JEJ
Jambura Equilibrium Journal

Volume 7. Issue 2. July 2025
P-ISSN 2655-9110
E-ISSN 2656-0445
http://ejurnal.ung.ac.id/index.php/equij

The Effect of Harvest Area, Rice Productivity, and Population Density on Food Security in NTT Province 2018-2023

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Abstract: *Food security is one of the main keys to realizing the welfare of the people in Indonesia. Currently, Indonesia is still experiencing serious food security problems, especially rice availability. Based on the Central Bureau of Statistics 2024, the highest level of insecurity across Indonesia is in East Nusa Tenggara Province, with a value of 14.68%. Meanwhile, the population in East Nusa Tenggara Province is quite large, with more than 5 million people. If the level of vulnerability is at the highest rank, it can be said that East Nusa Tenggara Province has very low food security. This study aims to analyze the effect of rice harvest area, rice productivity, and population density on food security in 21 districts and 1 city of East Nusa Tenggara Province from 2018 to 2023. This study uses secondary data in the form of panel data. The sample used in this study is data from 22 districts and cities in East Nusa Tenggara Province for 6 periods, with details, namely 22 x 6 = 132. This study found that simultaneously, the variables of rice harvest area, rice productivity, and population density in East Nusa Tenggara Province had a significant effect on food security. While partially obtaining results, namely the variable area of rice harvest and rice productivity, there is a significant effect on food security. The total population variable has no significant effect on food security.*

Keywords: Rice Harvest Area; Rice Productivity; Population Density; Food Security

Article History:

Received on 18 Nov 2024
Revised on 04 Jan 2025
Accepted on 21 Jan 2025

Doi: 10.37479

Indexing:
Google Scholar; Portal Garuda; Crossref; SINTA 3 (Science And Technology Index)

INTRODUCTION

Globally, food security has become an important issue that can affect all human lives (Onwe et al., 2024). Food security has become an important part of realizing people's welfare in Indonesia. Food security is defined as the ability to obtain sufficient or appropriate food in a socially acceptable manner to lead an active and healthy life (Hodges & Sweeney, 2024). Food security is achieved when all people can meet their physical, social, and economic needs regularly in their daily lives. Thus, food security will be achieved if the community has the ability, through physical, social, and economic means, to meet food needs. To overcome the problem of food security, especially in agriculture, the Indonesian government has diverted the use of modern agricultural technology and increased crop productivity.

Currently, Indonesia is still experiencing serious food security problems, especially rice availability. Based on the Global Food Safety Initiative (GSFI) ranking, Indonesia is still inferior to Singapore. Despite the fact that Indonesia has a large area of land to be developed into a larger productive economy than Singapore (Lembaga Riset Dan Ekonomi Kemanusiaan, 2020). Inflation of food prices in the world has caused global insecurity to increase, including Indonesia, which currently still imports basic food needs. Communities on small islands are at the forefront of being most vulnerable to this crisis because they have to pay more for food (Kompas Id, 2024). Based on the Central Bureau of Statistics 2024, the highest level of insecurity throughout Indonesia is in East Nusa Tenggara Province, with a value of 14.68%. Food insecurity is a problem in poverty, which affects the social groups with the weakest or most fragile food rights, both in terms of access to social networks and safety nets

or productive assets (capital, land, agricultural inputs) (Adeyeye, 2017). Meanwhile, the population in East Nusa Tenggara Province is quite large, with more than 5 million people. If the level of vulnerability is at the highest first rank, it can be said that East Nusa Tenggara Province has very low food security. One of the sectors that has a major role in food security is the agricultural sector. Problems that can threaten the value of food security that are not included in socio-economic problems are shrinking agricultural land area and falling production values due to climate change. Malthus' theory explains that population growth can put high pressure on agricultural resources, negatively impacting agricultural productivity and reducing food supply (Mahrous, 2019). Malthus' view states that increasing food production is a game of counting and increasing population production (Dewi Sartikasari, 2023).

