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INDONESIA'S REGIONAL FOOD SECURITY IN LIGHT OF THE IMPENDING GLOBAL FOOD CRISIS

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Abstract

Multiple disruptions in health sectors and geopolitics has been alarming food security worldwide. This study provides insights by assessing the determinants of food security in Indonesia and creating a map of the country's most food insecure areas as a basis of developing anticipating strategies. This study is quantitative in nature using secondary data from the Statistics Indonesia. To estimate the model, we used Non-Parametric Splines Regression and Clustering Analysis. The results show that food security in Indonesia is greatly impacted by rice production, population density, purchasing power index, food expenditures, and harvested area. Additionally, most of the provinces in Indonesia has a medium to high food security level. The results showed the need for integrating Indonesian food chain policies such as land, water, and fertilizer availability. In addition, the Indonesian Bureau of Logistics must take measures to preserve the availability and distribution of staple foods.

Keywords*: food insecurity index; non-parametric splines regression; regional economics activity; food chair policies; staple foods*

INTRODUCTION

Millions of people suffer from hunger, which has become a global nutritional concern, especially in low- and middle-income countries (LMICs) with the largest populations such as Indonesia, this was exacerbated by the covid-19 pandemic and the prolonged war between Russia and Ukraine (Celik & Dane, 2020; Janssen et al., 2021). Various strategies such as physical distancing, school closures, trade restrictions, and country lockdowns, have been implemented to control the pandemic (Honein et al., 2020) which disrupt economic activities including the agricultural sector (Arita et al., 2022; Blazy et al., 2021; Stephens et al., 2022). Food imports, particularly those of Russian fertilizer and grain from Ukraine, have been sluggish. This is exacerbated by the fact that several countries, such as India and China, have started limiting the flow of food products in anticipating the food crisis. These impacts manifest as a disruption in food access, a shift in consumer desire for cheaper foods with low nutritional value, and price volatility in the food market (Laborde et al., 2020; Siche, 2020). Hence, food availability is the most significant out of the four food security dimensions, encompassing availability, access, utilization and stability (Godfray et al., 2010; Kakaei et al., 2022; Samia et al., 2021).

The Food and Agriculture Organization (2019) report showed that approximately 820 million people suffer from hunger worldwide. The Global Report on Food Crisis (2020) shows that around 135 million people in 55 countries are affected by acute food insecurity, of which 73 million are in 36 countries in Africa. This food crisis has the potential to disrupt the stability of a country. Moreover, research by Vasary et al. (2014) and Zahrnt (2011) revealed that food security in Asian countries did not increase enough to meet the regional demand. The gap between the national food supply and demand has led to an increase in the import of food and livestock. The United Nations (UN) reports that COVID-19 is likely to increase poverty and food insecurity on a global scale. Therefore, achieving sustainable development goals is considered a top priority. Other international organizations such as the Food and Agriculture Organization of the United Nations (FAO) and the International Food Policy Research Institute (IFPRI) have also endorsed this concept. The health and nutrition of people in a food crisis are at greater risk because of their inability to access health services and their inability to recoup their expenses.

One form of support from the FAO and the World Food Program (WFP) is the issuance of a stern warning to the various causes of the food crisis that has overshadowed many countries. FAO explained that the food crisis is a condition when acute food hazards and net malnutrition increase sharply. The impact, starting from the national scale to the international level, is that there are 107 countries affected by the crisis, some of which are estimated to have gone bankrupt. It is estimated that 553 million people are threatened with extreme poverty, and 345 million people are threatened with food shortages and up to starvation (International Labour Organization, 2022).

Food security is defined by FAO, IFAD and UNICEF (2019) as a situation when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. In line with the conceptualization of 'food system' which is now widely adopted in the literature such as The High Level Panel of Experts (2017), the two main concepts used are the concept of Food Security (Food and Agriculture Organization, 1996, 2008) and the concept of Food Environment (Downs et al., 2020; Herforth & Ahmed, 2015). The complementary dimensions of the two concepts include the four elements of food security (availability by the indicator of land area, access by the purchasing power index indicator, utilization by proxy for food spending and population density, and stability by proxy for rice production) (Kakaei et al., 2022) and the five important elements for the food environment (proximity, convenience, availability, affordability, and quality of foodstuffs) were considered.

