

Analysis of the Influence of Food Availability, Access, and Utilization on Food Security in South Minahasa Regency

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Received: February 28, 2026

Revised: March 27, 2026

Accepted: April 25, 2026

Published: April 30, 2026

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DOI: [10.29303/jppipa.v12i4.14870](https://doi.org/10.29303/jppipa.v12i4.14870)

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Abstract: This study aims to (1) identify variables related to food availability, access, absorption, and security in South Minahasa Regency; and (2) determine the effect of food availability, access, and absorption on food security in South Minahasa Regency. The population in this study was all subdistricts in South Minahasa Regency, namely 17 subdistricts. The analysis method in this study used two approaches, namely descriptive analysis and intrinsic analysis. The descriptive analysis used in this study is presented in tables and graphs, while the inferential analysis in this study uses SEM-PLS analysis. Data processing in this study uses the Smart-PLS 4.0 application. Food security will be achieved if the three main dimensions of food security, namely: (i) availability; (ii) accessibility; and (iii) affordability by an individual (family) can be fulfilled. However, this study found that food availability does not affect food security, food access does not affect food security, and food absorption affects food security in South Minahasa Regency.

Keywords: Food; Food security; Three pillars of food security; South Minahasa Regency

Introduction

FAO (2016) defines food security as a condition in which individuals or households have both physical and economic access to sufficient food for all members and are not at risk of losing such access. Food security encompasses three key components: food availability, access to food, and the utilization or absorption of food. These three elements must be fulfilled in a balanced manner to achieve optimal levels of societal welfare and public health.

South Minahasa Regency in North Sulawesi Province covers an area of 1,456.46 km², with the majority of its population engaged in agricultural activities (BPS Minahasa Selatan, 2024). The region holds significant potential for the development of the agriculture, fisheries, tourism, and industrial sectors, with approximately 11,144 hectares designated as sustainable food agriculture areas. The 2023 Food Security Index (IKP) score of 83.20 indicates a favorable condition of food availability.

South Minahasa Regency Government, through the Food Agency, has implemented various programs such as the Community Food Enterprise Development (PUPM) and Government Food Reserve (CPP) initiatives through rice procurement, as well as promoting food diversification as a strategy to enhance food security (Arifin, 2005).

However, the achievement of food security in this region remains uneven. Government programs have primarily focused on the aspect of food availability, while access to and utilization of food have not been optimized. This condition has led to several districts being unable to achieve genuine food security, despite statistically showing a production surplus.

The results of a study on food security using an analysis of household food intake levels and PLS-SEM analysis indicate that (1) household food intake levels fall into the "somewhat food-insecure" category, (2) The factors influencing household food intake levels—namely, energy adequacy, protein adequacy, dietary diversity, and vitamin A adequacy do not have a

How to Cite:

Kaunang, R., Tarore, M. L. G., & Baroleh, J. (2026). Analysis of the Influence of Food Availability, Access, and Utilization on Food Security in South Minahasa Regency. *Jurnal Penelitian Pendidikan IPA*, 12(4), 942-952. <https://doi.org/10.29303/jppipa.v12i4.14870>

significant effect on food intake (Ain et al, 2024). Social capital, food security, and household well-being are relatively high and satisfactory. Social capital has a direct and significant positive impact on food security and household well-being (Handayani, 2023). The Food Security Index (FSI) has a significant positive direct effect on the Human Development Index (HDI). The HDI has a significant negative direct effect on poverty. On the other hand, the FSI has a significant negative effect on poverty in Indonesia, both directly and indirectly. A comprehensive and targeted policy is needed to ensure that the Food Security Index continues to improve (Sihombing et al, 2022).

Method

Time and Place

The research location, which was determined purposively (Mukhlis et al., 2019; Mukhlis et al., 2024; Asgaf et al., 2025). This research was conducted over a period of 8 months in 17 subdistricts throughout South Minahasa Regency.

Data Collection Methods

The types of data collected in this study consist of both primary and secondary data (Sugiyono, 2021; Mukhlis et al., 2022; Mukhlis et al., 2023). Primary data were obtained through the distribution of questionnaires, followed by in-depth interviews with respondents, who were sub-district heads in South Minahasa Regency. Secondary data were gathered from institutions relevant to the research topic, including the Food Security Agency of South Minahasa Regency, the Agriculture Office, the Social Affairs Office, the Health Office, as well as sub-district-level data, research journals, and several academic references.

Sampling Method

The respondents in this study were determined using a purposive sampling technique (Mubarokah et al., 2024; Marliyah et al., 2025; Ogari et al., 2026), consisting of sub-district heads (Camat) across 17 sub-districts in South Minahasa Regency.

Data Analysis Method

This study employed a quantitative approach using numerical data analyzed statistically to address the research objectives (Sugiyono, 2018). Data analysis was conducted through descriptive and inferential statistics. Descriptive statistics were used to present data in tables, graphs, and charts, while inferential statistics were applied to test relationships between variables using SmartPLS software.

The study utilized the Structural Equation Modeling (SEM) technique with the Partial Least

Squares (PLS) approach. SEM-PLS integrates regression, factor, and path analyses to test model validity, reliability, and relationships among variables. This method was chosen because it is flexible and does not require strict assumptions about data distribution or large sample sizes (Hair et al., 2014).

