

DASHBOARD VISUALIZATION OF FOOD SECURITY IN INDONESIA: ADDRESSING CHALLENGES OF FOOD DISTRIBUTION AND ACCESS

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ABSTRACT

Food, a basic human need, is crucial for survival. Food shortages signal vulnerability to food security in a country. This affects the welfare of the people and the economy of a country. This research explores the challenges of food security in Indonesia, where unequal distribution creates access gaps and affects food management. It presents visualizations highlighting aspects of food security, including limited access in vulnerable areas, and emphasizes the need for government intervention to prevent food crises and stunting. The study underscores the importance of optimizing food utilization through education and community empowerment to drive economic growth. In addition, with Indonesia's high population growth, ensuring sustainable food availability is crucial. The visualization takes the National Food Agency dataset, which includes the scores of each province based on aspects of food security. The data is processed and presented using Tableau, representing various visuals such as bar charts, maps, trend lines, and several other visuals made into a dashboard. The results show that food security in each region, especially vulnerable areas, exhibits good progress, with an average improvement from 2018 to 2022, ranging from a low of 93.34% in 2018 to a high of 106.02% in 2019, followed by a decrease to 99.12% in 2020, and an increase again to 100.68% in 2022. The visualization results can be used as a reference for the government in developing strategies to prevent food crises by considering these aspects in reducing stunting rates and encouraging the economy in Indonesia.

Keywords: *food security, Indonesia, food access, food availability, food utilization, Visualization*

1. Introduction

In human life, necessity is one of the things that must be met for survival (Manaf, 2022). Primary needs are needs that must be met because they are directly related to survival so that there are no difficulties in life (Ulmasruroh, 2020). One example of a primary need is food, but in fulfilling these needs, various indicators such as demand and supply, production, and prices prevailing in the market must be considered.

Food is a primary need that must be met daily, including biology, and water is processed into food and drinks suitable for consumption. According to the *Undang – Undang Republik Indonesia No. 18/2012*, food is everything that comes from biological sources of products, agriculture, plantations, forestry, fisheries, waters, and water, both processed and unprocessed, which are intended as food or drinks for human consumption including food additives, food raw materials, and other materials used in the process of preparing, processing, and making food or drinks. In Indonesia, food distribution is a problem, especially in some districts, which causes Indonesia's food security low.

Table 1 illustrates that food security ensures sufficient food availability that meets state and individual needs, encompassing quantity, quality, safety, diversity, nutritional adequacy, affordability, and cultural compatibility, promoting a healthy, productive lifestyle

sustainably (Badan Pangan Nasional, 2023). Despite efforts, Indonesia still faces food security challenges. According to the Global Food Security Index, Indonesia scored 60.2, ranking 63rd globally.

Table 1. Global Food Security Index 2018-2022

Rank	Country	Global Food Security Index			
		2019	2020	2021	2022
1	Finland	83.6	84.3	82.7	83.7
2	Ireland	82.7	82.4	81.6	81.7
3	Norway	81.7	80.9	78.4	80.5
4	France	77.9	78.0	78.3	80.2
5	Netherlands	80.9	79.5	79.9	80.1
6	Japan	79.7	80.1	79.5	79.5
7	Canada	76.1	77.8	79.3	78.8
8	Sweden	80.4	79.3	77.7	79.1
9	United Kingdom	78.4	78.8	79.3	78.8
10	Portugal	78.8	79.7	77.0	78.7
...					
63	Indonesia	61.5	61.6	59.8	60.2

Source: *Processed data from Global Food Security Index*

Based on these details, Indonesia's Food Security Index increased by 40% compared to 2021. Overall, Indonesia's Food Security Index is average, but the government needs to consider some factors and aspects of food security.

Food security is influenced by several factors, namely internal factors and external factors (Sihite & Tanzaha, 2021). Internal factors of food security depend on how much income/salary and age of the head of the household affect the ability to buy food, directly affecting an area's food security. According to research by Saputro and Fidayani (2020), factors affecting food security are income levels, rice prices, and the nutritional knowledge of homemakers. However, farmers must increase income not only from the farming sector but also from outside the farm. Farmers' income is also one of the factors causing low food security in Indonesia (Syarifuddin et al., 2022). In addition, farmers tend to depend on one sector, namely rice, which impacts food security in their respective households and affects food security for non-farmers (Irawan et al., 2023). Then, external factors of food security are influenced by government policies, which include controlling food security to obtain qualified food availability (Nurlina et al., 2019). According to research conducted by Taufik et al. (2021) in the Majene district, the development and improvement of food security in the Majene district, the government prioritizes the coordination function with various agencies and involves the community in improving food security for economic progress. However, more than the availability of food in the area is required. Hence, it is necessary to empower and counseling related to food security efforts that the local community can carry out. Therefore, the government must pay more attention to food availability through the policies issued. Both factors influence a household's food security, farmers, and the wider community. In addition to food security factors, aspects of food security also need to be a concern for the Indonesian government.

