs will not be threatened.

CONCLUSION

Food security in the provinces of Java and the Sumatra Islands is significantly impacted by rice land productivity in 2019–2022. In Java and Sumatra provinces between 2019 and 2022, population density has a major impact on food security. Food security in the provinces of Java and Sumatra is significantly impacted by agricultural labor in the years 2019–2022. Cooperation and an active role from the government and society are needed in optimizing the implementation of policies related to the protection of agriculture and human resources in order to maintain sustainable food security.

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DECLARATION OF CONFLICTING INTEREST

With regard to the research, writing, and/or publication of this work, the writers disclosed no potential conflicts of interest that would arise, purely for academic purposes.

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