

The Role of Human Development Index (HDI) and Population Growth in Improving Food Security from the Perspective of Defense Economics in Indonesia

Azizah Nur Rizkasari^{1*}, Sri Sundari², Haetami³

Indonesia Defense University

Coresponding Author: Azizah Noor Rizkasari azizahrizkasari@gmail.com

ARTICLE INFO

Keywords: Houthi Attacks, Red Sea, Maritime Security, Middle East Conflict, Global Trade

Received : 19 January

Revised : 28 February

Accepted: 27 March

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ABSTRACT

The issue of Indonesia's Human Development Index (HDI) has shown a consistent upward trend in recent years, accompanied by continuous population growth. Food security plays a crucial role in maintaining national stability, particularly in addressing hybrid threats that integrate both military and non-military dimensions, such as food crises and social unrest. This study aims to examine the impact of the Human Development Index and Population Growth on food security from 2019 to 2023. A quantitative research approach was employed, utilizing secondary data from 34 provinces in Indonesia. Panel data regression analysis was conducted using the Fixed Effect Model (FEM) approach. The findings indicate that the t-test probability value for the Human Development Index is 0.0000, which is below the significance threshold of 0.05, signifying a direct impact on food security. In contrast, the probability value for Population Growth is 0.3189, exceeding 0.05, indicating no direct influence on food security. Moreover, the F-test results suggest that the Human Development Index and Population Growth collectively influence food security, with 91.06% of the variance explained by these variables, while the remaining 8.94% is attributed to other factors

INTRODUCTION

The global food crisis has become one of the biggest challenges facing the world today and in the future. As the population continues to grow every year, the need for food is also increasing, while the available resources remain limited. This makes the food issue not only an economic issue, but also concerns social and security aspects. The food crisis can trigger social unrest that has the potential to develop into an armed conflict. For example, in Yemen, the severe food crisis caused by the war and blockade has led to widespread insecurity and prolonged armed conflict (Andrini, 2022). Food insecurity in Yemen has been one of the factors exacerbating the conflict situation in the country.

In the Indonesian Defense White Paper, the food crisis is even categorized as a threat that can have an impact on national stability and national security. If a country's food security is weak, the risk of social conflicts, economic instability, and dependence on food imports becomes even greater. Countries that do not have the capacity to produce food independently are often trapped in dependence on the global market. When international food prices increase or there are disruptions in supply chains, these countries can face a severe food crisis (Alfarizi & Ngatindriatun, 2023). In this context, countries that are unable to overcome the food crisis can become more vulnerable to conflict, both internal and external. Therefore, food security cannot be separated from the defense economy, because sufficient and equitable food availability is one of the main foundations in maintaining national stability.

Food security is a concept that includes three main aspects, namely availability, accessibility, and food utilization. In accordance with Law Number 18 of 2012 concerning Food, it emphasizes the responsibility of the state to ensure the availability of sufficient, safe, and quality food for all people. One of the key factors that affect food security is the Human Development Index (HDI), which reflects the level of education, health, and economic well-being of a region. The higher the HDI, the better the capacity of a community to manage and utilize the available food resources effectively. People with better levels of education tend to have wider access to agricultural information and technology, which can increase food productivity. Likewise with health, because good nutrition will produce more productive human resources and be able to contribute to the national food system. Higher incomes also play a role in increasing people's purchasing power for nutritious and quality food.

Indonesia has continued to show an increasing trend in recent years. In 2024, Indonesia's HDI will reach 75.02, an increase of 0.63 points or 0.85% compared to the previous year which was 74.39 (BPS, 2024). Thus, building food security is not only about ensuring the availability of foodstuffs, but also about improving the overall quality of human life. Strong food security not only ensures the welfare of the community, but also becomes part of the country's defense strategy that ensures long-term social and economic stability.