Several aspects comprise food security in Indonesia, including food availability, food utilization, and food access (Hadi et al., 2020). Based on UU No. 18/2012 on Food, food availability depends on the availability of domestically produced food and domestic food reserves, as well as imports, if the two primary sources of supply still need to be met. Then the next aspect is food utilization, in this case, seen by covering how to manage food and how to serve food, which has been adapted to the conditions of habits in feeding, especially in people who need particular types of food or experience certain health conditions. This includes regional conditions, access to clean water, and the population ratio in each household. Moreover, the last aspect of food security is food access, where several factors influence food access because not all areas or regions get the desired food; examples of factors from food access are economic access, physical access, and social access (Abel et al., 2022; Hemerijckx et al., 2022).

After learning about the factors and aspects of food security in Indonesia, we found several main problems that affect national food security. There are 3 (three) main problems, namely low economic access to meet food needs, many cases of malnutrition in children, and lack of preparedness in uncertain weather. These three things are highly interdependent and are the main problems that affect food security in Indonesia. With these factors, uneven food security can lead to malnutrition. Malnutrition does not only happen to children, but even adults can also experience it if food is not nutritionally adequate. The definition of nutrition, in general, is the science of how the body uses food. In contrast, the definition of nutrition is the life of all living things requiring food and drink for growth, development, and health (Quis et al., 2020). Therefore, humans need food rich in nutrients for their health. Nutritional fulfillment is an important issue that significantly impacts public health, especially for children and pregnant women (Janggu et al., 2021). Adequate and balanced nutrition can help children grow and develop optimally and avoid chronic diseases in the future (Aryastuti et al., 2022; Marchamah et al., 2023; Nugroho et al., 2023). Good nutrition is essential for maternal and fetal health for pregnant women and helps prevent stunting (Darus & Abdurrahman, 2023). Despite the government's commitment to maintaining and improving national food security, existing solutions still need to be improved to address the problem of malnutrition. This is shown by the high stunting rate in Indonesia, which is around 24.4% in 2021.

To overcome the low food security in Indonesia, the government has implemented the best solution for the people of Indonesia. Solutions that the government has carried out include increasing food availability, which is where the government conducts a food estate program. In this activity, the government builds national food barns in several regions to increase the production of food crops such as potatoes, chilies, shallots, and garlic. Furthermore, the government's solution is the development of agricultural infrastructure. In this development, the government builds dams, irrigation networks, and reservoirs to provide adequate water supply for farmers, especially in the dry season. Then, the solution is to improve food access by subsidizing several food commodities such as rice, sugar, and cooking oil so that the price is affordable for the community. The last solution taken by the government is to improve the quality of food consumption by socializing with the public about the importance of balanced nutrition and healthy eating patterns.

Despite these efforts, the government must improve its food security, including natural disasters, climate change, and budget constraints. Natural disasters such as floods and droughts can disrupt food production (Widyasari et al., 2019). Climate change can cause

changes in weather patterns and rainfall, which can impact crop yields. The government has a limited budget to finance food security programs. Seeing these challenges, the government needs to take several steps to overcome the problems that occur such as the government needs to increase investment in agriculture to increase food production and food security, the government needs to develop agricultural technology that is adaptive and resistant to climate change, and the government needs to improve coordination between related institutions to ensure food security programs run effectively.