A larger harvested area contributes to increased food availability, especially in areas that depend on rice as the main food source. If the harvested area decreases, rice availability may decrease, increasing the risk of food insecurity. Conversely, an increase in harvested area can strengthen food security. High productivity indicates efficiency in food production and can increase food reserves. If productivity is low, even if the harvested area is large, the yield may still be insufficient for the population's needs, which may trigger food insecurity. Therefore, increasing rice productivity is important to strengthen food security. High population density increases the demand for food. If population growth is not matched by an increase in food production, shortages may occur. This increases the risk of food insecurity, especially in areas with limited resources. On the other hand, areas with low population density tend to find it easier to maintain food security as long as food production is sufficient. In general, high rice harvest areas and productivity can strengthen food security by providing a more food supply. However, if population density increases without a corresponding increase in food availability, food insecurity may occur.

Some research on food security is a study (Nkoko et al., 2024) which analyzed factors related to food security among smallholder farming households in Lesotho and concluded that socioeconomic factors that can affect the achievement of household food security such as the number of household members, household income, education, and marital status. The findings suggest that agricultural development interventions should be more sensitive to food security as well as nutrition, which includes training farmers on nutrition and food security issues. Meanwhile, according to research (Dewi Sartikasari, 2023) regarding the analysis of factors affecting rice food security in Bojonegoro Regency concluded that the variables of rice stock, rice production, and population simultaneously have a significant influence on rice food security in Bojonegoro Regency.

Another study conducted (Prasetya, 2024) on analyzing the effect of population, food availability, food consumption, and strategic food prices on the food security index in Indonesia found that population, food availability, and food consumption did not show a significant effect on the Food Security Index. In contrast, strategic food prices harm the Food Security Index. Overall, when considering all variables together, namely Population, Food Availability, Food Consumption, and Strategic Food Prices, there is a significant influence on the Food Security Index, although the effect is very slight. According to (Nubun, 2022), the results show that individually the variable rice harvest area is insignificant and positively related to food security, rice productivity individually has a significant effect and is negatively related to food security, population individually has a significant effect and is negatively related to food security and rainfall is individually insignificant and positively related to food security. While simultaneously, the variables of rice harvest area, rice productivity, population, and rainfall on food security in Central Java Province have a significant influence on food security.

From these studies, the authors took several factors to be tested, so that this study differs from previous studies, which lie in the use of variables. The variables used in this study include rice harvest area, rice productivity, and population. The three variables will then be analyzed to determine how much influence, or even no influence on food security in East Nusa Tenggara Province. By referring to some of the previous research above, the author can determine the hypothesis that the variable rice harvest area (x1) is not significant, the variable rice productivity (x2) has a significant effect, and the variable population density has a significant effect on the food security variable (y). While simultaneously, the variables of rice harvest area, rice productivity, and population density have a significant effect on food security.

METHODOLOGY

This research was conducted in September-October 2024 online using data from the Central Bureau of Statistics of East Nusa Tenggara Province. This study uses a quantitative type and approach, with independent variables and dependent variables that form the affected variables. Quantitative research can be said to be a type of approach that must be objective, include the collection and analysis of quantitative data, and must go through statistical tests.

Population and Sample

This study uses probability sampling techniques to determine the sample. The population used includes all districts and cities in East Nusa Tenggara Province, totaling 21 districts and 1 city. The sample used in this study is 22 districts and cities in East Nusa Tenggara Province for 6 periods, with details, namely 22 x 6 = 132. So, it can be concluded that this study used 132 samples.

Data Collection Technique

Data collection techniques in this research were carried out through literature and documentation studies. Data

collection technique through literature study and documentation is a method used to obtain information or data by collecting various references from books, articles, journals, and other documents relevant to the research topic. The documentation technique is data collection through written documents, recordings, photographs, or existing archives. The data collected can be in the form of financial reports, diaries, meeting minutes, correspondence, photos, videos, or other statistical data that have been previously documented.

Data Analysis Technique

Based on the problems that have been identified, the authors perform data analysis techniques using the panel data regression analysis method. Panel data regression analysis techniques are carried out using time series data and cross-sectional data, because data from several objects or subjects are combined in several periods. The data analysis method begins with testing the determination of the panel data regression model. The goal is to be able to decide the right model to use, such as the common effect, fixed effect model, or random effect model. Researchers use quantitative data analysis techniques using multiple linear regression for the data processing process and use Eviews 12 software for the data analysis process, including model preparation and variable determination as follows:

$$Y = f(X1, X2, X3) \ldots\ldots\ldots\ldots (1)$$

Multiple linear regression is a linear regression in which the dependent variable (Y) is associated with three or more variables with independent variables (X). In general, the form of the equation is below:

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + e \ldots\ldots\ldots\ldots..(2)$$

Then the two equations are transformed into logarithmic form as below:

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + e$$

Description:

Y	= Food Security
X1	= Harvest Area
X2	= Rice Productivity
X3	= Total Population
β0	= Constant
β1,β2,β3	= Regression Coefficient
e	= Error

RESULTS

Overview of East Nusa Tenggara Province

East Nusa Tenggara (NTT) is one of the provinces located in the southeastern part of Indonesia. East Nusa Tenggara Province has hundreds of small islands, and there are also large islands such as Flores Island, Sumba Island, Timor Island, Alor Island, and Rote Island. The capital of this province is located in Kupang. Geographically, it is located between latitudes 8° N to 12° N, and longitudes 118° East to 125° East. East Nusa Tenggara Province has boundaries to the east, namely the country of Timor Leste and the Timor Sea, to the west, namely West Nusa Tenggara Province (NTB), to the south, the Indian Ocean, and to the north, the Flores Sea. NTT has hilly and mountainous natural conditions. Some areas have vast savannas, especially on Sumba Island. The province has a tropical climate, but tends to be drier than other provinces in Indonesia, especially in the dry season.

Selection of Panel Data Regression Estimation Model

1. F Statistical Test (Chow Test)

The Chow Test is conducted to determine the model that will be used, namely between the Common Effect Model (CEM) or using the Fixed Effect Model (FEM). The Chow test has the following assessment qualifications where when (p-value> 0.05) the CEM estimation model is selected, and when (p-value < 0.05) the FEM estimation model is selected. The Chow test results are shown in Table 1.

Table 1. Chow Test

Redundant Fixed Effects Tests Equation:
Untitled

Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.

Cross-section F	0.601668	-21,107	0.9095
Cross-section Chi-square	14.733414	21	0.8361

Source: Eviews 12, 2024

From the test results in the table above, the cross-section Chi-Square value is 0.8361, which means the p-value> 0.05. So the conclusion is obtained using the Common Effect estimation model.

2. Uji Hausman

The Hausman test is conducted in order to determine the estimation model between the Random Effect model and the Fixed Effect model. The Hausman test has an assessment qualification, where when (p- value> 0.05) then REM is chosen, but when (p-value < 0.05) then FEM is chosen. The Hausman test results are shown in Table 2.

Table 2. Hausmann Test

Correlated Random Effects - Hausman Test Equation: Untitled

Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	1.541466	3	0.6727

Source: Eviews 12, 2024

From the results of the table test above, it can be seen that the cross-section random value is 0.2775, which means that the p-value> 0.05. So the conclusion is that the Random Effect estimation model is selected.

3. Lagrange Multiplier (LM) Test

The LM test is carried out to determine the estimation model between the Random Effect Model (REM) and the Common Effect Model (CEM). The LM test has an assessment qualification, namely when (p-value <0.05), then REM is chosen, but when (p-value> 0.05), then CEM is chosen. The Hausman test results are shown in Table 3.

Table 3. LM Test

Lag range Multiplier Tests for Random Effects Null hypotheses: No effects
Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives

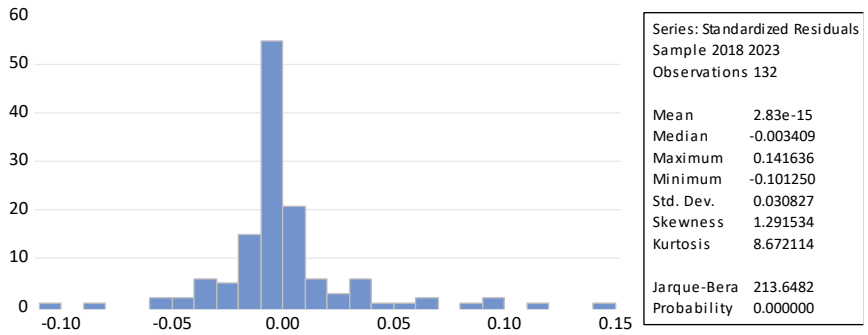
	Cross-section	Test Hypothesis Time	Both
Breusch-Pagan	2.311722	28.17443	30.48616
	-0.1284	0	0
Honda	-1.520435	5.30796	2.678184
	-0.9358	0	-0.0037
King-Wu	-1.520435	5.30796	4.103599
	-0.9358	0	0
Standardized Honda	-1.107782	6.001421	-0.69188
	-0.866	0	-0.7555
Standardized King-Wu	-1.107782	6.001421	1.513619
	-0.866	0	-0.0651
Gourieroux, et al.	--	--	28.17443
			0