To date, research on the impact of the COVID-19 phenomenon and Russia-Ukraine's war on food security tends to be anecdotal. At the end of 2020, more and more peer-reviewed articles began to be published regarding the food security crisis during the economic shock including COVID-19 and Russia-Ukraine's war (Kakaei et al., 2022; Läderach et al., 2021; O'Hara & Toussaint, 2021) thereby increasing the quality of available information. However, most of this article remains based on a limited sample, focusing on specific geographic areas and case studies (Breisinger & Ecker, 2014; Ceesay & Ben Omar Ndiaye, 2022; Corriero et al., 2022; Lever et al., 2022).

There are several theories that discuss food security, one of which is the Neo-Malthusian theory which analyzes food security from the perspective of food production (Hopfenberg, 2003; Hopfenberg & Pimentel, 2001; Maisonet-Guzman, 2011; Scanlan, 2001).

According to Kakaei et al. (2022), Food Security Indeks consists of for dimensions, those are availability, access, utilization and stability. the relationship between each independent variable and the dependent variable in this study can be explained as follows: the greater the amount of rice production, the greater the availability of food so that it is able to meet the food needs of the community and make food prices more stable. Population density shows the number of people in a certain area. The higher the population density causes the need for food to increase so that the impact on access to food is increasingly limited The people's purchasing power index is an indicator of the people's purchasing power, including to meet their food needs. People's purchasing power is getting higher causing more and more people to be able to meet their food needs, so that it will facilitate access and utilization of food by the community. Greater spending on food reflects greater food needs. This will cause food demand to increase so that it needs to be supported by adequate food availability and if food expenditure is able to be met by its availability it will cause food prices to stabilize. Additionally, the relations between household expenditure and welfare is stated by Mankiw (2001) that consumption expenditure has a positive correlation with welfare. The wider the harvested land can have an impact on the ability to produce more rice so that it can increase food availability. Thus, overall the existence of the five independent variables in this study will affect the food security index. The variables relationship are relations as depicted in Figure 1 (Wang et al., 2019).

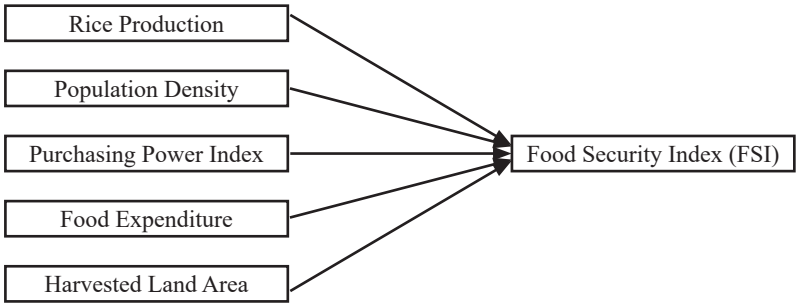

Figure 1. Conceptual Framework

One of the largest commodity food producers is the country of Indonesia with a harvested land area in 2021 reaching 10,606,513.22 Ha (Statistic Indonesia, 2022). Based on Statistics Indonesia (2022), Indonesia is a relatively large rice producing country. Indonesia's total rice production in 2021 reach 54,415,294.22 tons. Indonesia succeeded in achieving self-sufficiency in rice in the 2019-2021 period. Efforts to maintain Indonesia's rice production level in a pandemic situation are not easy, however, during the 2020-2021 period, stability in the supply and price of rice throughout the year can be maintained.

