Food security analysis based on the proportion of food expenditure and energy consumption of carrot farm households in Tawangmangu Karanganyar

A N Afifah, S Marwanti and Agustono
Department of Agribusiness, Faculty of Agriculture, Universitas Sebelas Maret, Indonesia

Corresponding author: aufaafifah@student.uns.ac.id

Abstract. Food security is reflected in two indicators, the level of energy intake and the proportion of household food expenditure (PFE). In 2015, the Tawangmangu sub-district in Karanganyar, Central Java, experienced a rice deficit, causing rice prices to hinder food access. It affects the food expenditures of carrot farm households in the Tawangmangu sub-district. The income of carrot farmers, which is highly unpredictable, affects nutrition fulfillment to determine food security. This study analyzes PFE, energy and protein consumption, and food security of carrot farm households in Tawangmangu, Karanganyar. The number of respondents in this study was 40 carrot farm households, and the sampling method used the accidental sampling technique. The data analysis method in this study used household income and expenditures, PFE, food consumption, and food security. The results showed that the average PFE of the household was 44%. The average energy and protein consumptions are 1,803 kcal/person/day and 58 grams/person/day with 84% energy level intake and 96% protein intake. The distribution of household food security conditions are 62.5% food secure, 5% food vulnerable, 30% food less secure, and 2.5% are food insecure.

1. Introduction
Food is anything that comes from biological sources and water, whether processed or not. Food and its components must have health benefits and reduce the risk of contracting a disease. In addition to meeting human nutritional needs, eating food also repairs damage to the body, maintains the smooth functioning of vital functions, and increases immunity to prevent disease [1]. Over time, the orientation in consuming food has shifted from attention to commodities to concern the nutrients contained in a type of food. Diversification of food consumption increases public awareness of balanced nutrition in realizing food security [2].

The definition of food security based on Undang-Undang No 18 of 2012 is the condition where food for the state to individual fulfilled, as reflected by the availability of sufficient food, both in quantity and quality, safe, diverse, nutritious, equitable, affordable, doesn't conflict with religion, belief, and community culture to be able to live a healthy, active, and productive life in a sustainable manner. There are four dimensions of food security based on the definition: availability, access, utilization, and stability.

Food availability means the physical availability of food in an area from domestic production, imports, and food assistance [3]. Rice is the main food commodity that affects food security in Indonesia,
so rice’s availability must be guarantee. Karanganyar Regency is one of the rice-contributing districts in Central Java Province. In general, the availability of food, especially rice, is sufficient to meet the food consumption needs of the people in the Karanganyar regency but viewed from certain parts of the regency, some districts are experiencing a deficit. Tawangmangu district is one of the districts experiencing a rice deficit in 2015. The rice deficit condition causes the price of rice in the Tawangmangu district to become more expensive than the districts with a surplus rice condition.

Rising prices lead to hampered food access. High food prices affect the household’s food expenditure and income. The per capita expenditure of the Karanganyar Regency in 2020 non-food expenditure was IDR 572,777 and IDR 490,491 food expenditure [4]. In 2020 the income per capita in Karanganyar Regency IDR 28,051,140 per year or IDR 2,337,595 per month. Per capita income growth in 2020 in Karanganyar Regency decreased by 6.65% due to the Covid-19 pandemic that affected the global economy. The tendency of society if income increases, consumption patterns will be more diverse [5].

Food security problems often occur in farmer households in rural areas. In 2015 the condition of carrot production in the Tawangmangu area was so abundant, the selling price of carrots only reached IDR 2,000/kg or even lower [6]. Agricultural activities depended on nature, such as climate, weather, seasons, and living creature, which causes the income of farmer’s household to be uncertain. The low level of income leads to differences in income distribution patterns with high-income households. These affect the fulfillment of nutrition to determine household food security. This study aims to analyze the PFE on household expenditure, household energy and protein consumption, and the condition of household food security of carrot farmers in Tawangmangu, Karanganyar, based on the PFE and household energy consumption.

2. Methods
The basic method of this study uses the descriptive method with survey technique. The study was conducted in Tawangmangu district, Karanganyar regency, purposively in March 2021. The number of samples taken using accidental sampling was 40 samples of carrot farms’ households. Data collection was carried out by observation, interview, documentation, and recall.