Source: Eviews 12, 2024

Based on the test results of the table above, it can be seen that the Breusch-Pagan cross-section value is 0.0000, which means that the p-value <0.05. So that the conclusion is obtained that the Random Effect estimation model is chosen.

4. Normality Test Results

Table 4. Normality Test



Source: Eviews 12, 2024

There is a Jarque-Bera value of 213.6482, which means p<0.05, so it is concluded that the data is normally distributed.

5. Multicollinearity Test Results

Table 5. Multicollinearity Test

	LOGX1	LOGX2	LOGX
LOGX1	1	0.12631089...	-0.4777897...
LOGX2	0.12631089...	1	0.17653249...
LOGX3	-0.4777897...	0.17653249...	1

Source: Eviews 12, 2024

The Multicolonierity test aims to find out how the correlation between independent variables during the regression formula. Based on the table above, it can be seen that none of the variable coefficient values are> 10, so the conclusion is that there is no multicollinearity in this research data.

6. Heteroscedasticity Test Results

Table 6. Heteroskedasticity Test

Heteroskedasticity Test: White
Null hypothesis: Homoskedasticity

F-statistic	0.828347	Prob. F(9,122)	0.5913
Obs*R-squared	7.601677	Prob. Chi-Square(9)	0.5747
Scaled explained SS	27.41994	Prob. Chi-Square(9)	0.0012

Source: Eviews 12, 2024

From the table of Heteroscedasticity Test results above, it can be seen that the p-value = 0.5913, which means> 0.05, and the conclusion is that the data is free from indications of heteroscedasticity.

7. Analysis of Panel Data Regression Results

From the results of the Chow test, Hausman test, and Lagrange Multiplier test, it is concluded that the Random Effect model (REM) estimation model is the best to use in this study.

Table 7. Regression Analysis

Dependent Variable: LOGY Method: Panel Least Squares Date: 10/11/24 Time: 20:03 Sample: 2018 2023
Periods included: 6
Cross-sections included: 22
Total panel (balanced) observations: 132

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.508575	0.036205	-14.04715	0

LOGX1	1.000569	0.002636	379.5321	0
LOGX2	0.970747	0.01365	71.11576	0
LOGX3	0.002049	0.004046	0.506555	0.6133
R-squared	0.999397	Mean dependent var		9.412105
Adjusted R-squared	0.999383	S.D. dependent var		1.255331
S.E. of regression	0.031186	Akaike info criterion		-4.067831
Sum squared resid	0.124492	Schwarz criterion		-3.980473
Log likelihood	272.4768	Hannan-Quinn criter.		-4.032333
F-statistic	70708.63	Durbin-Watson stat		2.380705
Prob(F-statistic)	0			

Source: Eviews 12, 2024

From the table above, the multiple linear regression equation formed is:

Where:

Y = Food Security
X1 = Harvest Area
X2 = Rice Productivity
X3 = Total Population
β0 = Constant
β1,β2,β3 = Regression Coefficient
e = Error

8. Simultaneous Test (F Test)

The F-test is used to determine whether the independent variables simultaneously affect or have no influence on the dependent variable. From the test results above, using the random effect model, it can be seen that the probability value of the F-test is 0.0000. Based on the significance level of 0.05%, the F-test has a significant influence on food security in 21 districts and 1 city in East Nusa Tenggara Province. So, it is concluded that the three independent variables simultaneously have a significant effect on the dependent variable, namely food security in 21 districts and 1 city in East Nusa Tenggara Province.

9. Coefficient of Determination (R2 Test)

This R2 test is needed to determine how much influence the independent variable (independent) has on the dependent variable (dependent).