Even though Indonesia is one of the largest rice producing countries globally, the risk of a food crisis still overshadows Indonesia's population of 270 million (Statistic Indonesia, 2020). Several studies have investigated the relationship between populations and food insecurity (He et al., 2022; Niza-Ribeiro, 2022). The threat of a crisis that has the potential to occur in 2023 is considered to be far more risky in terms of food (Mohidem et al., 2022; Nodin et al., 2022; VASA et al., 2020). In fact, the National Food Agency (NFA) has taken a number of steps to mitigate the potential for a food crisis in Indonesia, starting from synergizing national food data to encouraging diversity in consumption.

Apart from the quantity aspect, there are concerns about food affordability due to price fluctuations. (Mehrabi et al., 2022; Mostenska et al., 2022). Food prices are one aspect of the food economy that is always monitored by the government on a regular basis because sharp price increases have the potential to cause social unrest. This food price will affect people's purchasing power as reflected in the Community Purchasing Power Index figures. Until 2021, the condition of the people's purchasing power index in Indonesia is relatively stable, but if the Russia-Ukraine war continues and climate change worsening, food security requires serious attention. Based on Statistic Indonesia (2022) data, nationally, food security in Indonesia is relatively safe, as reflected in the average food security index value of 73.55. However, when viewed regionally, conditions are not evenly distributed because there are several provinces that have a relatively low index of food security.

In new normal era, the whole world needs to prioritize food, energy and water security programs as basic human needs. To anticipate the food security crisis in Indonesia, this study aims at analyzing the level of food insecurity and its antecedents in Indonesia. Moreover, we also attempt to portray areas based on the level of food insecurity in various provinces in Indonesia as a basis for formulating strategies to strengthen food security.

METHODS

This study is quantitative in nature. Data sources were obtained through secondary data such as Food Security Index (FSI) score, rice production (ton), population density level (people/km2), Purchasing Power Index, Food Expenditure (IDR) and Harvested Land Area (hectare) from FAO, World Bank, Statistics Indonesia, and the Ministry of Agriculture. Secondary data was obtained through a review of several sources of literature that are relevant to the research objectives. The technique used in collecting research data was a library research by conducting a study of several related literature through the official website.

Technical data analysis was carried out in several stages. The first step in modeling the rice food security index is to create a Scatterplot between the response variables and each predictor variable. This is done to see whether there is a relationship pattern between the rice food security index data and the influencing factors. If the data has a certain pattern, then the parametric regression method is used, whereas if there is no certain pattern, the nonparametric regression approach is used (Budiantara, 2011).

Because previously there were no assumptions about the shape of the regression curve, this study employed nonparametric regression models particularly spline regression - a regression method approach where the shape of the curve of the regression function is unknown (Conover, 1999). In nonparametric spline regression the regression curve is assumed to be contained in a certain function space so that it has high flexibility (Breunig & Haan, 2021). Splines are segmented polynomial pieces that have the property of flexibility. The point of the combination of these pieces or the point that shows changes in the behavior of the curve at different intervals.

Second, we determine the knot point. It is a joint point where there is a change in behavior in the data (Chang et al., 2012). According to Stone & Huang (2002), the best spline regression model depends on the optimal knot point. The methods for finding optimal knot points that are often used are Generalized Cross Validation (GCV) and Mean Squared Error (MSE). The optimal knot point is obtained from the minimum GCV value. Spline is a flexible piece of continuous segmented polynomial (Doksum and Koo 2000). This property distinguishes spline regression from ordinary polynomial regression. The point of joining together of these pieces that causes a change in the behavior of the curve is called the knot point.

The third step is to estimate the spline functions. In general, spline functions of order m and knot points K^1, K^2, …, Kk are functions that can be written as follows:

$$f(x) = \beta_0 + \beta_1 x + \beta_2 (x-K)_+^m \quad \text{.....(1)}$$

Computation or calculations in estimating the model, is the main obstacle in nonparametric regression. Along with the rapid development of computer media today, nonparametric regression is also developing. The calculation process uses R software.