In this study, we also quoted from several journals to identify existing research gaps. Based on the analysis of three journals on food security in Indonesia, several research gaps need to be explored further: Research Rasman et al. (2023) shows the failure of food estate programs due to poor planning, land issues, and limited knowledge of farmers. Research focusing on strategies to improve planning, solve land problems, and strengthen farmers' capacity in food estate programs is needed. Research by Azhar et al. (2023) highlighted the high level of food waste in Indonesia that exacerbates the food crisis. In-depth research is needed on the factors that cause food waste, educational strategies to reduce food waste, and a more effective food waste management system. Research (Priandana et al., 2023) proposed the concept of food security based on local wisdom to overcome the decline in food production in West Java. More comprehensive research is needed to identify effective local wisdom practices, evaluate their impact on food security, and develop food security models that integrate local wisdom and modern technology. Research that fills these gaps can significantly improve food security in Indonesia. By addressing the problems of the food-estate program, reducing food waste, and utilizing local wisdom, Indonesia can achieve food self-sufficiency and more robust food security.

Therefore, the distribution of food security in Indonesia must be equalized. If food security is uneven or insufficient for the community, Indonesia will have many health problems. In addition, nutritional fulfillment is an important issue that requires serious attention from the government and all elements of society. The government's efforts to improve food security need to be optimized and strengthened by overcoming various existing challenges.

The growing concern for food security in Indonesia, particularly in areas facing vulnerabilities, has prompted this study to address several key questions. Firstly, we aim to understand the current state of food access across the country, focusing on regions experiencing food insecurity. Secondly, we will investigate the yearly trends in food security vigilance levels within vulnerable provinces. To assess the potential link between access

and availability, the study will explore the influence of food access on overall food availability in Indonesia between 2018 and 2021. Finally, we will examine the yearly variations in food utilization practices across different islands in Indonesia. By delving into these critical aspects, this research seeks to understand Indonesia's current food security landscape comprehensively.

This research uses secondary data obtained from the National Food Agency (BPN) through <https://katalog.data.go.id/>, namely food and nutrition alert system data based on availability, access, and utilization for the period 2018 to 2021.

Driven by the concerns raised in section 1.1, this study aims to achieve a multifaceted understanding of food security in Indonesia. Firstly, we will investigate the current state of food access nationwide, focusing on areas facing food insecurity alerts. Secondly, we will analyze the trends in food alert status within vulnerable provinces. Thirdly, the research will explore the relationship between food access and overall food balance in Indonesia between 2018 and 2021. Finally, we will examine the food utilization patterns across different provinces in Indonesia over the same period. By addressing these objectives, this study seeks to provide a comprehensive picture of food security challenges and opportunities in Indonesia.

This research aims to contribute significantly to understanding and mapping food security gaps across provinces in Indonesia. The research focuses on the equity of food availability, access, and utilization across Indonesia. The government can utilize the research to gather valuable information about Indonesia's regions, which can serve as a basis for developing and implementing regional food security policies. This will ultimately help the government achieve more targeted and equitable food distribution nationwide. This study offers concrete evidence as a basis for further research that researchers can build upon in the future, focusing on specific regions with high development potential. Future research can further improve our understanding of the potential for regional food security across Indonesia by exploring new methods and tools.

The methodology in this study uses a descriptive analysis method with a systematic description of the facts collected. It investigates the relationship between variables through data collection, which is processed and analyzed and displays the data as a dashboard showing related institutions. The tools used in this methodology are Tableau Public, a software used to analyze data in visual form and used for reporting. This software is easy to use because its features make it easy to manage data.

The researchers' primary dataset was obtained from the National Food Agency and includes information collected as of August 8, 2023. This dataset discusses the status of the food and nutrition alert system based on three main aspects: food availability, food access, and food utilization. The information contained in this dataset includes province name, province code, year, and month.

2. Literature Review

Food security is one of the strategic issues in the country's development, especially in the agricultural sector, which is the primary food provider, especially in developing countries, because it has a dual role, namely as one of the main targets of development and the main instrument of economic development (Rumawas et al., 2021). However, food security is influenced by climate and weather, so this will affect food availability; where the demand for food gets higher, it will affect the level of food availability and the availability of agricultural land to balance the demand.

According to research conducted by Harvian & Yuhan (2021), climate change has a significant influence on food security, which shows that the more severe climate change occurs, the more food security in the region decreases, so policies are needed in handling climate change to avoid vulnerability to food security.