Table 8. R2 test

R-squared	0.999397	Mean dependent var	9.412105
Adjusted R-squared	0.999383	S.D. dependent var	1.255331
S.E. of regression	0.031186	Akaike info criterion	-4.067831
Sum squared resid	0.124492	Schwarz criterion	-3.980473
Log likelihood	272.4768	Hannan-Quinn criter.	-4.032333
F-statistic	70708.63	Durbin-Watson stat	2.015876
Prob(F-statistic)	0		

Source: Eviews 12, 2024

Based on the test results above, the R-squared value is 0.999397, which means that the contribution of the independent variable to the dependent variable is 99.9% and the rest is influenced by other external variables.

DISCUSSION

Rice harvest area (X1) on food security (Y)

From the test results through the Random Effect Model, it can be seen that the t-count probability value is 0.0000 <0.05, which means that the rice harvest area variable (X1) has a significant effect on food security (Y). Meanwhile, according to previous research by Nubun and Yuliawati (2022), it was found that the size of the rice harvest did not have a significant effect on food security.

The results of the analysis of rice harvest area have a significant effect on food security in East Nusa Tenggara Province. This shows that the increase in rice harvest area in East Nusa Tenggara Province causes food security to remain stable or even increase. Based on BPS East Nusa Tenggara (2023), the rice harvest area in 2023 reached around 184.70 thousand hectares, an increase of 1.61 thousand hectares or 0.88 percent compared to the rice harvest area in 2022, which amounted to 183.09 thousand hectares. There are several factors that influence the increase in harvest area in East Nusa Tenggara Province. Some of the findings in the field that can strengthen the increase in rice harvest areas such as the factor of the larger land area, the use of labor, and the

increase in infrastructure technology, such as irrigation and others.

An increase in rice harvest area will occur and will tend to increase the availability of rice as a staple food. With increasing rice production, the supply of rice on the market will also increase, which has the potential to maintain rice price stability and reduce the risk of shortages. So that food security can be achieved.

Rice productivity (X2) on food security (Y)

From the test results through the Random Effect Model, it can be seen that the t-count probability value is 0.0000. Regarding $p<0.05$, it means that the variable Rice productivity (X2) has a significant influence on food security (Y). The results of this test agree with the results of research conducted by Sartikasari & Purnomo (2023), where they found that rice production has a significant effect on the ratio of rice availability as a proxy for rice food security in Bojonegoro Regency. The similarity of these results strengthens the argument that rice productivity is one of the important factors in ensuring food availability, especially rice, which is the staple food in many regions.

From the results of the above analysis, it is known that the rice productivity variable has a significant effect on food security in 22 districts/cities in East Nusa Tenggara Province. Which means that rice productivity has increased, which causes an increase or stability of food security, because rice productivity is obtained from the results of the amount of production divided by the harvest area, so that it only knows productivity, the smaller the amount of food availability ratio obtained, the better food security. If rice productivity increases, the yield per hectare will also increase, even though the land area used remains the same. This will increase the amount of rice available in the market, thus meeting the consumption needs of the community and reducing the risk of food scarcity. With the fulfillment of food scarcity, food security will also be achieved. Increasing rice productivity can therefore be a key strategy in strengthening food security.

Total population (X3) on food security (Y)

From the test results through the Random Effect Model, it can be seen that the t-count probability value is 0.6133. With reference to $p>0.05$, it means that the total population density variable (X2) has no significant effect on food security (Y). These results agree with research conducted by Prasetya (2024), which found that population does not significantly affect the value of food security in Indonesia. Meanwhile, based on the results of research conducted by Nkoko et al (2024), it is found that the number of household population influences food security.

Based on BPS NTT (2023), the population in 2023 increased by 5,569,068 people compared to 2022, of 5,466,285 people. When the population increases, the demand for food will also increase. This requires an increase in food production to meet the growing demand. If food production cannot keep up with population growth, there will be instability in food availability. When there is instability in the fulfillment of food needs, community food security will decrease.

Rice harvest area (X1), Rice productivity (X2), Total population (X3) on food security (Y)

From the test results above, it is found that the variable population density alone does not affect food security variables. So we can conclude that the variables of rice harvest area, rice productivity, and population density together or simultaneously have a significant effect on food security variables. These three variables are interrelated and affect food security. For example, if the rice harvest area increases but the productivity is low, then food security will not be guaranteed. Likewise, if rice productivity is high but population density is very high, food security will also be threatened. The larger the harvested land area, the more rice is produced. This can increase food availability, thus contributing positively to food security. High productivity means producing more paddy from each hectare of land. Thus, even if the harvested area does not change, an increase in productivity will increase the amount of paddy available for consumption. The higher the population density, the higher the demand for food. If the increase in population is not matched by an increase in paddy production, there could be a decline in food security as demand exceeds availability.