To achieve the second goal, the K-Means Clustering method is used to classify areas for food insecurity. K-Means Clustering is one of the popularly used Machine Learning algorithms in Unsupervised Learning (Liu et al., 2020). In this algorithm, the value of k is the number of clusters to be formed. K-Means has a function to group data into data clusters. This algorithm can accept data without any category labels. K-Means Clustering Algorithm is also a non-hierarchy method (Murai et al., 2022). Algorithm clustering method is to classify some data into groups that have the same characteristics (Ardani et al., 2022). Cluster Sampling is a sampling technique in which population units are randomly selected from pre-existing groups called clusters. The K-Means Clustering method aims to minimize the objective function that is set in the clustering process by minimizing variations between data in a cluster and maximizing variation with data in other clusters. It also aims to find groups in the data, with the number of groups represented by the variable K (Cerqueti & Ficcadenti, 2022). According to Liao et al. (2022), the variable K is the desired number of clusters. This Algorithm Cluster divides the data into several groups and receives input in the form of data without class labels. This is different from supervised learning which accepts input in the form of vectors (x1, y1), (x2, y2), …, (xi, yi), where xi is data from a training data and yi is a class label for xi.

RESULTS

The first step is to determine the estimation method by using a scatterplot diagram to identify the relationship between the food security index and the factors that are thought to influence it. Figure 2 shows an identification of the relationship between the rice Food Security Index (IHP) and the factors thought to influence it.

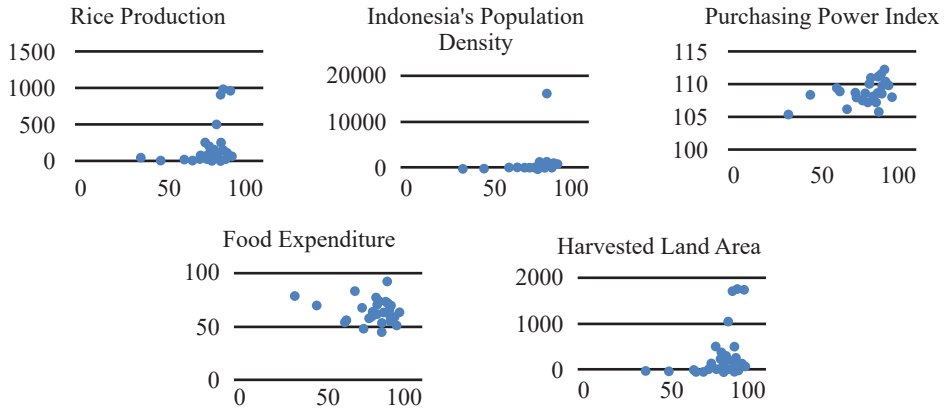

Figure 2. Scatterplot results of predictor variables and response variables.

The scatterplot results show that the relationship between the food security index and its determinants, namely the amount of rice production, population density, purchasing power index, food expenditure, and harvested area, does not show any tendency to form a particular pattern. Therefore, the Spline nonparametric regression estimation method was chosen.

The next step is to select the optimal knot point using the Generalized Cross Validation (GCV) method, by selecting the minimum GCV value.

Table 1. Point knots.

Knots	GVC
1	6.3294
2	5.8732
3	4.8623
combination	3.9592

Table 1 shows the results of estimation using the GCV method and the optimal knot point obtained from calculating the minimum GCV value is 3.9592 with a combination of knots 3, 3, 2, 3, 3 (Stone & Huang, 2002). This shows that the best Spline nonparametric regression model is to use a combination of knots. The combined GCV value will then be used to model the Food Security Index in Indonesia. Based on the estimation results of the Spline regression model using a combination of knots, the p-value = 0 and R2 = 91.73%, which means that the predictor variable variant is able to explain the food security index variant of 91.73%. A high R2 value indicates that the model is good at explaining the relationship between variables. Then the parameter test is carried out simultaneously. The test results can be seen in Table 2.

Table 2. Simultaneous Anova Test.

