
Analysis of household food security post pandemic in Mukomuko District, Bengkulu Province

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Abstract The results of multinomial logistic regression analysis highlighted several variables significantly impacting on household food security. Of the eleven independent variables, only two had significantly influenced on household food security, namely average expenditure and adequate sanitation. This study can serve as a foundation for strategic policy decisions by the Mukomuko Regency regional government. The findings can also act as an early warning system in case of a decline in the food security index, whether due to the pandemic or other factors. In addition, at the national level, Indonesia still has the same agricultural problems as before, namely labor, inputs, land use changes, etc. Indonesia needs to work harder to advance agriculture as a career, integrate agriculture to increase farmers' incomes, and increase agricultural intensification to cover its limited agricultural land. Import dependence is increased the possibility of problems in the future. Overemphasis on rice as the main ingredient to achieve food security is caused by other problems. Food diversification programs need to be advanced with more regulations and activities.

Keywords: Bengkulu province, Household food security, Post pandemic

Introduction

Food security was one of the most important issues, especially in developing countries. In Indonesia, the staple food was rice, and the vast majority of Indonesians consumed rice as their primary source of carbohydrates. Rice was a crucial commodity for Indonesia, not only as a staple food but also as the main source of income for millions of farmers. Furthermore, the availability of rice at affordable prices was an important factor for national food security, public safety, and government stability.

Food availability, food accessibility, and food utilization were the three primary components of food security in addition to food stability as defined by the Food and Agriculture Organization (FAO). The ability to have enough food to meet basic needs was known as food availability. The ability to have the

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financial and material means to receive wholesome food was known as food accessibility. The capacity to appropriately and proportionately employ food items was known as food utilization. Food insecure conditions were frequently linked to the genesis of several issues. Nutritional issues, such as malnutrition in children under five, arose from not having access to nourishing food (Hackett *et al.*, 2009; Motbainor *et al.*, 2015). Furthermore, food insecurity was associated with the number of obesities in women (Franklin *et al.*, 2011; Pan *et al.*, 2012) and chronic diseases (Seligman *et al.*, 2010; Gowda *et al.*, 2012). Food insecurity was associated with anxiety, sadness, and hazardous sexual activity (Vogenthaler *et al.*, 2013). It was also linked to risky coping mechanisms and unfavorable pregnancy outcomes in women (Ivers and Cullen, 2011). Moreover, there were wider societal effects of food insecurity, such as delayed mental development of children (Rose-Jacobs *et al.*, 2008; Slopen *et al.*, 2010). Aforementioned facts emphasized how important it was for food systems to be robust and resistant to disruptions such as pandemic (Roubík *et al.*, 2022; Devereux *et al.*, 2020).

Efforts to increase rice productivity continued to be made, even as the area of harvested land decreased and the population increased. Indonesia showed a downward trend in rice production and rice harvest area over the past 6 years from 2018 (up to 59 million Tons) to 2023 (Around 10 Million Tons). This condition was compounded by the population that continued to increase from year to year.

While aggregate rice production in Indonesia showed a downward trend, Mukomuko Regency in Bengkulu Province had been relatively successful in maintaining its rice production levels. Although the harvested area and rice production fluctuated from 2018 to 2023, the amount was still relatively stable and had not shown a downward trend. On the other hand, harvested area and rice production at Nasional and Province level showed a downward trend. During 2018-2023, the lowest rice harvested area in Mukomuko Regency was 3,752 ha and occurred in 2021 after the pandemic. The highest rice harvested area in Mukomuko Regency was 6,232 ha and occurred in 2020. In line with the harvested area, rice production in Mukomuko Regency was the lowest at 20,945 tons in 2021 and the highest at 37,105 in 2020.

The harvested area and rice production in Mukomuko Regency had a significant impact on the food security index. From 2018 to 2023, Mukomuko Regency consistently ranked in the "food secure" and "very food secure" categories. The food secure category had a score between >67.75 - 75.68 and the very food secure category has a score >75.68.

From a conceptual standpoint, food security functioned at different levels of hierarchy: the community (district, province), the macro (global, regional, and national), and the micro (household, individual) (Purwaningsih, 2008; Pinstруп-

Andersen, 2009; Jones *et al.*, 2013). Food availability on its own did not, on a macro level, guarantee good individual nutritional status (Barrett, 2010). There might be enough food in a certain location, but not every home able to acquire it. As a result, the household was crucial in guaranteeing that each member had access to food that was both sufficient in quantity and quality. While Lantarsih *et al.* (2011) contended that regional food security did not always guarantee the establishment of food security at the household level.