According to the Regulation of the Minister of Agriculture / Daily Chairperson of the Food Security Council, No. 43/2010 on Guidelines for Food and Nutrition Vigilance System or Food Vigilance is a series of processes in anticipating food and nutrition vulnerable events through collecting, processing, storing, analyzing, and disseminating information on food and nutrition situations. SKPG activities include analyzing data on the food and nutrition situation and disseminating the information. The three aspects of vigilance, such as food availability, food access, and food utilization, are the basis for analyzing the food and nutrition situation. Citing research from Indarwanto et al. (2022), the results of the Food and Nutrition Vigilance System Analysis (SKPG) in Musi Rawas Regency by analyzing three aspects as food availability, food access, and food utilization, that the Food Utilization Aspect in 14 sub-districts in Musi Rawas Regency is safe, but food availability must be increased by increasing the area of new plantings to increase agricultural production and food access must still be improved by accelerating supply and increasing the number of food stocks to maintain food price stability to increase people's purchasing power, especially the lower middle class.

Food availability is essential in meeting people's needs (Rusdianto et al., 2022), regardless of their geographic location or economic status. This includes several aspects. The first is the food distribution aspect, which can affect food availability if there are problems

in the food distribution system, such as during the COVID-19 pandemic, food is not well distributed, causing food scarcity in some areas (Yulianti et al., 2021). Agribusiness is The first factor affecting food availability (Alexandro, 2021). Another factor is market stabilization, where market stability significantly impacts food availability (Dijaya et al., 2021). Extreme weather conditions also significantly impact food availability (Scharadin et al., 2023).

Food access is a person's ability to obtain sufficient, safe, and nutritious food. Food access is, therefore, crucial in ensuring people's health and well-being. With good food access, people can fulfill their nutritional needs to work and be more productive, indirectly impacting the country's economy. Stable food access can also maintain social resilience as it reduces the risk of social conflict and unrest created by food scarcity (Oladipo & Oyinloye, 2022). Many things affect food access in a country, including accommodation factors such as transportation (Almalki et al., 2023). In addition, significant events such as the COVID-19 pandemic also indirectly significantly impact food access (Syukur et al., 2021).

Food utilization is how people in a region obtain and use available food resources. Food utilization practices are strongly influenced by many factors, including geographical factors, as has been proven from previous research where there are striking differences between Ontario and Quebec in the utilization of Oral Food Challenges (OFC) (Baba et al., 2022). In addition, the government also has an essential role in the food utilization of a region, where government policies are needed so that all people have sufficient, safe, and nutritious access to food (Kuzmenko & Chyzhevskaya, 2024). These policies can be in the form of agricultural policies, food safety regulations, etc.

3. Methodologies

The method used in this research includes a series of sequential processes, namely Observation and Literature Review, Data Collection, Data Pre-processing, and Data Visualization in the form of a Dashboard with Tableau. These stages are depicted in Figure 1. Observation and Literature Review involve extensive scrutiny of existing literature and data to establish a comprehensive understanding of food security dynamics in Indonesia. This foundational step ensures that the subsequent phases of Data Collection are strategically aligned with addressing critical gaps and leveraging existing insights. Data Collection encompasses gathering relevant datasets from diverse sources, including national databases and authoritative reports, to capture comprehensive and up-to-date information on food security indicators across various regions of Indonesia. Following data acquisition, Data Pre-processing involves refining and preparing the datasets to ensure consistency, accuracy, and compatibility for further analysis and visualization using

Tableau. This stage includes handling missing values, standardizing data formats, and integrating spatial data to facilitate meaningful insights into geographic patterns and disparities in food security outcomes. Finally, Data Visualization through Tableau transforms the processed data into interactive dashboards and visual representations, enabling stakeholders to interpret complex datasets easily and derive actionable insights for policy-making and intervention strategies aimed at enhancing food security resilience nationwide.

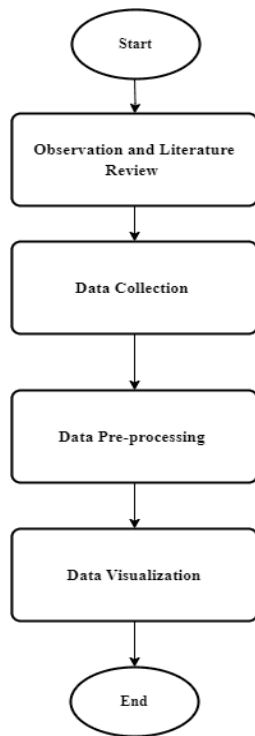


Figure 1. Flowchart Frame of Mind

3.1. Observation and Literature Review

This research aims to find out the distribution of food in the territory of Indonesia as an insight, especially for local governments engaged in agriculture to allocate food evenly in the territory of Indonesia and develop insights related to the situation of food distribution in the territory of Indonesia through the data source of the *Badan Pangan Nasional*. The mapping is carried out to see areas with distribution entering the alert phase, where the food distribution situation must be allocated with more than the previous period. Through Tableau, mapping is done in a dashboard that helps the government, especially the *Badan Pangan Nasional*, make the right decision in allocating food throughout Indonesia quickly and precisely based on the results of existing mapping. At this stage, the researchers conducted a literature study by collecting theories or journals related to the topic to compare previous research. The researchers also studied the methods and tools used by other researchers as a reference and development for this research.