The measurement model (outer model) was evaluated for validity and reliability through convergent validity, discriminant validity, and composite reliability tests (Henseler et al., 2015). Indicators were considered valid if their loading values exceeded 0.70, although values between 0.50–0.60 were acceptable for exploratory research. An Average Variance Extracted (AVE) value above 0.50 indicated adequate construct validity, while reliability was confirmed through Composite Reliability and Cronbach’s Alpha values above 0.70 (Ghozali & Latan, 2015; Abdillah & Hartono, 2015).

The structural model (inner model) was assessed using R-square values to determine the strength of relationships among latent variables, and t-tests to evaluate the significance of path coefficients. The Variance Inflation Factor (VIF) test was also used to ensure there was no multicollinearity, with acceptable values below 5 (Ghozali & Latan, 2012).

The conceptual model consisted of one exogenous latent variable (food availability) and three endogenous latent variables (food access, food utilization, and food security) (DKP, 2009). Food availability, access, and utilization were modeled formatively, while food security was modeled reflectively (Figure 1).

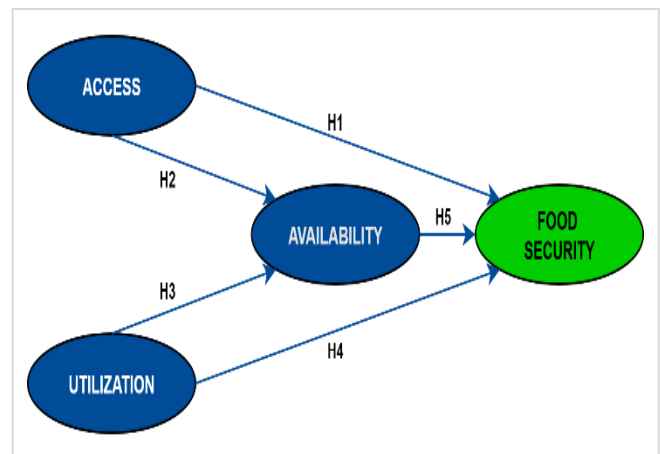


Figure 1. Study model

The hypotheses of this study are as follows: H1: There is a positive influence of food access on food security. H2: There is a positive influence of food access on food availability. H3: There is a positive influence of food utilization on food security.

Result and Discussion

General Condition of South Minahasa Regency

South Minahasa Regency is one of the regencies in North Sulawesi Province, with Amurang as its capital. The regency is located in the southern part of the province, approximately 88.9 km from Manado, and lies astronomically between 0°47'–1°24' N latitude and 124°18'–124°45' E longitude. The region is bordered by North Minahasa Regency to the north, Southeast Minahasa, Bolaang Mongondow, and East Bolaang Mongondow Regencies to the south, and the Sulawesi Sea to the west.

Based on Law Number 10 of 2003, South Minahasa Regency was officially established on August 4, 2003, as a result of the administrative division of Minahasa Regency. The regency covers an area of 1,456.46 km², with a population of 237,740 in 2021, which increased to 242,463 by mid-2024, resulting in a population density of approximately 163.91 people per km². The regency consists of 17 sub-districts, 10 urban villages (*kelurahan*), and 167 rural villages (*desa*).

The main food crop production areas are located in the sub-districts of Tumpaan, Tatapaan, Tompasso Baru, Maesaan, Ranoyapo, and Tenga, covering approximately 11,144 hectares. Meanwhile, plantation areas extend across 16 sub-districts, except Modinding, with a total area of about 89,817.4 hectares.

Food Security Potential in South Minahasa Regency

South Minahasa Regency is categorized as a food-surplus region, as indicated by its Food Security Index (IKP) score of 83.20 in 2023 (National Food Agency, 2023), reflecting a favorable level of food availability.

Table 1. Distribution of Agricultural Land Area Ratio to Population by Priority

| Priority | Ratio of Rice Field Area | Number of Villages | Percentage (%) |
|----------|--------------------------|--------------------|----------------|
| 1 | ≤ 0.0000 | 69 | 38.9 |
| 2 | > 0.0000 | 0 | 0.0 |
| 3 | > 0.000–0.0024 | 19 | 10.7 |
| 4 | > 0.0024–0.0154 | 36 | 20.3 |
| 5 | > 0.0154–0.0505 | 27 | 15.2 |
| 6 | > 0.0505 | 26 | 14.6 |

Source: FSVA South Minahasa, 2023

The food production potential of South Minahasa Regency includes agricultural commodities such as coconut, including one of the main centers of copra production in North Sulawesi (Kaunang et al., 2024), potatoes (the highest-producing area in the province as of 2021), and staple food crops such as rice, maize, and cassava. Other potential commodities include cabbage, Chinese cabbage (*petsai*), clove, vanilla, soybean, and

nutmeg, as well as products from the livestock and fisheries sectors. Among these, rice, maize, and cassava represent the most dominant food crops produced in South Minahasa Regency.