The percentage of the population living in poverty, the proportion of households spending over 65% of their income on food, and the proportion of households without access to electricity were the indicators of the food access subsystem. Income had a big impact on how much a household spent, especially on food consumption habits. Consumption habits tend to diversify with rising affluence, which increased the consumption of nutrient-dense foods (Yudaningrum, 2011; Purwaningsih, 2008).

Consumption typically rose or fell in tandem with changes in income (Pujoharso, 2013). Variations in income levels resulted in patterns of income distribution, which influenced household consumption patterns. Those with little money typically prioritized taking care of their eating needs, devoting a sizeable amount of their earnings to food expenses. As the percentage of money spent on food decreased, social wellbeing rises.

The food utilization subsystem's indicators included the proportion of households without access to clean water, the average number of years that women over the age of 15 had attended school, the population density to health worker ratio, life expectancy, and the proportion of stunted toddlers (Yuliantini *et al.*, 2022). Family income, maternal education, low birth weight, premature birth, non-exclusive breastfeeding, birth time, and deficiencies in macronutrients and micronutrients were consistent risk factors for stunting among children in coastal areas.

Sukiyono *et al.* (2015) claimed that the basic needs of farmers and fishermen limited the realization of food security in coastal areas. The existence of food insecurity was determined by whether the household had taken out a loan to cover essential expenses.

These illustrations could be used as a basis for estimating factors that can influence household food security. Household food security in Mukomuko Regency can serve as a role model. The purpose of this study was to provide a descriptive overview of household food security after pandemic and to identify the variables that affected household food security in Mukomuko Regency.

Materials and methods

This study analyzed the measurement of household food security in Mukomuko District post pandemic starting in 2021. The type of response variable was a categorical data (Agresti, 2013). It began with involves calculating and categorizing the response variable which was household food security by using an expenditure approach (Maxwell *et al.*, 2000). The proportion of food expenditure and level of energy consumption illustrated the variable response. It was determined by dividing household food expenditure by total household expenditure, which could be calculated using the following formula:

$$PF = \frac{PP}{TP} \times 100\%$$

PP meant Household Food Expenditures (Rp/Month) and TP meant Total Household Expenditures (Rp/Month). The Proportion of Food Expenditure (PF) was calculated by dividing PP by TP and then multiplied by 100% (Ilham and Bonar, 2007).

Energy consumptions were calculated from the volume of food consumed and the nutrients contained therein using the formula:

$$TKE = \frac{\sum \text{Energy Consumption}}{\text{Recommended AKE}} \times 100\%$$

Information:

The Energy Consumption Rate (%) or TKE was calculated by dividing $\sum$ Energy Consumption by recommended AKE (Energy Adequacy Rate (kcal/capita/day)) and then multiplied by 100%.

Cross-classification of PF and TKE that measured the degree of food security at the household level could be seen in the table 1.

Table 1. Measuring the degree of household food security

Energy Consumption	Proportion of Food Expenditure (Proportion of Food Expenditures to Total Expenditures)	
	Low	High
	(<60% Total Expenditures)	(≥60% Total Expenditures)
Sufficiently (>80% recommended energy consumption)	I (Food Security)	II (Food Vulnerable)
Less (≤80% recommended energy consumption)	III (Lack of Food)	IV (Food Insecurity)

The table provided the response variable that measured household food security divided by four categories, each defined as follows:

Food security: Households in this category had adequate access to food and their food needs were met satisfactorily.

Food vulnerable: Despite having access to food, these household prioritized food needs in their expenditure, ensuring adequate energy consumption.

Lack of food: These households prioritized non-food needs on their expenditure, resulting unsatisfied food needs.

Food insecurity: In this category, households lacked adequate access to food and their food needs remained unmet.

After identifying the response variable, this research involved multinomial logistic regression analysis to identify the factors that affected to household food security. The last step aimed to validate the model formed. The process typically involved several stages, outlined as follows:

The independence test was carried out to determine whether there existed a relationship between each predictor variable and the response variable (Agresti, 2013). The chi-square test (χ^2) was used for this purpose:

$$\chi^2 = \sum_{i=1}^a \sum_{j=1}^b \frac{(n_{ij} - m_{ij})^2}{m_{ij}}$$

n_{ij} were observation value in row i column j and m_{ij} were expected value in row i column j with hypothesis H_0 and H_1 . H_0 meant “there was no relationship between household food security and each of the factors that influence it” and H_1 meant “there was a relationship between household food security and each of the factors that influence”. H_0 rejection criteria: if $\chi^2 > \chi^2_{\alpha, (i-1)(j-1)}$ or P-value $< \alpha$ then H_0 was rejected. In other words, the model was deemed suitable for use.