Rapid population growth is a major challenge for many countries, including Indonesia, in facing food security issues. Food security, which includes the availability of sufficient, nutritious, and affordable food, is increasingly threatened by the growing population. From the perspective of the defense economy, population growth could increase pressure on domestic food production, exacerbate dependence on imports, and threaten economic and social stability. Maintained food security is an important element in strengthening the country's resilience, both in the face of internal and external threats. Therefore, the relationship between population growth, food security, and the defense economy needs to be understood as an effort to ensure national stability and sovereignty.

LITERATURE REVIEW

Defense economics is a branch of science that studies how economic resources are allocated and used for national defense purposes (Sundari, 2024). Defense economics as a discipline that analyzes the economic impact of defense policy (Hartley & Sandler, 1995). Poor food security can weaken the defense economy because it creates social and economic instability, which in turn weakens a country's defense capability. Food stability and community welfare are important components in maintaining national stability and the country's military capacity. Food instability can trigger conflicts and social chaos, which can ultimately become a threat to national security and affect the defense economy (Brinkman & Hendrix, 2011).

The main goal of the study of defense economics is to achieve effectiveness and efficiency in every defense process carried out in order to create a sense of security from existing threats (Yusgiantoro, 2014). Therefore, in studying an issue, defense economics cannot stand alone, but needs to be complemented by the study of other disciplines, such as macroeconomics, microeconomics, public economics and development economics.

Defense economics is a new relative field in the discipline of economics: studying all aspects of the economics of war and peace, covering a wide range of topics in macro and microeconomics. Discuss theory, empirical and policy, in normal/peaceful, war and post-war circumstances. The subject matter in defense economics is the analysis of economic decisions for the benefit of state prosperity and national security (Supandi, 2018).

Food security refers to a condition in which stable and sustainable access to essential food staples is ensured over the long term, encompassing both availability and affordability (Maxwell, 1996). According to the Republic of Indonesia Law No. 18 of 2012 on Food, food security is defined as a condition in which the state and individuals have access to adequate food supply, both in terms of quantity and quality. This includes food that is safe, diverse, nutritious, equitable, and affordable, while also aligning with religious, cultural, and societal values. Food security ensures that individuals can maintain a healthy, active, and productive life in a sustainable manner.

The Human Development Index (HDI) has a significant role in increasing food security in a country. Understanding the relationship between these two indicators is crucial, as HDI measures quality of life and development rates, including access to adequate and nutritious food. Research shows that good food security conditions contribute positively to social and economic progress, which in turn can increase HDI (Jakaria et al., 2022).

As Obayelu explains, food security and human development are inextricably linked. The quality of human resources, built through education and health, has a direct effect on agricultural productivity and household income, as well as reducing food insecurity (Obayelu, 2019). This means that to improve food security, investment in human resource development is very important. This is in line with Conceição's opinion which emphasizes that without simultaneous progress in food security and human development, both aspects cannot develop optimally (Conceição et al., 2011).

Population growth plays an important role in determining food security in a country. As a key indicator of social and economic growth, rapid population growth can worsen food security conditions, especially in areas with limited natural resources. Research shows that an increase in population numbers has the potential to trigger an increase in demand for goods and services, including food, which if not balanced with increased food production, can lead to food insecurity Ahmed & Elasaag (2023). As Islam et al. demonstrate, there is a significant correlation between population growth and food production, which affects each other in the context of food security in Pakistan (Islam et al., 2023).

When the population increases but food production cannot keep up, households face potential food insecurity. The study also emphasizes that to address this problem, attention needs to be paid to increasing agricultural output to support the needs of a growing population. Not only in Pakistan, but also in other countries experiencing rapid population growth, the impact on food security can be seen. Hall et al. in their research on The effects of population growth and climate change in Africa underscore that a rising population influences agricultural production capacity, which in turn has significant implications for future food security (Hall et al., 2017). In the absence of appropriate adaptation measures, such as an increase in environmental practices or an increase in food imports, this can result in significant food uncertainty. Løvendal and Knowles explain that rapid population growth is closely linked to increased food demand, which in turn can reveal vulnerabilities in food security systems around the world, especially in developing countries (Løvendal & Knowles, 2007).