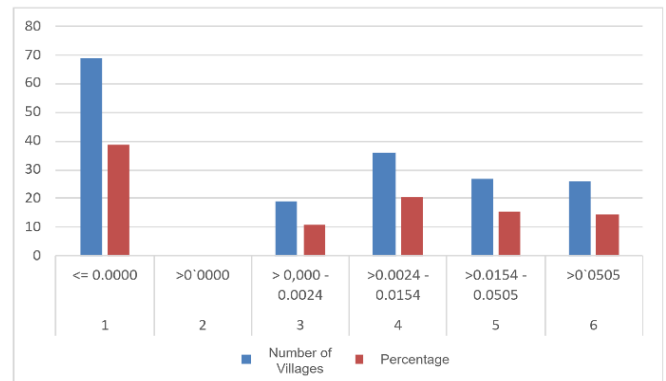


Figure 2. Graph of land area versus population

Factors Influencing Food Availability in South Minahasa Regency

Law Number 18 of 2012 defines food availability as a condition in which food is sufficiently supplied from domestic production, national food reserves, and imports when the first two sources are inadequate to meet demand. Food production includes activities such as producing, preparing, processing, packaging, and/or transforming food, while national food reserves refer to food stocks distributed across Indonesia that are used for human consumption as well as for managing emergencies, supply disruptions, or price fluctuations.

Food provision aims to meet community consumption needs sustainably, where most food products, whether locally produced or imported from other regions, are typically distributed through markets before reaching households (Hanafie, 2010). The stability of household-level food availability is measured based on the adequacy of food stocks and the frequency of daily meals consumed by household members. A household is considered to have stable food availability when it maintains food stocks above the adequacy threshold and its members consume three meals per day, in accordance with local norms. The combination of staple food availability and meal frequency serves as the main indicator for assessing household food stability.

Table 2. Indicators of Food Availability

| Adequacy of Food Availability | Frequency of Household Meals (Times) | | |
|-------------------------------|--------------------------------------|-------------|----------|
| | > 3 | 2 | 1 |
| > 240 to > 360 days | Stable | Less stable | Unstable |
| 1–239 days | Less stable | Unstable | Unstable |
| No stock available | Unstable | Unstable | Unstable |

Source: FSVA South Minahasa, 2023

Several variables influence food availability in a given region. The first is agricultural production, which can be observed from the extent of agricultural land. The larger the area of productive land, the greater the potential for food production, allowing the region to meet its own food needs. Land productivity is also a key determinant of food availability, influenced by factors such as the use of technology, fertilizers, improved seeds, and the application of modern agricultural practices (Moonik et al., 2020). In addition, weather and climate conditions significantly affect crop yields, as climate change, drought, or flooding can reduce food production levels.

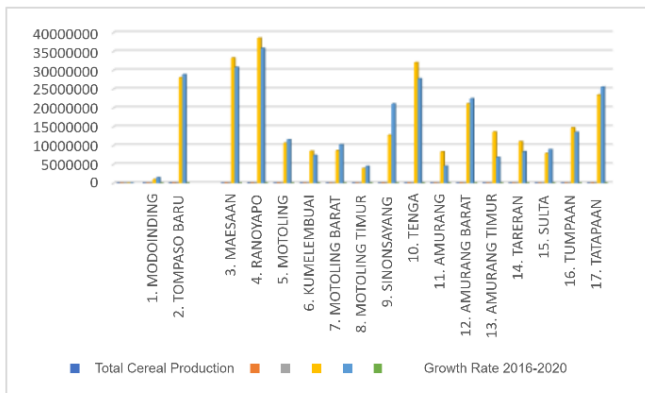


Figure 3. Production of staple cereals and tubers 2019-2021 in South Minahasa Regency

Second, production facilities and infrastructure such as the availability of irrigation water, agricultural tools, fertilizers, and pesticides have a significant effect on production yields.

Table 3. Distribution of Economic Infrastructure Ratio Based on Priority

| Priority | Economic Infrastructure Ratio | Number of Villages | Percentage (%) |
|----------|-------------------------------|--------------------|----------------|
| 1 | <0.0386 | 25 | 14.1 |
| 2 | >0.0386 - 0.0507 | 27 | 15.2 |
| 3 | >0.0507 - 0.0663 | 36 | 20.3 |
| 4 | >0.0663 - 0.0804 | 36 | 20.3 |
| 5 | 0.0804 - 0.0970 | 27 | 15.2 |
| 6 | >0.0970 | 26 | 14.6 |

Source: FSVA South Minahasa, 2023

Third, distribution and infrastructure play an important role in maintaining the stability of food availability. Inadequate transportation and logistics, especially in remote areas, can hinder food distribution. Damaged infrastructure, such as poor roads and storage facilities, can cause spoilage and food loss, which ultimately reduces the amount of food available.

Fourth, environmental factors and government policies also have a major influence. Land degradation,

deforestation, as well as soil and water pollution can reduce the natural capacity to provide food sustainably. The conversion of agricultural land to non-agricultural uses also disrupts the regional ecosystem balance. In addition, government policies such as agricultural subsidies, import-export policies, and national food stock management through agencies such as Bulog have a significant impact on food availability in the market.

Food Access in South Minahasa Regency

Food affordability or access to food is the ability of groups, households, or individuals to meet sufficient food needs at all times, either from self-production, purchases, or other assistance, based on resources (social, technological, financial, natural, and human) that are sustainably controlled in ways that do not contradict community beliefs.

Adequate food availability does not guarantee good food consumption if there are distribution disparities. Food distribution in a broad sense includes distribution between countries, regions, and groups of people (based on income), while in a narrower sense it refers to food distribution among family members within a household.