Sources	df	SS	Ms	Stat-F	p-values
Regression	18	432.4973	24.02762778	9.952131	0
Error	15	36.2148	2.41432		
Total	33	468.7121			

Table 2 shows the results of simultaneous parameter tests conducted to see the significance of the parameters on the overall response variable involving all predictor variables. From the results of simultaneous parameter estimation tests, a p-value of 0,000 is obtained which is smaller than the value of α (0.05), so that a decision can be taken to reject H0, which means that the model includes all the determinant variables of the Food Security Index (FSI) or model able to explain the determinants of FSI well.

Furthermore, a partial test was carried out to identify the variable significance level partially. The results of the partial variable significance test show that the five variables have a significant influence on the response variable in the model (Table 3).

Table 3. Spline Regression Estimation Results

Variables	Parameters	coefficient	Stat-t	p-values
Rice Production (X_1)	β_0	0.371	4,017	0.0081*
	β_1	25,327	3,391	0.0217**
	β_2	1,454	4.104	0.0007*
	β_3	0.651	3,191	0.0228**
	β_4	1932	2,912	0.0672
Population Density Level (X_2)	β_5	1037	5,001	0.0000*
	β_6	-0.182	-4,619	0.0001*
	β_7	-0.092	-3,187	0.0093*
	β_8	-0.085	-2017	0.0654
Purchasing Power Index (X_3)	β_9	0.7371	5,091	0.0000*
	β_{10}	-0.2821	-4,981	0.0000*
	β_{11}	-0.7891	-1,719	0.1290
Food Expenditure (X_4)	β_{12}	0.6871	4,091	0.0072*
	β_{13}	-0.3282	-4,212	0.0062*
	β_{14}	-0.8521	-3,901	0.0194**
	β_{15}	-0.701	-2,981	0.0917
Land Area (X_5)	β_{16}	5.1182	5,901	0.0000*
	β_{17}	0.7901	3,871	0.0457**
	β_{18}	0.0982	3,698	0.0489**
	β_{19}	0.0819	2091	0.1920

Note: *,** means significant at 1% and 5% respectively.

DISCUSSIONS

Estimation of the partial spline regression model for the factor of rice production (X_1) begins by determining the lower and upper values to be able to classify provinces based on the amount of rice production produced in the area. Based on the results of the xx test, the lower value and upper value were 7,215 and 54,241 respectively. Provinces that produce paddy: (1) below 7,215 tons are classified as province group 1; 7,215 to 54,241 classified as province group 2; more than 54,241 are classified as members of the province group 3. Therefore, the equation of the Food Security Index (Y) which is affected by rice production of rice production (X_1) to the food security index (Y) looks like it can be arranged in equation 2.

$$Y = \begin{cases} 25.327X_1 & \text{if} X_1 < 7.215 \\ 21.796 + 1.454X_1 & \text{if} 7.215 \leq X_1 < 54.241 \\ 18.490 + 0.651X_1 & \text{if} X_1 \geq 54.241 \end{cases} \quad \text{.....(2)}$$

Based on the partial test results, if rice production in province group 1 increases by 10,000 tons of rice, the food security index will increase by 25,327. This condition applies to the provinces of the Bangka Belitung Islands, North Kalimantan, North Maluku, West Papua, DKI Jakarta and the Riau Islands. The rice production factor has a positive effect on the food security index. This means that the higher the food availability factor in a region will have an influence on increasing the food security index in that region. This can happen due to the use of indicators to measure food availability factors that are less representative of the real situation in the field related to community food availability. In this study, the food availability factor was only measured by rice production indicators.

The government is always trying to improve food security, especially those originating from increased domestic rice production. These considerations are becoming increasingly important for Indonesia because the population is getting bigger with a wide population distribution and geographical coverage. In order to meet the food needs of its population, Indonesia requires the availability of sufficient and dispersed food, which meets the adequacy of consumption and sufficient national stock according to the operational requirements of a wide and dispersed logistics. Indonesia must maintain its food security.

Based on the results, the lower value and upper value for the population density factor (X_2) are 70 and 1240 respectively. Provinces with population density: (1) below 70 are classified as province group 1; 70 to 1,240 are classified as province group 2; more than 1,240 are classified as members of the province group 3.