3.2. Data Collection

The data used in this study are secondary data sources obtained indirectly through intermediary media such as <https://katalog.data.go.id/> sites that store data on government agencies from various sectors. Data obtained from local agencies have also been processed and shared.

3.3. Data Pre-processing

To facilitate the analysis of spatial aspects related to food security in Indonesia, Figure 2 illustrates the sources of datasets utilized in this study. The processing involved integrating spatial data obtained from various datasets and combining it with the researcher's dataset based on geographic regions. This approach ensures comprehensive coverage and accuracy in examining and visualizing the spatial dynamics impacting food security across different regions of Indonesia.

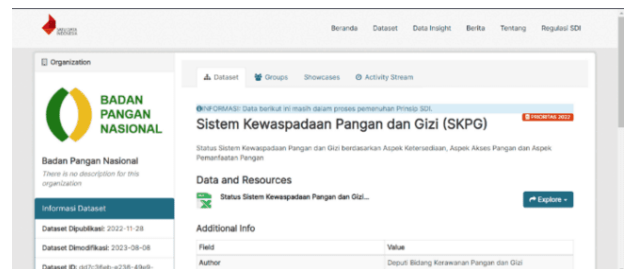


Figure 2. Source of Dataset

Once the data was acquired, it was processed in Excel, involving the conversion of data types within the specified period to enhance the ease of analysis. Figure 3 illustrates the dataset contents, highlighting the presence of null values crucial for data analysis.

No.	Kode Provinsi	Nama Provinsi	Periode	Ketersediaan	Akses Pangan	Pemanfaatan Pangan
1	11	Aceh	01/01/2018	3	3	3
2	12	Sumatera Utara	01/01/2018	3	2	2
3	13	Sumatera Barat	01/01/2018	3	3	3
4	14	Riau	01/01/2018	2	3	3
5	15	Jambi	01/01/2018	2	1	3
6	16	Sumatera Selatan	01/01/2018	2	3	3
7	17	Bengkulu	01/01/2018	2	3	2
8	18	Lampung	01/01/2018	2	1	3
9	19	Kepulauan Bangka Belitung	01/01/2018	2	2	3
10	21	Kepulauan Riau	01/01/2018	1	3	3
11	31	DKI Jakarta	01/01/2018	2	2	2
12	32	Jawa Barat	01/01/2018	2	1	2
13	33	Jawa Tengah	01/01/2018	2	1	3
14	34	DI Yogyakarta	01/01/2018	2	1	2
15	35	Jawa Timur	01/01/2018	2	1	2
16	36	Banten	01/01/2018	2	1	2
17	51	Bali	01/01/2018	2	2	2
18	52	Nusa Tenggara Barat	01/01/2018	2	2	2
19	53	Nusa Tenggara Timur	01/01/2018	3	3	3

Figure 3. Dataset Contents

This dataset contains some null values that are important for data analysis. Therefore, Tableau replaces these values with 0 values to smoothen the data visualization process.

3.4. Data Visualization

To support the research, researchers used Tableau to create dataset visualizations. The purpose of this visualization is to help readers understand the

content of the information that researchers have processed. In this study, researchers have four dashboards, each consisting of 3 to 4 sheets.