Table 4. Distribution of villages with the lowest welfare levels based on priority scale

| Priority | Range | Number of Villages | Percentage (%) |
|----------|-----------------|--------------------|----------------|
| 1 | >0.0641 | 26 | 14.6 |
| 2 | 0.0371 < 0.0641 | 27 | 15.2 |
| 3 | 0.0218 < 0.0371 | 35 | 19.7 |
| 4 | 0.0139 < 0.0218 | 37 | 20.9 |
| 5 | 0.0061 < 0.0139 | 37 | 15.2 |
| 6 | <0.0061 | 25 | 14.1 |

Source: FSVA South Minahasa, 2023

Food may be available in an area but not accessible to certain households due to limited: (1) Economic access: financial ability to purchase adequate and nutritious food; (2) Physical access: the existence of infrastructure to reach food sources; and/or (3) Social access: social capital that can be used to gain informal support in accessing food, such as barter, loans, or social safety net programs (Ngangi et al., 2021).

One of the main factors influencing food access is income level. Income determines a person's or family's ability to purchase various types of food needed. The poverty ratio has decreased in recent years. The number of poor people in South Minahasa Regency has continued to decline from 2017 to 2021, namely from 10.22% (20,880 people); 9.92% (20,420 people); 9.78% (20,260 people); 9.34% (19,540 people); 9.26% (19,490 people); and in 2021 decreased to 9.14% (19,380 people).

Table 5. Percentage of Population below the Poverty Line in South Minahasa Regency

| Description | Year | | | | |
|-------------------------------|------|------|------|------|------|
| | 2017 | 2018 | 2019 | 2020 | 2021 |
| Percentage of poor population | 9.78 | 9.34 | 9.26 | 9.14 | 9.37 |

Source: FSVA South Minahasa, 2023

Food prices significantly influence access to food, as rising staple prices reduce purchasing power, especially among low-income groups. Thus, maintaining price stability is crucial for sustainable food access. Physical access and infrastructure also matter—adequate roads, transport, and markets enable communities, particularly in rural areas, to obtain food more easily. In 2021, South Minahasa Regency had 673.95 km of district roads, with 46.35% in good condition and 39.77% severely damaged, highlighting the need for government attention. Efficient distribution and supply chain systems are essential to ensure equitable food distribution, while disruptions such as natural disasters or logistical issues can lead to shortages and price increases.

Food Utilization in South Minahasa Regency

Food utilization is a key stage in the food security system, reflecting how effectively available food meets the community’s nutritional and energy needs (Webb & Rogers, 2003). It depends not only on food quantity but also on nutritional quality, eating habits, and access. In South Minahasa, the average per capita income from 2018–2022 was around Rp3,344,748 per year, indicating limited purchasing power that affects access to diverse, nutritious food. High food prices further reduce utilization, as shown by a Consumer Price Index of 108.56 and 1.04% annual inflation in September 2025. Cultural eating habits—such as the Minahasa preference for spicy foods—also shape consumption patterns. Moreover, local food availability and community knowledge of balanced nutrition play crucial roles, as better access and awareness encourage more diverse and nutritious diets.

Table 6. Distribution of Health Worker Ratios in Villages Based on Priority Scale

| Priority | Range | Number of Villages | Percentage |
|----------|-------------------|--------------------|------------|
| 1 | > 100.0000 | 29 | 16.3% |
| 2 | 7.1724 < 100.0000 | 24 | 13.5% |
| 3 | 2.7389 < 7.1724 | 35 | 19.7% |
| 4 | 1.1734 < 2.7389 | 37 | 20.9% |
| 5 | 0.4224 < 1.1734 | 27 | 15.2% |
| 6 | <0.4224 | 25 | 14.1% |

Source: FSVA South Minahasa, 2023

The ratio of the number of village residents per health worker relative to population density shows the capacity of health workers in village areas to serve the

community. An adequate number of health workers will improve food utilization and nutritional status.

Food security is one aspect that influences community health and nutrition status. Children’s nutritional status is determined by food intake and diseases suffered. The number of malnourished toddlers in Minahasa Selatan Regency from 2017–2021 was 20 children. The highest numbers of malnourished children were found in Tumpaan Subdistrict (4) and in Maesaan, Modinding, Tatapaan, and Sinonsayang Subdistricts (2 each), while the lowest (0) were found in Amurang, Motoling Timur, Motoling, Motoling Barat, and Tompasobaru.

Table 7. Malnourished Children 2017–2021

| Subdistrict | Malnourished Children | | | | |
|----------------|-----------------------|------|------|------|------|
| | 2017 | 2018 | 2019 | 2020 | 2021 |
| Tareran | | | 1 | | |
| Suluun Tareran | | 1 | | | |
| Tumpaan | 1 | | | 2 | 1 |
| Tatapaan | | | 1 | | 1 |
| Amurang Timur | 1 | | | | |
| Amurang | | | | | |
| Amurang Barat | | | | 1 | 1 |
| Tenga | 1 | | | | |
| Sinonsayang | 2 | | | | |
| Kumelembuai | | | 1 | | |
| Motoling Timur | | | | | |
| Motoling | | | | | |
| Motoling Barat | | | | | |
| Ranoyapo | | 1 | | | |
| Tompaso Baru | | | | | |
| Maesaan | | | | 2 | |
| Modinding | | | | | 2 |
| Total | 5 | 2 | 3 | 5 | 5 |

Source: FSVA South Minahasa, 2023

The Influence of Availability, Access, and Utilization Factors on Food Security in Minahasa Selatan Regency

