Household food security of rainfed-rice farmers in Sragen District to achieve sustainable development goals

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Abstract. Goal 2 of the Sustainable Development Goals is Zero Hunger or ensure food security in the world. This study aims to determine households’ food security in Sragen District using descriptive and analytical methods with survey techniques. The research was conducted in Gemolong Sub-district, Sragen District. The determination of village samples is done deliberately (purposive) considering the largest rainfed rice fields. The data analysis used is the analysis of energy consumption and household food security. The results showed that the energy consumption of farmers' households amounted to 6,041 kcal/day with an energy sufficiency value of 5,368 kcal/day, then obtained energy consumption level of 113% and classified in the category of high level because energy consumption level ≥ 100%. Household food security conditions showed that 53.33% were food resistant households and 46.67% were food vulnerable. Increasing production and household income by optimizing drill wells to ensure water availability or procurement of seeds resistant to rainfed rice fields can address vulnerable food situations.

1. Introduction
Food is vital for the survival of human life. Based on this, the government needs to ensure food security for each individual of its citizens. According to Jayarni and Sumarmi [1], ensuring food security is in line with the Sustainable Development Goal's, a sustainable world development agenda for the welfare of people and the planet earth by ending the famine that occurs in each country. According to the United Nations Development Programme (UNDP), SDGs have 17 integrated objectives and recognize that actions on one goal will affect other goals. If food problems can be solved, it will facilitate the achievement of other goals. Based on this, food security must be guaranteed by every region. According to FAO, food security is a situation where every individual has physical/economic/social access to sufficient, safe, and nutritious food in the fulfillment of nutrition at all times.

Food Security is measured by a cross-indicator between energy consumption level (ECL) and the proportion of food expenditure [2]. Based on the Department of Agriculture and Food Security data, the amount of energy consumption in Sragen District in 2020 amounted to 2,560 kcal/cap/day. This figure met the sufficiency standards set by Permenkes No. 28 of 2019 [3], where the standard of energy needs is 2,100 kcal/cap/day. While in quality, consumption diversity in Sragen regency still needs improvement because the desirable dietary pattern (DDP) score is 90.5% or has not reached the maximum DDP score (100%).
Income affects farmers' households' purchasing ability or purchasing power, especially rain-affected rice paddies [4]. The water system of raindrops has a dependence on rainfall, which results in farmers having a schedule that also adjusts for weather changes and potentially becomes irregular. Irregular schedules in planting can affect farmers' incomes, especially if farmers cannot properly respond to changes in weather and nature [5]. Based on the description above, it is necessary to conduct research related to the food security of households of rainfed farmers in Sragen Regency.

2. Methods
The primary method used in this study is descriptive analytical. Descriptive analytical means that this research describes and analyzes the data obtained [6]. The implementation techniques in this research use survey techniques, namely collecting information by compiling a list of questions posed to respondents as part of a population sample [7]. The research location was determined purposively (intentionally), and Kaloran and Ngembatpadas Villages were chosen considering that both villages have the largest rainfed rice fields in Gemolong Subdistrict, Sragen.

The study used 30 samples of rainfed farmer households. Determination of the number of samples in each village proportionally so that the number of samples obtained for Kaloran Village is as many as 18 samples and Ngembatpadas Village as many as 12 samples. The types and data sources used in this study are primary and secondary data. Primary data is obtained from direct interviews with farmer households that are respondents. Secondary data were obtained from government agencies and related institutions, such as the Central Statistics Agency (BPS) Sragen Regency, The Department of Agriculture and Food Security Sragen, Gemolong Subdistrict, Counseling agency, and Implementing Gemolong Subdistrict (BPP). The data collection of this research was conducted through interviews, observations, recalls, and recordings.

2.1. Energy consumption
Consumption assessment is seen in terms of quality and quantity of food. Consumption assessment in this study was conducted in terms of food quantity to determine food security at the household level of farmers in rain-fed rice fields. The amount of food consumption is measured from the nutrients (energy and protein) contained in foodstuffs. According to Perdana and Hardinsyah [8], the assessment of the amount of energy consumed is calculated by the following formula:

\[ Gej = \frac{BPj}{100} \times \frac{Bddj}{100} \times KGej \]

Information:
- Gej : Energy consumed from food j.
- KGGej : Energy content of food j or food consumed per the unit.
- BPj : Weight of food or food j consumed (grams).
- Bddj : Percentage of edible food j (%).

The quantity of food consumption is seen through the volume of food consumed and the nutrients contained in food. It is used in determining the sufficiency of fulfilling a decent need for a healthy life (RDA). Quantitative measurement of consumption amount using energy consumption level (ECL) parameter with the following formula:

\[ ECL = \frac{\text{Energy Consumption}}{\text{Energy Sufficient Value}} \times 100\% \]

Where ECL = energy consumption level. Energy consumption was the energy content of food j or food consumed per the unit. Energy sufficient value (kcal) was obtained according to Permenkes No. 28 of 2019 [3], as presented in Table 1.