METHODOLOGY

This research employs a quantitative approach to examine the relationship between the independent variables—Human Development Index and Population Growth—and the dependent variable, Food Security. The study utilizes panel data, which integrates cross-sectional observations across multiple time periods. The data is sourced from the National Food Security Agency and the Central Statistics Agency (BPS). For data analysis, this study applies the EViews 12 software, utilizing three estimation models: the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM) (Ajija, Sari, Setianto, & Primanti, 2019).

RESULT AND DISCUSSION

This study examines the Independent variable, namely the human development index and population growth on the dependent variable, namely Food Security. The following is an explanation of the influence of each independent variable on the dependent variable.

Uji Lagrange Multiplier

The LM test was carried out to select the best model between the Common Effect Model (CEM) and the Random Effect Model (REM).

H0 = Common Effect Model

Ha = Random Effect Model

Table 1. Lagrange Multiplier Test

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	148.7868 (0.0000)	0.559174 (0.4546)	149.3460 (0.0000)

The result of the Lagrange Multiplier (LM Test) where The cross-section value is 0.0000, which is lower than the significance level ($\alpha = 5\%$ or 0.05). Consequently, the null hypothesis H₀ is rejected, and the alternative hypothesis Ha is accepted. This indicates that the Random Effect Model (REM) is more appropriate than the Common Effect Model (CEM).

Chow Test

The Chow test is used to help choose the best model between the Common Effect Model or the Fixed Effect Model.

H0 = Common Effect Model

Ha = Fixed Effect Model

Table 2. Chow Test

Effects Test	Statistic	d.f.	Prob.
Cross-section F	18.802293	(33,134)	0.0000
Cross-section Chi-square	293.791148	33	0.0000

The Chow Test results indicate that the probability value of Cross-section F is 0.0000, which is lower than the predetermined significance level ($\alpha = 5\%$ or 0.05). As a result, the null hypothesis H_0 is rejected, and the alternative hypothesis H_a is accepted. This finding suggests that the Fixed Effect Model (FEM) is more suitable than the Common Effect Model (CEM).

Hausman Test

The Hausman test is used to determine the best model between the Fixed Effect Model (FEM) or the Random Effect Model (REM).

H_0 : Random Effect Model (REM)

H_a : Fixed Effect Model (FEM)

Table 3. Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	21.174150	2	0.0000

The Hausman Test results indicate that the probability value of the Cross-section Random is 0.0000, which is below the predetermined significance level ($\alpha = 5\%$ or 0.05). As a result, the null hypothesis H_0 is rejected in favor of the alternative hypothesis H_a , suggesting that the Fixed Effect Model (FEM) is more appropriate than the Random Effect Model (REM). Therefore, based on the estimation of the panel data model, the Fixed Effect Model (FEM) is identified as the most suitable model for this study.

Normality Test

Normality test was conducted to determine whether each variable follows a normal distribution. The assessment was performed using the Jarque-Bera (J-B) Test at a significance level of $\alpha = 5\%$. If the test result exceeds the significance threshold of $\alpha = 0.05$, the data can be considered normally distributed. Conversely, if the result is below $\alpha = 0.05$, the data is deemed not to follow a normal distribution.

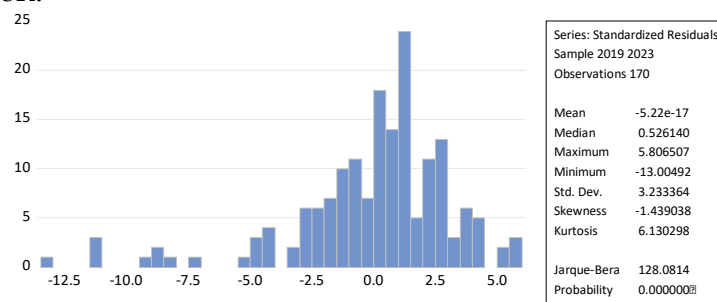


Figure 1. Normality Test

Based on the output results above, it shows that the value of Jarque-Bera is 123.1814 with a probability of 0.00000. With a probability value of 0.00000 which is smaller than the significant level of 0.05, it can be concluded that the data in this study is not normally distributed. In the Gujarati study (2003) stated that if the data of the research sample is small or limited, less than 100 observations, then the assumption of normality is considered important to do, as it will help to get the exact probability distribution of the OLS estimator, and it is also possible to use the statistical *u* *t* and *F* for the regression model. Thus, although the data in this study were not normally distributed based on processing through EViews 12, because the observation data was quite large (170), the normality test could be ignored.