This analysis was continued by using simultaneous testing. Simultaneous testing was conducted to assess the collective influence of the predictor variables on the response variable (Agresti, 2013). Testing was done using the likelihood test with the following equation:

$$G^2 = -2\ln \left[\frac{\left(\frac{n_1}{n}\right)^{n_1} \left(\frac{n_2}{n}\right)^{n_2} \dots}{\prod_{j=1}^b \pi_1(x)^{y_{1j}} \pi_2(x)^{y_{2j}} \dots} \right]$$

The hypothesis employed in this context were H0 and H1. H0 meant “there was no single factor that significantly influences household food security” and H1 meant “there was at least one factor that significantly influences household food security”. The decision-making procedure entailed rejecting H0 if $\chi^2 > \chi^2_{0,05}$ or P-value $< \alpha$.

For partial testing to evaluate the influence of each the predictor variable on the response variable (Fargerland and Horner, 2012). The test statistics for partial testing used the Wald test, represented by the following equation:

$$W^2 = \frac{\beta_j^2}{SE(\beta_j^2)}$$

$SE(\beta_j^2)$ explained coefficient standard error and β_j^2 was coefficient value of estimated predictor variable W2. If the P-value $< \alpha$ or $W^2 > \chi^2_{(\alpha,v)}$ then reject H0. Hypotheses for partial testing were H0 and H1. H0 meant $\beta_j = 0$ and H1 meant $\beta_j \neq 0, j = 1, 2, \dots, 13$

The suitability test of the model was conducted using Goodness of Fit. This test helped evaluate the predicted results aligned with the observed results. The Goodness of Fit could be represented by the following equation:

$$C = \sum_{i=1}^n \frac{(O_i - n_i \pi_i)^2}{n_i \pi_i (1 - \pi_i)}$$

Information:

O_i were observations in the group-i. π_i meant probability of observing the group-i and n_i were the number of observations in the group-i.

Determining the decision result, if the P-value $> \alpha$ or $C > \chi^2_{(\alpha,v)}$ then accepted H0 and the model was suitable for use. Hypotheses for partial testing were the model feasible for H0 and unfeasible for H1. If the model was unfeasible, the best model could be selected using the Stepwise method (Idman *et. al.*, 2022).

Results

Secondary data from the National Socio-Economic Survey (SUSENAS), spanning post pandemic, was used and created by the Central Bureau of Statistics (BPS) of Mukomuko Regency. This data incorporated individual, household and community data at the district levels (Table 2).

Table 2. Characteristics of respondents

No	Item	n	Proportion	
1	Household_Food_Security	Food Security	534	46.8%
		Food Vulnerable	363	31.8%
		Lack of Food	156	13.7%
		Food Insecurity	88	7.7%
2	Classification_City_Rural	City	177	15.5%
		Rural	964	84.5%
3	Home_Ownership_Status	Private Property	934	81.9%
		Rent	24	2.1%
		Rent Free	91	8.0%
		Accommodation Official Residence	92	8.1%
4	Type_of_Lighting	PLN Postpaid	1075	94.2%
		PLN Prapaid	42	3.7%
		Non PLN	24	2.1%
5	Type_of_Cooking_Fuel	No Cooking/ Dine out	4	0.4%
		Electricity	3	0.3%
		LPG 5,5	9	0.8%
		LPG 12	47	4.1%
		LPG 3	1034	90.6%
		Kerosene	2	0.2%
		Firewood	42	3.7%
6	PKH	Yes	164	14.4%
		No	977	85.6%
7	Source_of_Income	Work	1113	97.5%
		Jobless	25	2.2%
		Investment	1	0.1%
		Pension	2	0.2%
8	Assurance_Ownership	Yes	161	14.1%
		No	980	85.9%
9	Dept_Ownership	Yes	364	31.9%
		No	777	68.1%
10	Adequate_Sanitation	Yes	558	48.9%
		No	583	51.1%
11	Average Household	1141	100.0%	
12	Number of Dependent	1141	100.0%	

Based on the independence test, where the significance value was less than α (0.05) for all independent variables, H_0 was rejected. This suggested a

relationship between household food security in Mukomuko Regency and the five factors that influenced it (Table 3). Therefore, it concluded that there was sufficient evidence to support the existence of a relationship between five factors and household food security in Mukomuko Regency at a significant level $\alpha=0.05$. The five factors were number of dependent, home ownership status, assurance ownership, adequate sanitation, and average household expenditure.