The level of population density (X_2) on the food security index (Y) is described in formula (2) below. The partial test results for the effect of population density on the food security index show that the p-value is 0.0261. This means that the dimension of population density has a significant influence on the dimension of food security.

$$Y = \begin{cases} 7.9127 + 1.0371X_2 & \text{if} X_2 < 70 \\ 225.325 - 0.182X_2 & \text{if} 70 \leq X_2 < 1240 \\ 198.285 - 0.0917X_2 & \text{if} X_2 \geq 1240 \end{cases} \quad \text{.....(3)}$$

There are 9 provinces included in province group 1, namely North Kalimantan, West Papua, Papua, Central Kalimantan, East Kalimantan, West Kalimantan, Maluku, North Maluku and Central Sulawesi. If the province experiences an increase of 1 level of population density, it will increase the food security index. This is contrast to provincial groups 2 and 3, namely Banten, West Java, and DKI Jakarta where if there is an increase of one level of population density, it will lower the food security index.

The condition of a very dynamic population certainly has an impact on the condition of food security in a region and vice versa. Malthus' theory (Montano & García-López, 2020), which states that food growth is an arithmetic progression and population growth is a geometric progression, showing that as the number and population growth increase, the need for food also increases. This makes a study of the influence of population dynamics on food conditions indispensable as input for efforts to achieve food security, particularly in Indonesia.

Indonesia's large population (more than 270 million) and continues to grow require food products in increasing quantities (increase in national food demand 1-2% per year), so that there is sufficient and proper amount of paddy fields to support availability and resilience absolutely necessary food. Besides that, it is necessary to increase food production (especially rice) in a sustainable manner. Relying on imported food for national food security is certainly risky for various aspects of life, including the national economy, social and politics.

Food security is not only influenced by the availability and adequacy of food, but also by the people's purchasing power towards food prices. In addition, food security also means eliminating dependence on food sources from other countries. This is identified through the purchasing power index factor. The form of the functional relationship between the purchasing power index (X_3) and the food security index (Y) is modeled in the form of the following spline regression equation.

$$Y = \begin{cases} 0.7371X_3 & \text{if} X_3 < 107 \\ 107.325 - 0.282X_3 & \text{if} X_3 \geq 107 \end{cases} \quad \text{.....(4)}$$

From the results of the partial test of the purchasing power index factor, a p-value of 0.0087 was obtained. This means that the purchasing power index factor has a significant effect on the food security index. The Riau Islands Province, DKI Jakarta and Papua are three regions that have a purchasing power index below the cut off value of 107. Each increase of one level for the purchasing power index will increase the value of the food security index by 0.7371. On the other hand, for areas outside the three provinces, if there is an increase of one level in the value of the purchasing power index, it will decrease the food security index by 0.282.

Based on the results of the partial test of the purchasing power index factor, the lower value and upper value for the food expenditure (X_4) were 51 and 70 respectively. Provinces with population density: (1) below 51 are classified as province group 1; 50 to 71 are classified as province group 2; more than 71 are classified as members of province group 3.

The following is a form of functional relationship in the spline regression model involving the food expenditure with the food security index.

$$Y = \begin{cases} 45.7891 + 0.6871X_4 & \text{if} X_4 < 51 \\ 76.5826 - 0.3282X_4 & \text{if} 51 \leq X_4 < 70 \\ 125.8170 - 0.8521X_4 & \text{if} X_4 \geq 70 \end{cases} \quad \text{.....(5)}$$

The three provinces in province group 1 are Southeast Sulawesi, East Nusa Tenggara and West Sulawesi. In province group 1, if there is an increase of one level of the food expenditure index, it will increase the food security index by 0.6871. In equation (5) the cut off value for group 1 is 51. In DKI Jakarta, Riau Islands, Papua, Bangka Islands, Banten, North Kalimantan, East Kalimantan, Central Kalimantan and South Kalimantan, if there is an increase in the food expenditure index by one level, will reduce the food security index by 0.8521.