Multicollinearity Test

The multicollinearity test aims to test whether a correlation between independent variables is found in the regression model. In a good regression model, there should be no correlation between the independent variables. The results of the multicollinearity test are shown in table 4.7 below:

Table 4. Multikolinieritas Test

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	1286.098	16581.81	NA
X1	0.243603	16109.25	1.178398
X2	0.712548	22.10602	1.178398

Based on Table 5, the results of the multicollinearity test show that between the independent variables, namely the Human Development Index (X1) and Population Growth (X2), there is no multicollinearity because the Centerd Variance Inflation Factor (VIF) value is below 10.

Heteroskedastisity Test

The heterokedasticity test is carried out before the classical assumption test which aims to find out whether or not heterokedasticity exists using the white test. If the Obs*R-Squared value in the short-term regression exceeds the significance level of $\alpha = 5\%$, it indicates that the model does not exhibit heteroskedasticity. The following are the results of the heterokedasticity test using the White test:

Table 5. Heteroskedastisity Test

F-statistic	23.46383	Prob. F(5,164)	0.0000
Obs*R-squared	70.89547	Prob. Chi-Square(5)	0.0000
Scaled explained SS	106.4368	Prob. Chi-Square(5)	0.0000

Table 6, you can see the Prob value. The Chi-Square value of Obs*R-Squared is 0.0972, which exceeds the significance threshold of 0.05, indicating the absence of heteroskedasticity in the model.

Autocorrelation Test

The autocorrelation test is conducted to determine whether there is a correlation between sequentially ordered observations within the dataset. To identify the presence of autocorrelation, the Durbin-Watson (DW) test is employed, with the following criteria:

- a) A DW value below -2 indicates the presence of negative autocorrelation.
- b) A DW value ranging between -2 and +2 suggests the absence of autocorrelation.
- c) A DW value exceeding +2 signifies the presence of positive autocorrelation.

Table 6. Autocorrelation Test

Durbin-Watson stat	1.774754
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In Table 6, it is known that the results of the autocorrelation test are based on the Durbin-Watson stat value of 1.774754, where the value is greater than -2 and smaller than 2 ($-2 < 1.774754 < 2$), meaning that there is no autocorrelation.

T Test

This test was conducted to assess the extent to which each independent variable individually influences the dependent variable while assuming other variables remain constant. If the regression results indicate a probability value below the significance level ($\alpha = 0.05$), the independent variable is considered to have a statistically significant effect on the dependent variable. Conversely, if the probability value exceeds $\alpha = 0.05$, the independent variable is deemed to have no significant impact on the dependent variable. The results of the t-test are presented as follows:

Table 7. T Test

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-156.2656	35.86221	-4.357390	0.0000
X1	3.163442	0.493562	6.409411	0.0000
X2	0.844511	0.844126	1.000457	0.3189

Referring to Table 7, the coefficient value of the Population Number (X1) variable is 0.0000, which is below the significance threshold of $\alpha = 5\%$ ($0.0000 < 0.05$). Consequently, the null hypothesis H_0 is rejected, while the alternative hypothesis H_a is accepted, indicating that the Human Development Index (HDI) variable has a statistically significant direct effect on the Food Security variable. This finding suggests that an increase in the Human Development Index positively influences Food Security in Indonesia during the 2019–2023 period.