Table 3. First independence test

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	2311.521 ^a	0.000	0	
Number_of_Dependent	2501.166	189.645	3	0.000
Average_Expenditure	2517.102	205.580	3	0.000
Classification_City_Rural	2311.951	0.430	3	0.934
Home_Ownership_Status	2329.729	18.208	9	0.033
Type_of_Lighting	2320.641	9.120	6	0.167
Type_of_Cooking_Fuel	2331.820	20.299	18	0.316
PKH	2314.714	3.193	3	0.363
Source_of_Income	2321.800	10.279	9	0.328
Assurance_Ownership	2319.863	8.341	3	0.039
Dept_Ownership	2315.636	4.115	3	0.249
Adequate_Sanitation	2324.714	13.193	3	0.004

When the significance value, or p-value, was less than α (0.05), the results of the independence test were, in fact, supported by the results of the simultaneous testing. The result was household food security was considerably influenced by at least one factor (Table 4).

Table 4. First simultaneous test

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	2714.139			
Final	2311.521	402.618	63	0.000

However, the results of the model suitability test using the goodness of fit test showed a p-value of 0.000 ($<\alpha=0.05$). The model was not suitable for use is illustrated in Table5.

Table 5. First suitability test

	Goodness-of-Fit		
	Chi-Square	df	Sig.
Pearson	32263.752	3357	0.000
Deviance	2311.521	3357	1.000

Based on the results of the model goodness-of-fit test, it showed that the model was not yet feasible. The next step was carried out the stepwise method to determine the best model. The used criteria were factors or independent variables with $p\text{-value} < \alpha$ (0.05) and which determined whether the predictor variable was included in the model or not. Another criterion was to check whether the results of the model formed met the model feasibility requirements at $\alpha > 5\%$.

The result of the stepwise method were two independent variables that entered the model. The results of the model suitability test using the goodness of fit test showed a $p\text{-value}$ of 0.094 ($>\alpha=0.05$). It concluded that the model was feasible to use (Table 6).

Table 6. Final suitability test

	Goodness-of-Fit		
	Chi-Square	df	Sig.
Pearson	3523.133	3414	0.094
Deviance	2580.983	3414	1.000

The independence and simultaneous tests were repeated according to the stepwise results. Based on the independence test, it could be seen that both independent variables had a significance value $<\alpha$ (0.05) and it could be concluded to reject H_0 . This result shown in table 7. that there was a relationship between household food security in Mukomuko Regency and the two factors that influenced it. Or it could be concluded that there was sufficient evidence to show that there was a relationship between average household expenditure and adequate sanitation on household food security in Mukomuko regency at $\alpha = 0.05$. This was certainly in line with the results of the simultaneous test. The result illustrated that household food security was considerably influenced by at least one factor (Table 8).

Table 7. Final independence test

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	2580.983 ^a	0.000	0	
Average_Expenditure	2702.043	121.060	3	0.000
Adequate Sanitation	2594.167	13.184	3	0.004

Table 8. Final simultaneous test

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	2714.139			
Final	2580.983	133.156	6	0.000

Based on the Interpretation of the odds ratio from the multinomial logistic regression analysis in Table 9: For the "food vulnerable" category: The odds of being classified as "food vulnerable" who had adequate sanitation which were approximately 1.12 times greater than whose was not adequate sanitation. For the "lack of food" category: The odds of experiencing "lack of food" who had adequate sanitation are approximately 0.64 times greater than whose was not adequate sanitation. For the "food insecurity" category: The odds of facing "food insecurity" who had adequate sanitation were approximately 0.60 times greater than whose was adequate sanitation.

Table 9. Final partial test

Variabel	Food Vulnerable		Lack of Food		Food Insecurity	
	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)
Intercept	0.00	0.00	0.58	0.00	0.33	0.00
Average Expenditure	0.00	1.00	0.00	1.00	0.00	1.00
[Adequate Sanitation=Yes]	0.40	0.89	0.02	1.56	0.03	1.68
[Adequate Sanitation=No]						

This finding strengthened the conclusion drawn from the multinomial logistic regression analysis, which showed that 5 out of 11 variables used had a significant effect on household food security at $\alpha=0.05$. However, if referring to the model fit requirements, there were only two variables that had a significant effect on household food security at $\alpha=0.05$, namely average household expenditure and adequate sanitation.