2.1. PFE
PFE is analyzed by calculating the total household expenditure, which consists of food and non-food expenditure. Data analysis of the PFE using the following method [7]:

\[ PF = \frac{PP}{TP} \times 100\% \]

Note:
PF = proportion of food expenditure (%)
PP = household food expenditure (IDR/month)
TP = household total expenditure (IDR/month)

2.2. Household consumption
Household consumption is calculated by adding up the total nutrition, energy, and protein consumed by one household member in one day. Consumption comes from food expenditure and farm products. Then calculated the level of household nutritional consumption using the following method [8]:

\[ TKG = \frac{C}{AKG} \times 100\% \]

Note:
TKG = nutrient level intake (%)
C = consumption intake, energy (kcal), protein (gram)
AKG = Standard Indonesian Nutrient Sufficiency from food consumption based on gender and age

Household nutrient level intake is classified into 4 groups:
Good: TKG ≥ 100% AKG
Moderate: TKG 80 – 99% AKG
Low: TKG 70 – 80% AKG
Deficit: TKG < 70% AKG

2.3. Food security

Household food security can be classified using various indicators, one of which is the food security classification by Jonsson and Toole. The household food security condition is measured by cross-classification between the proportion of food expenditure (PFE) and the level of energy intake [9].

Household food security is divided into four classifications:

- **Food secure**: sufficient energy intake (>80% from AKE) and low PFE (<60% of total expenditure)
- **Food vulnerable**: sufficient energy intake (>80% from AKE) and high PFE (≥60% of total expenditure)
- **Food less secure**: not sufficient energy intake (≤80% from AKE) and low PFE (<60% of total expenditure)
- **Food insecure**: not sufficient energy intake (≤80% from AKE) and high PFE (≥60% of total expenditure)

3. Results and discussion

3.1. Household PFE

| No | Expenditure                  | Nominal (Rp/month) | Percentage (%) |
|----|------------------------------|--------------------|----------------|
| 1  | Food expenditure            | 815,336            | 44.0           |
|    | Grains                      | 204,550            | 11.1           |
|    | Tubers                      | 29,938             | 1.6            |
|    | Fish                        | 14,545             | 0.8            |
|    | Meat                        | 75,175             | 4.0            |
|    | Eggs and milk               | 52,460             | 2.8            |
|    | Vegetables                  | 35,821             | 1.9            |
|    | Nuts                        | 74,250             | 4.1            |
|    | Fruits                      | 33,075             | 1.8            |
|    | Oil and fat                 | 28,413             | 1.5            |
|    | Drink                       | 53,675             | 2.9            |
|    | Spices                      | 32,498             | 1.7            |
|    | Other consumption           | 40,438             | 2.2            |
|    | Instant food and beverages  | 42,050             | 2.3            |
|    | Tobacco and betel           | 98,450             | 5.3            |
| 2  | Non-food expenditure        | 1,041,756          | 56.0           |
|    | Housing                     | 134,200            | 7.3            |
|    | Goods and services          | 399,588            | 21.5           |
|    | Education                   | 260,900            | 14.0           |
|    | Health                      | 26,750             | 1.3            |
|    | Clothing                    | 28,500             | 1.5            |
|    | Durable goods               | 19,375             | 1.0            |
|    | Tax and insurance           | 53,694             | 2.9            |
|    | Social needs                | 118,750            | 6.5            |
The proportion of food expenditure is the percentage of food expenditure compared to the household's total expenditure, consist of food expenditure and non-food expenditure per month. There are 14 types of food expenditure, and 8 types of non-food expenditure [10].

Based on Table 1, the average monthly food expenditure of carrot farmer households in Tawangmangu district is IDR 815,336. The highest food expenditure comes from grains, especially rice, which is the staple food of the people in Indonesia. Every month the average household buys 17.67 kg of rice. The high expenditure on grains shows that the respondent still focused on grains as the source of energy consumption. The respondents' preference for consuming a specific type of food is caused by several factors, including welfare and tastes. The balance in consuming various types of food reflects the quality of food consumption [11]

The average non-food expenditure of respondents per month is IDR 1,041,756. The highest type of non-food expenditure is the expenditure of goods and services, and respondent spends IDR 399,587 per month. Expenditures on goods and services consist of the daily needs of all respondent members such as bath soap, laundry soap, toothpaste, toothbrush, shampoo, transportation costs, gasoline, and communication or credit.

The PFE of farmer households reflects the priority of farmers in meeting household needs [12]. The higher priority food needs than non-food needs causing a higher PFE. It tends to have low levels of welfare compared to households with low PFE. The proportion of respondent's food expenditure lower than non-food expenditure indicates that the respondent's welfare level is already good.