4. Result and Discussion

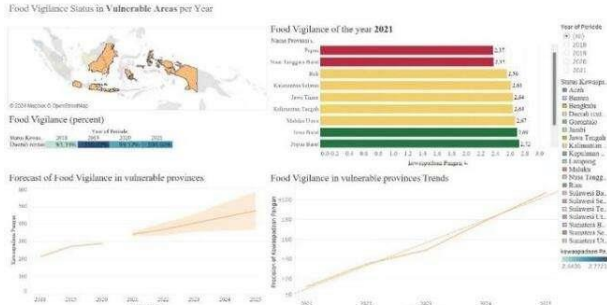


Figure 4. Dashboard of Food Vigilance Status in Vulnerable Area per Year

The visualization above, as depicted in Figure 4, showcases the evolution of food alert status in vulnerable provinces across Indonesia. The map visualization at the top left illustrates the geographical distribution of these vulnerable areas. In the center left, a table presents the trends in food vigilance from 2018 to 2021, highlighting a notable increase from 93.34% in 2018 to 106.02% in 2019, followed by a decrease to 99.12% in 2020 and a subsequent rise to 100.68% in 2022. The graph on the lower left visually represents the upward trajectory of food vigilance in vulnerable provinces up to the projected year 2025, indicating a consistent upward trend over the years. Concurrently, the trend line on the bottom right predicts a future increase in food access. Finally, the bar chart on the right side of the visualization compares the levels of food vigilance across different provinces in Indonesia, highlighting Central Sulawesi with the highest and Papua with the lowest values.



Figure 5. Dashboard of Relationship between Food Access and Food Availability

The visualization above, as shown in Figure 5, examines the impact of food access on food balance within Indonesia. The scatter plot on the left illustrates the relationship between food availability and access, revealing scattered data points that suggest a positive correlation: as food access increases, so does food availability. However, beyond a certain threshold, the

influence of food availability on access diminishes, and availability itself begins to decline. This suggests a complex relationship where food availability may not always dictate access levels, as evidenced by the variability in data points and the need for a stronger correlation line. On the right side of the visualization, three distinct clusters (green, yellow, and red) categorize regions based on their combinations of food access and availability, providing insights into varying food security scenarios across Indonesia.



Figure 6. Dashboard of Food Access in Areas that are in a Status (Vulnerable/Alert)

In Figure 6, the visualization provides insights into food access across regions in Indonesia. The bar chart on the left categorizes food access levels by island, highlighting Maluku Island with the highest score of 3.00, followed closely by Kalimantan Island at 2.99. Beneath the bar chart, maps depict provinces still vulnerable to food access issues, indicated in orange. Additionally, the top right section features a line graph illustrating the stability of food alert statuses from 2018 to 2021, showing minimal fluctuations over the years. Finally, a detailed table below the line chart presents the specific developments in food access for each province, aiding in comprehensive analysis and decision-making regarding food security initiatives.

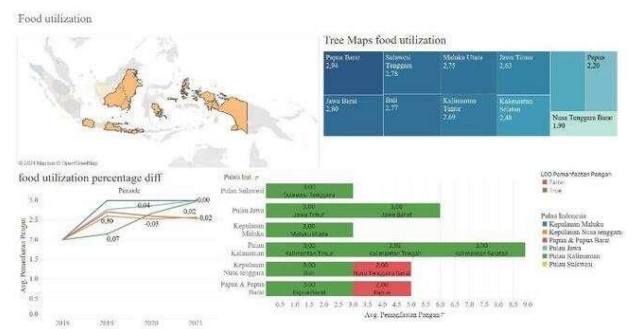


Figure 7. Dashboard of Food Utilization in Vulnerable Areas

In Figure 7, the visualization focuses on food utilization in vulnerable areas. These regions are particularly critical as they impact resource management and economic considerations. The Tree Maps on the right illustrate food utilization levels, while the line chart

on the bottom left tracks changes in utilization percentages from 2018 to 2021 for each vulnerable area. Additionally, the bar chart on the bottom right compares average food utilization across various islands, providing insights into regional disparities and guiding targeted interventions to improve food security strategies.

5. Conclusions

Food security is a crucial issue in overcoming food crises and hunger. Food access, availability, and utilization are fundamental factors determining food balance in various parts of Indonesia. This research reveals that food access in vulnerable areas is still concerning, so serious attention from the government is needed to prevent food crises and high stunting rates. Food utilization in these areas needs to be optimized to encourage economic progress. This can be achieved by increasing education and community empowerment in optimally managing and utilizing food resources. In addition, food availability is also a significant concern, given Indonesia's high population growth, which increases food demand. The government must take anticipatory steps to ensure adequate and sustainable food availability. This research provides a complete picture of Indonesia's food security complexity. Food access, availability, and utilization are interrelated and sustainable in realizing solid food security. The findings provide an essential foundation for the government to formulate targeted policies and strategies to overcome various food security challenges and promote economic progress.

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