Discussion

The results of multinomial logistic regression analysis highlighted several variables significantly impacting on household food security. Surprisingly, of the eleven independent variables, only two had significant influenced on household food security, namely average expenditure and adequate sanitation. These two factors could be used as a basis for strategic policy decisions by the Mukomuko Regency regional government. The findings could also act as an early warning system in case of a decline in the food security index, whether due to the

pandemic or other factors. Furthermore, the results of this study could be used as a reference for future research.

Apart from these factors, there were also various technical factors that could be taken into consideration. Some evidence was found in the US and Canada. The COVID-19 pandemic had a more significant effect on the global food supply chain (GFSC) and food security since it disrupted the latter and increased food insecurity. A weak economy, a shortage of farm workers, restrictions on food accessibility, restrictions on the transportation of agricultural commodities, shifts in consumer demand, the closure of food production facilities, uncertainty about the quality and safety of food, restrictions on food trade policies, delays in the transportation of food products, etc. were just a few of the ways that the pandemic has impacted the GFSC (Alabi and Ngwenyama, 2023).

In Indonesia, it was possible to consider food security in both rural and urban areas. Prior to the onset of the pandemic, 27,4% of Indonesians residing in urban areas reported feeling insecure, a proportion that had undoubtedly increased due to the epidemic, according to a study by Kharisma and Abe (2020). In a country like Indonesia that was not self-sufficient, Greenville *et al.* (2020) contend that food exports had to be stopped in order to concentrate on supplying domestic food demand. the BULOG could be maximized in its ability to release food stock, and dietary awareness could boost immunity (Rozaki, 2020). But Indonesia still had the same old agricultural problems with regard to manpower, inputs, changing land usage, etc. Indonesia needed to work more to promote agriculture as a career, integrate agriculture to increase farmer incomes, and increase agricultural intensification in order to make up for its small amount of farmland. Import dependency increased the likelihood of problems later on. Overemphasizing rice as the main ingredient to achieve food security led to another issue. The food diversification program needed to be advanced with more regulations and activities (Rozaki, 2021).

Conflicts of interest

The authors declare no conflict of interest.

References

- Alabi, M. O. and Ngwenyama, O. (2023). Food security and disruptions of the global food supply chains during COVID-19: building smarter food supply chains for post COVID-19 era. *British Food Journal*, 125:167-185.
- Agresti, A. (2013). *Categorical Data Analysis* 3th edition. Florida, John Willey and Sons Inc, pp. 207-237.

- Barrett, C. B. (2010). Measuring Food Insecurity. *Science*, 327:825-828.
- Ilham, N. and Bonar, M. S. (2007). The use of food expenditure share as a composite indicator of food security. *SOCA: Jurnal Sosial Ekonomi Pertanian*, 7:1-22.
- Devereux, S., Béné, C. and Hoddinott, J. (2020). Conceptualising COVID-19's impacts on household food security. *Food Security*, 12:769-772.
- Fargerland, M. W. and Hosmer, D. W. (2012). A generalized HosmerLemeshow goodness-of-fit test for multinomial logistic regression models. *The Stata Journal*, 12:447-453.
- Franklin, B., Jones, A., Love, D., Puckett, S., Macklin, J. and White-Means, S. (2011). Exploring mediators of food insecurity and obesity: A review of recent literature. *The Journal of Community Health*, 37:253-264.
- Gowda, C., Hadley, C., and Aiello, A. E. (2012). The association between food insecurity and inflammation in the US adult population. *American Journal of Public Health*, 102:1579-1586.
- Greenville, J., Mcgilvray, H., Cao, L. Y. and Fell, J. (2020). Impacts of COVID-19 on Australian agriculture, forestry and fisheries trade. Canberra, Australia. Retrieved from <https://www.agriculture.gov.au/abares/research-topics/trade/impacts-of-COVID-19-on-Australian-trade>
- Hackett, M., Melgar-Quinonez, H. and Álvarez, M. C. (2009). Household food insecurity associated with stunting and underweight among preschool children in Antioquia, Colombia. *Revista Panamericana de Salud Pública*, 25:506-510.
- Idman, M., Talangko, L. P. and Sahriman, S. (2022). Application of stepwise method and dominance analysis in binary logistic regression (Case Study: Hypertension Data in Indonesia). *Journal of Statistics and Its Application*, 3:76-86.
- Ivers, L. C. and Cullen, K. A. (2011). Food insecurity: special considerations for women. *American Journal of Clinical Nutrition*, 94:1740S-1744S.
- Jones, A. D., Ngure, F. M., Peltó, G., and Young, S. L. (2013). What are we assessing when we measure food security? A Compendium and Review of Current Metrics. *Advances in Nutrition*, 4:481-505.
- Kharisma, V. and Abe, N. (2020). Food insecurity and associated socioeconomic factors: Application of Rasch and Binary Logistic Models with household survey data in three megacities in Indonesia. *Social Indicators Research*, 148:655-679.
- Lantarsih, R., Widodo, S., Darwanto, D. H., Lestari, S. B. and Paramita, S. (2011). National food security system: contribution of energy availability and consumption and optimizing rice distribution. *Analisis Kebijakan Pertanian*, 9:33-51.