According to Law No. 7 of 1996, food security is a condition in which food is sufficiently available, safe, evenly distributed, and affordable. Hanani (2009) distinguishes it from food self-sufficiency, which focuses on national food availability, whereas food security emphasizes individuals’ access to nutritious food for a healthy and productive life. Suryana (2003) adds that food availability must meet caloric needs, while food access reflects the ability of households and individuals to obtain adequate food using their resources. Food access involves economic, physical, and social dimensions—income and prices, infrastructure and distribution, and food preferences, respectively. Food utilization concerns the effective use of food for health and nutrition, influenced by knowledge, sanitation, water, healthcare, and nutrition education. Based on the 2024 Food Vulnerability Map of South Minahasa Regency, among 177 villages and urban areas, 1 was

categorized as Priority 1, 10 as Priority 2, 16 as Priority 3, 13 as Priority 4, 78 as Priority 5, and 59 as Priority 6, indicating varying levels of food vulnerability across factors of availability, access, and utilization. Areas with higher vulnerability should therefore be prioritized in food insecurity mitigation efforts (DKP, 2005, 2009).

Table 8. Distribution of villages based on priority

| Priority | Number of Villages | Percentage (%) |
|----------|--------------------|----------------|
| 1 | 1 | 0.5 |
| 2 | 10 | 5.6 |
| 3 | 16 | 9.0 |
| 4 | 13 | 7.3 |
| 5 | 78 | 44.0 |
| 6 | 59 | 33.3 |

Source: FSVA South Minahasa, 2023

The village most vulnerable to food insecurity under Priority 1 (1 village) is Liandok Village in Tompaso Baru Subdistrict. Villages classified as Priority 2 are located in Tumpaan (3 villages), Tatapaan (3), Tenga (2), Maesaan (1), and Tareran (1). Villages under Priority 3 are found in Motoling Timur (3), Motoling Barat (2), Tatapaan (2), Sinonsayang (2), Tenga (2), Motoling (1), Tompasobaru (1), Ranoyapo (1), Tareran (1), and Suluun Tareran (1).

Food security cannot be considered achieved if only food availability is fulfilled. True food security is

realized when access to and utilization of food are also adequate and well-functioning.

Before analyzing the structural model, research using Partial Least Squares Path Modeling (PLS-PM) must first ensure the validity and reliability of its measurement indicators. Thus, the measurement model was validated prior to assessing the structural model's goodness. Using SmartPLS4 software, inferential statistical analysis was conducted to test the measurement model through assessments of outer loading, convergent validity, discriminant validity, reliability, and Average Variance Extracted (AVE). The results showed that all indicators had outer loading values above 0.7 and AVE values exceeding 0.5, indicating good convergent validity. The Fornell-Larcker criterion also confirmed discriminant validity, as the square root of each construct's AVE was higher than its correlations with other constructs. Composite reliability values above 0.7 further demonstrated that all constructs were both valid and reliable. Multicollinearity testing yielded VIF values below 5, confirming acceptable correlations among independent variables. The R-square results indicated that Food Utilization was explained by Food Availability and Food Access by 74.0%, while Food Security was explained by Food Availability, Food Access, and Food Utilization by 89.1%, with the remaining variances attributed to other unobserved factors.

Table 9. Outer Loading Results

| Variable | Indicator | Outer Loading | Rule of Thumb | Evaluation |
|-------------------|-----------|---------------|---------------|------------|
| Food Availability | X1.1 | 0.891 | > 0,7 | Valid |
| | X1.2 | 0.992 | > 0,7 | Valid |
| | X1.3 | 0.888 | > 0,7 | Valid |
| | X1.4 | 0.879 | > 0,7 | Valid |
| | X1.5 | 0.879 | > 0,7 | Valid |
| | X1.6 | 0.891 | > 0,7 | Valid |
| | X1.7 | 0.922 | > 0,7 | Valid |
| | X1.8 | 0.888 | > 0,7 | Valid |
| Food Access | X2.1 | 0.893 | > 0,7 | Valid |
| | X2.2 | 0.893 | > 0,7 | Valid |
| | X2.3 | 0.820 | > 0,7 | Valid |
| | X2.4 | 0.725 | > 0,7 | Valid |
| | X2.5 | 0.763 | > 0,7 | Valid |
| | X2.6 | 0.753 | > 0,7 | Valid |
| | X2.7 | 0.729 | > 0,7 | Valid |
| | X2.8 | 0.820 | > 0,7 | Valid |
| Food Utilization | X3.1 | 0.947 | > 0,7 | Valid |
| | X3.2 | 0.850 | > 0,7 | Valid |
| | X3.3 | 0.747 | > 0,7 | Valid |
| | X3.4 | 0.779 | > 0,7 | Valid |
| | X3.5 | 0.814 | > 0,7 | Valid |
| | X3.6 | 0.813 | > 0,7 | Valid |
| | X3.7 | 0.845 | > 0,7 | Valid |
| | X3.8 | 0.784 | > 0,7 | Valid |
| Food Security | Y1.1 | 0.782 | > 0,7 | Valid |
| | Y1.2 | 0.806 | > 0,7 | Valid |

| Variable | Indicator | Outer Loading | Rule of Thumb | Evaluation |
|----------|-----------|---------------|---------------|------------|
| | Y1.3 | 0.846 | > 0,7 | Valid |
| | Y1.4 | 0.826 | > 0,7 | Valid |
| | Y1.5 | 0.901 | > 0,7 | Valid |
| | Y1.6 | 0.886 | > 0,7 | Valid |
| | Y1.7 | 0.708 | > 0,7 | Valid |
| | Y1.8 | 0.780 | > 0,7 | Valid |