CONCLUSION

This study aims to analyze the effect of rice harvest area, rice productivity, and population density on food security in 21 districts and 1 city of East Nusa Tenggara Province. Based on the results of the analysis, it can be concluded that:

1. The variable of rice harvest area (x1) has a significant influence on the variable of food security (y). This statement can be taken because an increase in the area of rice harvest has an effect that will tend to increase the availability of rice as a staple food. With the increase in rice production, the supply of rice in the market also increases, which has the potential to maintain rice price stability and reduce the risk of scarcity, so that food security can be achieved.

2. The rice productivity variable (x2) has a significant influence on the food security variable (y). This is because as rice productivity increases, the yield per hectare will also increase, even though the land area used remains the same. This will increase the amount of rice available in the market, so as to meet the consumption needs of the community and reduce the risk of food scarcity. With the fulfillment of food scarcity, food security will also be achieved.

3. The variable population density (x3) does not affect the food security variable (y). This is because the increase in population is followed by an increase in food production in order to meet the growing needs. So, if food production cannot keep up with the growth in population, there will be instability in food availability in the fulfillment of food security.

4. Simultaneously, the variables of rice harvest area, rice productivity, and population density affect food security.

REFERENCES

Adeyeye, S. A. (2017). The role of food processing and appropriate storage technologies in ensuring food security and food availability in Africa. Nutrition & Food Science, 47(1). http://dx.doi.org/10.1108/NFS- 03-2016-0037

Ahmad Arif, Frans Pati Herin, Saiful Rijal Yunus, Y. S. (2023). Darurat Kemandirian Pangan di Kepulauan. Kompas.Id. Mengutip sumber internet URL: https://www.kompas.id/baca/humaniora/2023/10/13/rawan-pangan-di-kepulauan

Amhamed, A., Genidi, N., Abotaleb, A., Sodiq, A., Abdullatif, Y., Hushari, M., & Al-Kuwari, M. (2023). Food security strategy to enhance food self-sufficiency and overcome international food supply chain crisis: the state of Qatar as a case study. Green Technology, Resilience, and Sustainability, 3(1). https://doi.org/10.1007/s44173-023-00012-8

BPS. (2024a). Kepadatan Penduduk (Jiwa/km2), 2015-2024. Badan Pusat Statistik. https://ntt.bps.go.id/id/statistics-table/2/NTM2IzI=/kepadatan-penduduk.html

BPS. (2024b). Ketersediaan Pangan Untuk Konsumsi Per Kapita Sehari Menurut Kelompok Bahan Makanan dan Protein (gram), 2021-2022. Badan Pusat Statistik. https://ntt.bps.go.id/id/statistics-table/2/NTE3IzI=/ketersediaan-pangan-untuk-konsumsi-per-kapita-sehari-menurut-kelompok-bahan-makanan-dan-protein--gram-.html

BPS. (2024c). Luas Panen Padi (Hektar), 2018-2023. Badan Pusat Statistik. Luas Panen Padi (Hektar), 2021-2023

BPS. (2024d). Produktivitas Padi menurut Kabupaten Kota (Ton/Hektar), 2021-2023. Badan Pusat Statistik. https://ntt.bps.go.id/id/statistics-table/2/OTM1IzI=/produktivitas-padi-menurut-kabupaten-kota--ton-hektar-.html

Cruz-Sánchez, Y., Aguilar-Estrada, A., Baca-del Moral, J., & Monterroso-Rivas, A. I. (2024). The availability of food in Mexico: an approach to measuring food security. Agriculture and Food Security, 13(1), 1–16. https://doi.org/10.1186/s40066-024-00484-2

Dewi Sartikasari, D. P. (2023). Analisis Faktor Yang Mempengaruhi Ketahanan Pangan Beras Di Kabupaten Bojonegoro Tahun 2017-2021. Economics and Digital Business Review, 4(1), 649–654.