The process of determining the upper and lower values for the land area factor (X_5) produces values of 10 and 105. Provinces with population density: (1) below 10 are classified as province group 1; 10 to 105 are classified as province group 2; more than 105 are classified as members of province group 3.

The modeling of harvested area (X_5) to the food security index (Y) is as in Equation (5) below.

$$Y = \begin{cases} 32.914 + 5.1182X_5 & \text{if} X_5 < 10 \\ 6.9187 + 0.7901X_5 & \text{if} 10 \leq X_5 < 105 \\ 0.0982X5 & \text{if} X_5 \geq 105 \end{cases} \quad \text{.....(6)}$$

There are four provinces included in province group 1, namely Riau Islands, DKI Jakarta, North Maluku and West Papua. In province group 1, if there is an increase of 1000 hectares of harvested land, the food security index will increase by 5.1182. Whereas for the three big regions where the rice harvest area is dominant or included in province group 3, namely East Java, Central Java and West Java, if the harvested area increases by 1000 hectares, the food security index value will increase by 0.0982.

Classification of the level of food insecurity based on parameters of rice production, population density, purchasing power index, consumption of food spending, and area of harvested land on the food security index is divided into four criteria, namely vulnerable, almost vulnerable, almost safe, and safe. The following is the result of an analysis of food security in Indonesia. The classification method used in this analysis is K-Means Clustering.

Based on the results of the analysis, there are six provinces which are categorized as vulnerable areas, 11 provinces are almost vulnerable, 12 are almost safe, and five provinces are safe. Provinces that are categorized as vulnerable (in red) are Bengkulu, Riau Archipelago, DKI Jakarta, East Nusa Tenggara, North Maluku and West Papua. Near-prone criteria characterized in yellow are the provinces of Riau, Jambi, Bangka Belitung Islands, Banten, North Kalimantan, North Sulawesi, Southeast Sulawesi, Gorontalo, West Sulawesi, Maluku, Papua. Then the provinces that are almost safe (in blue) are Aceh, North Sumatra, South Sumatra, Lampung, West Java, Central Java, DI Yogyakarta, East Java, West Nusa Tenggara, West Kalimantan, East Kalimantan and South Sulawesi. Finally, provinces in the safe category (green color) are West Sumatra, Bali, Central Kalimantan, South Kalimantan and Central Sulawesi.

The characteristics of food insecure areas in Indonesia are characterized by areas that have low rice production and have a fairly large distribution of dry land (Mohidem et al., 2022; Nodin et al., 2022; VASA et al., 2020). The need for water is an important issue both for consumption and for irrigation. Crop failure is often caused by dry seasons that are too long (Caparas et al., 2021). In addition to production, the causes of food insecurity in Indonesia are based on indicators of food insecurity used, namely consumption of food needs, population density and area of harvested land (Anwar et al., 2010). The aspect of food availability is used to see the ability of an area to produce its own food. The resource potential of each region is different (Suharno et al., 2019). Some are centers of food crops while other areas are centers of horticultural crops, plantations and others. The difference in agricultural production potential is of course very much related to climate and weather conditions as well as very specific soil conditions in each region.

This classification of food insecurity can be used as one of the determinants of the direction of strengthening food security in the future. Suggestions that can be given as a follow-up to this research are that the data used in the analysis should have a larger size (big data) with the aim of increasing the accuracy of the classification carried out. Variable additions can also be made so that the characteristics possessed can be more visible. In addition, the addition of ensembles or other approaches can also be done so that the best approach can be identified.

CONCLUSIONS

Food security in Indonesia is greatly impacted by rice production, population density, purchasing power index, food expenditures, and harvested area, both individually and collectively. Nevertheless, the influence of each variable on food security in each province of Indonesia varies according to each province's threshold value. Regional mapping based on the extent of food insecurity in several provinces of Indonesia reveals that six provinces are classified as vulnerable, eleven provinces are virtually in critical care, twelve provinces are almost safe, and five provinces are safe. This research is without its limitations. The result of the study cannot be generalized across countries without further investigation.

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