The Population Growth variable (X2) exhibits a probability value of 0.3189, which exceeds the significance threshold of $\alpha = 5\%$ ($0.3189 > 0.05$). Consequently, the null hypothesis H_0 is accepted, while the alternative hypothesis H_a is rejected, indicating that Population Growth does not have a direct impact on Food Security in Indonesia during the 2019–2023 period. This finding suggests that fluctuations in population growth do not influence the level of food security in Indonesia over the specified timeframe.

F Test

The simultaneous test, commonly referred to as the F-test, is conducted to evaluate the collective influence of all independent variables on the dependent variable. This test determines whether the independent variables, when considered together, significantly impact the dependent variable. The F-test assessment is based on the probability value, where a value lower than the significance level ($\alpha = 0.05$) indicates that the independent variables have a statistically significant effect on the dependent variable. Conversely, if the probability value exceeds $\alpha = 0.05$, it suggests that the independent variables do not exert a significant influence on the dependent variable. The results of the F-test are presented as follows:

Table 8. F Test

R-squared	0.910654	Mean dependent var	71.55735
Adjusted R-squared	0.887318	S.D. dependent var	10.81726
S.E. of regression	3.631161	Akaike info criterion	5.602553
Sum squared resid	1766.834	Schwarz criterion	6.266604
Log likelihood	-440.2170	Hannan-Quinn criter.	5.872017
F-statistic	39.02256	Durbin-Watson stat	1.774754
Prob(F-statistic)	0.000000		

Referring to Table 8, the probability value of the F-statistic is 0.0000, which is below the significance level of $\alpha = 5\%$ ($0.000000 < 0.05$). As a result, the null hypothesis H_0 is rejected, and the alternative hypothesis H_1 is accepted, indicating that the Human Development Index and Population Growth variables collectively have a significant impact on the Food Security variable in Indonesia during the 2019–2023 period.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

The findings of this study highlight the critical role of food security in sustaining social and economic stability, which ultimately contributes to a nation's defense economy. The results indicate a significant correlation between the Human Development Index (HDI) and population growth with food security in Indonesia.

The results of the study show that HDI has a positive and significant influence on food security. The higher the HDI of an area, the better the food security. This is due to better education, health, and economic well-being factors in societies with high HDI, which contributes to increased food production and more equitable distribution. Better education allows people to adopt more advanced agricultural technologies, while access to good health services supports labor productivity in the agricultural sector.

High population growth tends to put negative pressure on food security. As the population grows, the demand for food increases, which if not balanced with increased food production, can lead to an imbalance in food availability. In addition, rapid population growth can increase dependence on food imports, which ultimately weakens a country's defense economy due to instability

From the perspective of the defense economy, food security is a key element in maintaining national stability. Countries with good food security will be better able to face external and internal threats, including potential social conflicts caused by food scarcity. Therefore, policies that focus on increasing HDI through education and health, as well as effective population growth management strategies, are urgently needed to ensure sustainable food security and support economic resilience and national security.

Recommendation

Based on the results of research on the relationship between food security, the Human Development Index (HDI), and population growth in the perspective of the defense economy, there are several strategic recommendations that can be implemented by the Ministry of Defense and the Ministry of Agriculture to strengthen national stability and state sovereignty:

1. For the Ministry of Defense, increasing cooperation with the Ministry of Education and Culture and the Ministry of Health to strengthen the development of the Human Development Index (HDI) as a strategic element in national resilience. Develop food security policies that are oriented towards increasing HDI, with a focus on improving farmers' welfare and accessibility to agricultural technology. Increase investment in research and development (R&D) in the food sector to improve efficiency and productivity, given that high HDI correlates with increased food security.
2. For the Ministry of Agriculture, Develop training and education programs for farmers and workers in the agricultural sector to improve skills in the use of modern agricultural technology. Collaborate with universities and research institutions to develop agricultural innovations based on science and technology (IPTEK). Increase incentives for the younger generation to be involved in the agricultural sector through agricultural entrepreneurship programs and financial incentives for young farmers. Increasing public access to nutritious food with food diversification programs and the development of local foods based on balanced nutrition. Encourage policies that focus on improving farmers' welfare through stabilizing agricultural product prices and providing social security for farmers.

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