- Maxwell, D., Levin, C., Armar-Klemesu, M., Ruel, M., Morris, S. and Ahiadeke, C. (2000). Urban livelihoods and food and nutrition security in Greater Accra, Ghana. In Research Report of the International Food Policy Research Institute 112. Retrived from <https://doi.org/10.2499/0896291154rr112>
- Motbainor, A., Worku, A. and Kumie, A. (2015). Stunting is associated with food diversity while wasting with food insecurity among under five children in East and West Gojjam Zones of Amhara Region, Ethiopia. *PLoS One*, 10:1-14.
- Pan, L., Sherry, B., Njai, R. and Blanck, H. M. (2012). Food insecurity is associated with obesity among US Adults in 12 States. *Journal of the Academy of Nutrition and Dietetics*, 112:1403-1409.
- Pinstrup-Andersen, P. (2009). Food security: definition and measurement. *Food Security*, 1:5-7.
- Pujoharso, Cahyo. (2013). Application of keynes' theory of consumption to the consumption patterns of indonesian people. (Bachelor Thesis). Universitas Brawijaya, Malang.
- Purwaningsih, Y. (2008). Food security: situations, problems, policies and community empowerment. *Jurnal Ekonomi Pembangunan*, 9:1-27.
- Rose-Jacobs, R., Black, M. M., Casey, P. H., Cook, J. T., Cutts, D. B., Chilton, M. and Frank, D. A. (2008). Household food insecurity: associations with at-risk infant and toddler development. *Pediatrics*, 121:65-72.
- Roubík, H., Lošťák, M., Ketuama, C. T., Procházka, P., Soukupová, J., Hakl, J. and Hejzman, M. (2022). Current coronavirus crisis and past pandemics - What can happen in post-COVID-19 agriculture ?. *Sustainable Production and Consumption*, 30:752-760.
- Rozaki, Z. (2020). COVID-19, agriculture, and food security in Indonesia. *Reviews in Agricultural Science*, 8:243-260.
- Rozaki, Z. (2021). Food security challenges and opportunities in indonesia post COVID-19. *Advances in Food Security and Sustainability*, 6:119-168.
- Seligman, H. K., Laraia, B. A. and Kushel, M. B. (2010). Food insecurity is associated with chronic disease among low-income NHANES participants. *The Journal of Nutrition*, 140:304-310.
- Slopen, N., Fitzmaurice, G., Williams, D. R. and Gilman, S. E. (2010). Poverty, food insecurity, and the behavior for childhood internalizing and externalizing disorders. *Journal of the American Academy of Child & Adolescent Psychiatry*, 49:444-452.
- Sukiyono, K., Widiono, S., Cahyadinata, I. and Sriyoto. (2015). Study on local concept of household food security: case of fishery and paddy farming community in Mukomuko District, Bengkulu Province. *International Seminar on Promoting Local Resources for Food and Health, Bengkulu, IND*, 133 p.

- Vogenthaler, N. S., Kushel, M. B., Hadley, C., Frongillo, E. A., Riley, E. D., Bangsberg, D. R. and Weiser, S. D. (2013). Food insecurity and risky sexual behaviors among homeless and marginally housed HIV-infected individuals in San Francisco. *DS and Behavior*, 17:1688-1693.
- Yudaningrum, A. (2011). Analysis of the relationship between the proportion of food expenditure and consumption with household food security of farmers in Kulon Progo Regency. (Bachelor Thesis). Universitas Sebelas Maret, Indonesia.
- Yuliantini, E., Sukiyono, K., Yuliarso, M. Z. and Sulisty, B. (2022). Food security and stunting incidences in the Coastal areas of Indonesia. *Macedonian Journal of Medical Sciences*, 10:454-461.

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