Source: Data analysis results, 2025

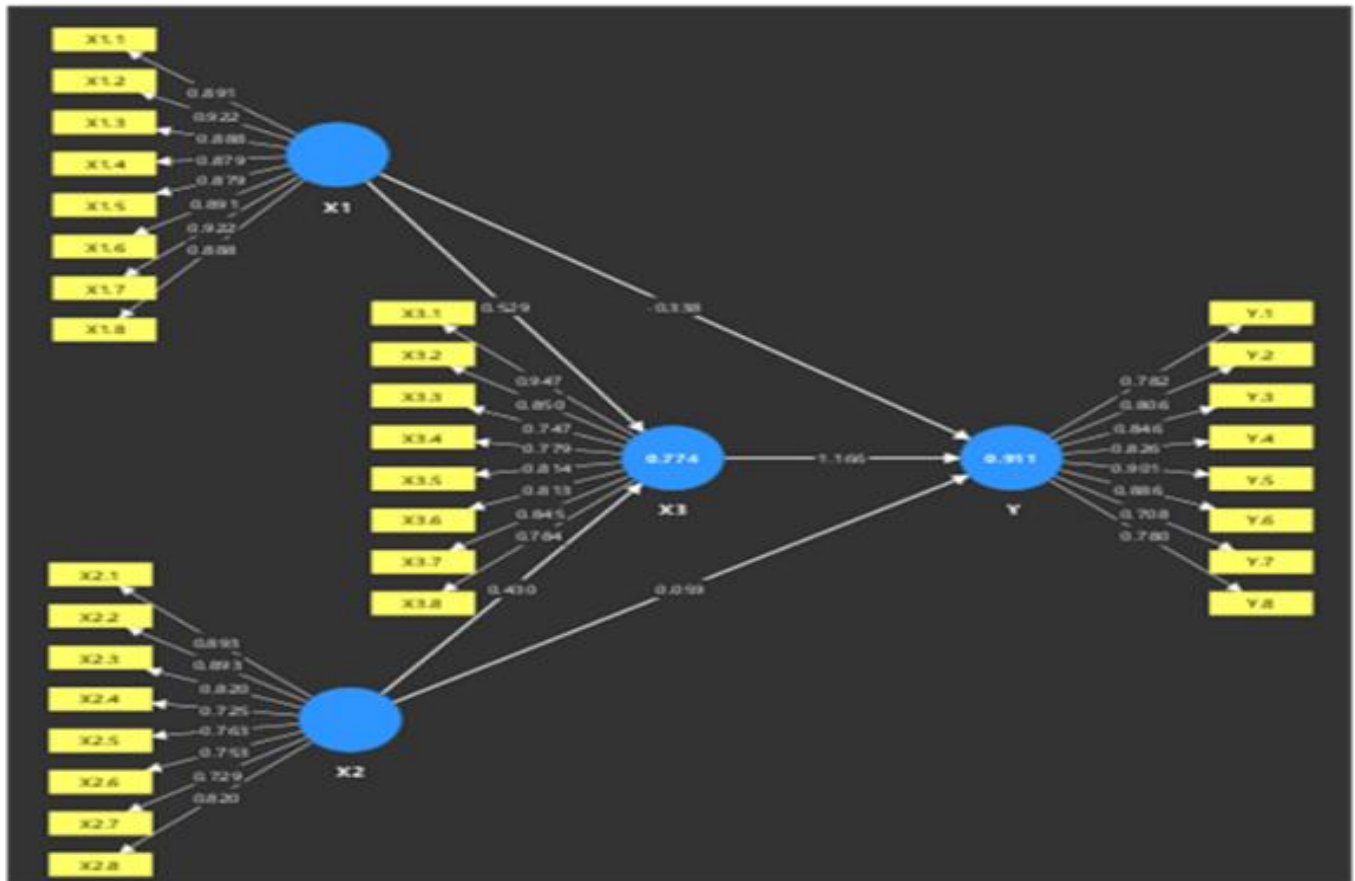


Figure 4. Actual measurement model output display

Table 10. Average Variance Extracted (AVE) Values

| Variable | AVE | Rule of Thumb | Evaluation |
|-------------------|-------|---------------|------------|
| Food Availability | 0.801 | > 0.5 | Valid |
| Food Access | 0.643 | > 0.5 | Valid |
| Food Utilization | 0.679 | > 0.5 | Valid |
| Food Security | 0.671 | > 0.5 | Valid |

Source: Data analysis results, 2025

After testing and validating the model, the next step is hypothesis testing, which aims to identify whether there is a correlation between independent and

dependent variables. This study used a one-tailed hypothesis test with a significance level of 0.05 and a confidence level of 95%. The rule of thumb used for hypothesis testing is T-statistic > 1.645.

H1: Food Availability does not affect Food Security. The first hypothesis has an original sample value of -0.338, t-statistic of 1.745, and p-value of 0.081. Since the t-statistic exceeds 1.645 and the p-value is greater than 0.05, it can be concluded that Food Availability does not significantly affect Food Security.