3.2. Household consumption

The respondent's energy and protein consumption was calculated based on each household member's food and drink in a day. Energy and protein consumption was determined using the recall method, which records the consumption of all household members in the last 24 hours. The energy and protein contained in the respondent's consumption calculate using the DKBM table guidelines. The energy consumption of each household member is compared with the nutritional adequacy rate (AKG). The amount of AKG for each individual is different (but in general, 2,150 kcal/person/day for energy and 60 grams/person/day for protein), depending on the gender and age group of the individual. After being compared, it will show every household member's level of nutrition intake (TKG).

Table 2. The average consumption and level nutrition intake of carrot farms' household member

| Nutrient | Consumption       | AKG             | TKG (%) |
|----------|-------------------|-----------------|---------|
| Energy   | 1,803 kcal/person/day | 2,158 kcal/person/day | 84      |
| Protein  | 58 grams/person/day          | 60 grams/person/day          | 96      |

The respondents in this study consisted of 40 carrot farmer households, where the number of members from all the households was 132 people. Based on Table 2, the average level of energy and protein intake of household members is classified as moderate. The household member food consumed is still not good enough because it does not meet the AKG standards. Furthermore, it is necessary to know the amount of TKE for each household to determine food security.

Table 3. Distribution of nutrition intake level categories of carrot farms' household

| Nutrient intake level | Energy | Protein |
|-----------------------|--------|---------|
|                       | Number of households | %     | Number of households | %     |
| Good                  | 0      | 19      | 47.5                |
| Moderate              | 29     | 72.5    | 22.5                |
| Low                   | 9      | 22.5    | 5                   | 12.5   |
| Deficit               | 2      | 5.0     | 7                   | 17.5   |
3.3. Household food security

The distribution of respondents' food security categories shows that most households have achieved food security. The second category with the highest percentage is food less secure because the respondent not used their income as well as possible. The mother's education level is still low, which made a lack of understanding about the nutritional content of food [13]. Meanwhile, 7.5% of the total respondents experienced food insecurity and food insecurity, meaning that the overall food security of carrot farmer households in the Tawangmangu district is quite good.

| Food security categories | Number of households | Percentage (%) |
|--------------------------|----------------------|----------------|
| Food secure              | 21                   | 52.5           |
| Food vulnerable          | 2                    | 5.0            |
| Food less secure         | 16                   | 40.0           |
| Food insecure            | 1                    | 2.5            |

Table 4. Distribution of food security categories of farms' households based on PFE and energy consumption (from food expenditure)

Based on Table 3, none of the households are classified as good on energy intake level. Food acquisition outside of expenditure can be an alternative for farmer households to increase the nutritional consumption of household members so that the level of household energy consumption increases. However, although the acquisition of sufficient food will lead to adequate food availability, it does not mean that there will be an increase in the quality of food consumption due to the lack of attention to food selection based on nutritional content [14].

| Food security categories | Number of households | Percentage (%) |
|--------------------------|----------------------|----------------|
| Food secure              | 25                   | 62.5           |
| Food vulnerable          | 2                    | 5.0            |
| Food less secure         | 12                   | 30.0           |
| Food insecure            | 1                    | 2.5            |

Table 5. Distribution of food security categories of farms' households based on PFE and energy consumption (from expenditure and farming)

Compared to Table 4, after the food acquisition from farming was added, the households with the food secure category increased from 21 to 25 households. Based on Table 5, households that categorized not sufficient level of energy intake become sufficient. The number of households in the food vulnerable and food insecure categories is the same due several factors. The first factor is that not all of the respondents carrying out the recall by consuming food from their farming so that the TKE sourced from farming results is zero and does not add to the household TKE. Furthermore, because of the two food security indicators, only the TKE indicator is affected by food acquisition while the PFE is not. The amount of food consumption from farming does not impact the respondents' TKE very significantly.

4. Conclusion

This study concludes that the household PFE is 44%, showing that most households achieved a good level of welfare. The average household member consumes energy and protein of 1,803 kcal/person/day and 58 grams/person/day with a moderate level of consumption. In the food security analysis of 40 carrot farming households, 62.5% are food insecure, 5% are food vulnerable, 30% are food less secure, and 2.5% are food insecure. The food acquisition from farming can increase farm households' food security, both by increasing consumption intake levels and contributing to household income.
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