Dossa, K. F., & Miassi, Y. E. (2023). Exploring the nexus of climate variability, population dynamics, and maize production in Togo: Implications for global warming and food security. Farming System, 1(3), 100053. https://doi.org/10.1016/j.farsys.2023.100053

Dröge, S., Poudyal, M., Hockley, N., Mandimbiniaina, R., Rasoamanana, A., Andrianantenaina, N. S., & Llopis,

J. C. (2022). Constraints on Rice Cultivation in Eastern Madagascar: Which Factors Matter to Smallholders, and Which Influence Food Security? Human Ecology, 50(3), 493–513. https://doi.org/10.1007/s10745-022-00336-2

He, J., Osabohien, R., Yin, W., Adeleke, O. K., Uduma, K., Agene, D., & Su, F. (2024). Green economic growth, renewable energy and food security in Sub-Saharan Africa. Energy Strategy Reviews, 55(June), 101503. https://doi.org/10.1016/j.esr.2024.101503

Hodges, C., & Sweeney, S. (2024). Food security change in the college student population due to the COVID-19 pandemic: A decline for many, an improvement for a few. Social Sciences and Humanities Open, 9(September 2023), 100820. https://doi.org/10.1016/j.ssaho.2024.100820

Mahrous. (2019). Climate change and food security in EAC region: a panel data analysis. Review of Economics and Political Science, 4(4), 270–284. http://dx.doi.org/10.1108/REPS-12-2018-0039

Matondang, Z., Si, M., Fakultas, D., Islam, B., & Padangsidimpuan, I. (2016). KETAHANAN PANGAN DALAM PENINGKATAN PEMBANGUNAN EKONOMI SERTA KAITANNYA DALAM PANDANGAN ISLAM Zulaika Matondang, M.Si. Dosen Fakultas Ekonomi dan Bisnis Islam IAIN Padangsidimpuan. 24–39.

Mutungi, C., Manda, J., Feleke, S., Abass, A., Bekunda, M., Hoschle-Zeledon, I., & Fischer, G. (2023). Adoption and impacts of improved post-harvest technologies on food security and welfare of maize-farming households in Tanzania: a comparative assessment. Food Security, 15(4), 1007–1023. https://doi.org/10.1007/s12571-023-01365-5

Nkoko, N., Cronje, N., & Swanepoel, J. W. (2024). Factors associated with food security among small-holder farming households in Lesotho. Agriculture and Food Security, 13(1), 1–10. https://doi.org/10.1186/s40066-023-00454-0

Onwe, J. C., Ojide, M. G., Subhan, M., & Forgenie, D. (2024). Food security in Nigeria amidst globalization, economic expansion, and population growth: A wavelet coherence and QARDL analysis. Journal of Agriculture and Food Research, 18(July), 101413. https://doi.org/10.1016/j.jafr.2024.101413

Phillips, J., Durand-Morat, A., Nalley, L. L., Graterol, E., Bonatti, M., Loaiza de la Pava, K., Urioste, S., & Yang, W. (2024). Understanding demand for broken rice and its potential food security implications in Colombia. Journal of Agriculture and Food Research, 15(August 2023), 100884. https://doi.org/10.1016/j.jafr.2023.100884

Polykarvos Nubun, Y. (2022). PENGARUH LUAS PANEN PADI, PRODUKTIVITAS, JUMLAH PENDUDUK DAN CURAH HUJAN TERHADAP KETAHANAN PANGAN DI PROVINSI JAWA TENGAH. Jurnal Pemikiran Masyarakat Ilmiah Berwawasan Agribisnis, 8(2), 583–594.

Prasetya, A. W. Y. (2024). Analisis Pengaruh Jumlah Penduduk, Ketersediaan Pangan, Konsumsi Pangan, Dan Harga Pangan Strategis Terhadap Indeks Ketahanan Pangan. Jurnal Pertahanan Dan Bela Negara, 14(2), 82–102.

Wilayah, D. I., Besuki, K., Nadhirah, A., Napitupulu, T. S., & Marseva, A. D. (2023). ANALISIS SEBARAN PRIORITAS KETAHANAN PANGAN DI WILAYAH KARESIDENAN BESUKI. Jurnal Pemikiran Masyarakat Ilmiah Berwawasan Agribisnis, 9(2), 2606–2628.