Table 11. Fornell-Larcker Criterion Values

| Variable | Food Availability | Food Access | Food Utilization | Food Security |
|-------------------|-------------------|-------------|------------------|---------------|
| Food Availability | 0.895 | | | |
| Food Access | 0.679 | 0.802 | | |
| Food Utilization | 0.821 | 0.789 | 0.824 | |
| Food Security | 0.659 | 0.750 | 0.935 | 0.819 |

Source: Data analysis results, 2025

Table 12. Cronbach’s Alpha and Composite Reliability Values

| Variable | Cronbach's alpha | Composite reliability (rho_a) | Composite reliability (rho_c) | Remark |
|-------------------|------------------|-------------------------------|-------------------------------|-----------------------------------|
| Food Availability | 0.965 | 0.967 | 0.970 | Reliable (Rule of Thumb > 0.7) |
| Food Access | 0.920 | 0.921 | 0.935 | |
| Food Utilization | 0.932 | 0.937 | 0.944 | |
| Food Security | 0.929 | 0.933 | 0.942 | |

Source: Data analysis results, 2025

H2: Food Access does not affect Food Security. The second hypothesis has an original sample value of 0.059, t-statistic of 0.296, and p-value of 0.767. Since the t-statistic is below 1.645 and the p-value is above 0.05, Food Access is not significantly related to Food Security.

H3: Food Utilization affects Food Security. The third hypothesis has an original sample value of 1.166, t-statistic of 5.176, and p-value of 0.000. Since the t-statistic exceeds 1.645 and the p-value is below 0.05, Food Utilization significantly affects Food Security.

Based on the SEM-PLS analysis results, Food Availability and Food Access do not have a significant

effect on Food Security in South Minahasa Regency. This indicates that current food security is influenced by other variables, such as agricultural land area and poverty levels.

Table 13. Multicollinearity Test Results

| Variable | VIF |
|-----------------------------------|-------|
| Food Availability → Food Security | 3.092 |
| Food Access → Food Security | 2.674 |
| Food Utilization → Food Security | 4.421 |

Source: Data analysis results, 2025

Table 14. Hypothesis Testing Results

| Hypothesis | Original Sample (O) | T-statistics (O/STDEV) | P-value | Analysis |
|-----------------------------------|---------------------|------------------------|---------|---------------|
| Food Availability → Food Security | -0.338 | 1.745 | 0.081 | Not supported |
| Food Access → Food Security | 0.059 | 0.296 | 0.767 | Not supported |
| Food Utilization → Food Security | 1.166 | 5.176 | 0.000 | Dukung |

Source: Data analysis results, 2025

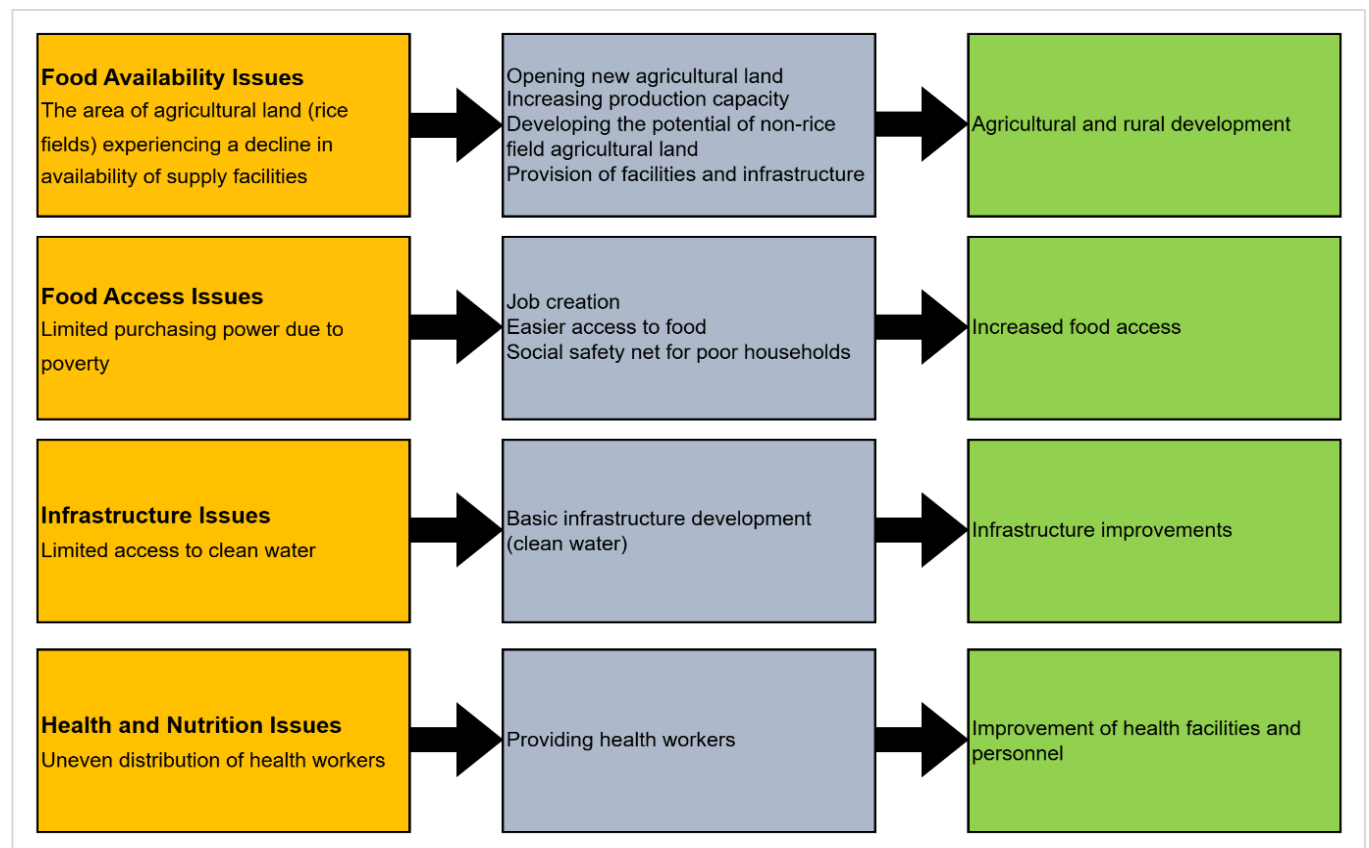


Figure 5. Intervention framework to improve food security

As the regional economy develops, agricultural land area tends to decline due to land conversion for non-agricultural purposes. This conversion poses a serious threat to sustainable food security. In South Minahasa, the population growth rate from 2017–2021 reached 0.082% per year, while rice and corn production grew by 0.19% and 0.08%, respectively. The ratio of agricultural land to total land is 62.18%. The ratio of food-supplying economic infrastructure in priority levels 1–3 reaches 16.56%, with an economic growth rate of 4.91% in 2021. This presents challenges in maintaining food availability. Land conversion, driven by population growth and increased demand for residential areas, indirectly affects the number of poor people who struggle to afford housing.

Poverty conditions influence food access and, consequently, food security (Suriadi, 2010). The government needs to conduct a deeper assessment of factors affecting food security to formulate more effective strategies for improving it in South Minahasa Regency (Hasan, 2006).

Food utilization plays an essential role in food security. It refers to the household's and individual's ability to absorb and metabolize nutrients, meaning it represents the level of food consumption or the community's capacity to use available food in terms of quantity, nutritional quality, and dietary diversity. The effectiveness of food utilization depends on individual or household knowledge, sanitation and water availability, health facilities and services, as well as nutrition education and childcare.

Proper food utilization can improve nutritional and health status, which in turn strengthens overall food security. When people consume sufficient and balanced food, their nutritional status improves, health increases, and food security becomes stronger. Conversely, poor food utilization leads to weakened food security—even if food is available, inadequate consumption or lack of dietary diversity can still result in food insecurity. Hence, food utilization is a key aspect of food security—availability and access are meaningless without proper utilization, as the essence of food security lies in the human body's ability to benefit nutritionally from the food consumed.

Based on these findings, the South Minahasa Regency Government should implement strategies to enhance food security in the region. Food plays not only a vital role in meeting basic physical needs and preventing hunger but also in improving national intelligence and human quality—resulting in healthy, intelligent, active, and productive individuals, as described in the definition of food security. Adequate food quantity and quality correlate with productivity, brain growth, intelligence, and overall societal welfare.

Policies that should be undertaken by the government regarding food availability include managing economic resources to ensure community food security by improving the welfare of farmers, fishers, SMEs, small industries, and cooperatives through strategies to sustain resource productivity. Resource management should also focus on enhancing consumption quality, food fortification and biofortification, and improving the availability of agricultural food products.

Food accessibility refers to households' ability to obtain sufficient food, whether from self-production, stock, purchases, barter, gifts, loans, or food aid. Food may be available in a region but not accessible to certain households due to limited: (1) Economic access—financial ability to purchase adequate and nutritious food; (2) Physical access—infrastructure to reach food sources; and/or (3) Social access—social capital for gaining informal food access support (e.g., barter, loans, or social safety nets).

The government's strategy for maintaining food access in South Minahasa Regency, although access did not significantly affect food security, includes reducing poverty, improving the welfare of poor and vulnerable populations, and enhancing the quality of social welfare services through professional providers. Additionally, the government must increase food availability, access, and consumption quality.

Food utilization has a significant effect on food security in South Minahasa Regency. Utilization includes food storage, processing, and serving methods, including water use during processing and cultural practices in food preparation—especially for individuals requiring special diets (e.g., during growth, pregnancy, breastfeeding, or due to health conditions).

The local government's strategy should focus on improving community health and life expectancy through a life-cycle approach, strengthening basic and referral health services, and enhancing public health efforts, maternal and child nutrition, and overall health programs.

Investment in nutrition is one of the most cost-effective development interventions, with a high benefit-cost ratio—not only for individuals but also for sustainable national development—since it helps protect health, prevent disability, boost economic productivity, and ensure survival. Moreover, efforts to improve food security should address the root causes of food vulnerability in villages (DKP, 2005), as illustrated in Figure 5.

Conclusion

Based on the research results and discussion, the following conclusions can be drawn: First, food

availability does not impact food security. This is evident in sub-districts with food surpluses, such as Modinding, a horticultural crop center, but which do not grow rice as a staple food. While adequate food access and maximum food absorption are still present in sub-districts indicated as food insecure, food security in sub-districts with food surpluses is more influenced by food access. Second, food access does not impact food security in South Minahasa Regency. Food may be available in an area but inaccessible to certain households due to limited economic, physical, and social access. Third, food absorption impacts food security in South Minahasa Regency. The quality of public health and increased life expectancy, as well as the realization of improved public health through a life cycle approach and strengthening basic and referral health services, significantly impact household food security, thereby improving food absorption.

Acknowledgments

We would like to thank all parties involved in the completion of this research.

Author Contributions

R.K.: Developing ideas, analyzing, writing, reviewing, responding to reviewers comments; M.T, J.B.: analyzing data, overseeing data collection, reviewing scripts, and writing.

Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

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