According to Suparisa [9], energy consumption level (ECL) is classified based on various values of energy sufficiency, which are evaluated in stages, namely:

a. Good : ECL ≥100% AKE
b. Keep : ECL 80-99% AKE
c. Less : ECL 70-80% AKE
d. Deficit: ECL < 70% AKE

Table 1. List of requirement dietary allowance (energy and protein) by age and gender according to Permenkes No. 28 of 2019.

| No. | Category         | Energy (kcal) | Protein (grams) |
|-----|------------------|---------------|-----------------|
| 1.  | Baby/Child       |               |                 |
|     | 0 – 5 months     | 550           | 9               |
|     | 6 – 11 months    | 800           | 15              |
|     | 1 – 3 months     | 1,350         | 20              |
|     | 4 – 6 months     | 1,400         | 25              |
|     | 7 – 9 months     | 1,650         | 40              |
| 2.  | Male             |               |                 |
|     | 10 – 12 years old| 2,000         | 50              |
|     | 13 – 15 years old| 2,400         | 70              |
|     | 16 – 18 years old| 2,650         | 75              |
|     | 19 – 29 years old| 2,650         | 65              |
|     | 30 – 49 years old| 2,550         | 65              |
|     | 50 – 64 years old| 2,150         | 65              |
|     | 65 – 80 years old| 1,800         | 60              |
|     | 80+ years old    | 1,600         | 60              |
| 3.  | Female           |               |                 |
|     | 10 – 12 years old| 1,900         | 55              |
|     | 13 – 15 years old| 2,050         | 65              |
|     | 16 – 18 years old| 2,100         | 65              |
|     | 19 – 29 years old| 2,250         | 60              |
|     | 30 – 49 years old| 2,150         | 60              |
|     | 50 – 64 years old| 1,800         | 60              |
|     | 65 – 80 years old| 1,550         | 55              |
|     | 80+ tahun        | 1,400         | 55              |
| 4.  | Other            |               |                 |
|     | Pregnant TM1     | 180           | 1               |
|     | Pregnant TM2     | 300           | 10              |
|     | Pregnant TM3     | 300           | 30              |
|     | Breastfeed 6 months I | 330 | 20              |
|     | Breastfeed 6 months II | 400 | 15              |

2.2. Food security

Food Security is measured by a cross-indicator between energy consumption level and proportion of food expenditure [2]. Energy consumption level is calculated by comparing the average actual consumption of households and energy sufficient value that have been determined by Permenkes No. 28 of 2019. Meanwhile, the expenditure share is calculated by comparing food expenditure with the total household expenditure. The classification of food security is seen in Table 2.

Table 2. Food security matrix.

| Household energy consumption level | Share of Food Expenditure |
|-----------------------------------|---------------------------|
|                                   | Low (<60% total expenses) | High (≥60% total expenses) |
| Enough (>80% Energy Sufficient Value) | 1. Food Resistant | 2. Food Vulnerable |
| Less (≤80% Energy Sufficient Value) | 3. Lack of Food | 4. Food Insecurity |
3. Result and discussion

3.1. Energy consumption

Energy consumption is calculated to know food consumption in terms of quantity and can be a measurement tool in determining food security. The quantity of food referred to in this study is seen through nutrients (energy) contained in food using the level of energy sufficiency assessed from the energy consumption level (ECL). The energy consumption level (ECL) value is obtained from the share between energy consumption and the recommended AKE. Energy consumption level is categorized into 4 categories, namely good category (ECL ≥ 100%), medium (ECL 80-99%), less (ECL 70-80%), and deficit (ECL<70%).

Based on the results obtained, the energy consumption of farmers' households amounted to 6,041 kcal/day with an energy sufficiency value of 5,368 kcal/day, then obtained energy consumption level of 113% and classified in the category of high level because energy consumption level ≥ 100%. The high value of energy consumption level obtained is inseparable from a large amount of household rice production and able to meet the needs of families. In addition, rice is also the most prominent energy contributor food in household consumption.

The energy consumption level of sampled farmers' households falls into the high category, which means it has a good enough energy consumption. However, this does not cover the possibility that some households are still in the medium, lack, or deficit category. The distribution of energy consumption level category of households of rainfed rice fields can be seen in Table 3.

| No. | Energy consumption level | %     |
|-----|--------------------------|-------|
| 1.  | Good                     | 76.67 |
| 2.  | Medium                   | 23.33 |
| 3.  | Less                     | 0.00  |
| 3.  | Deficit                  | 0.00  |
|     | Total                    | 100.00|

Based on Table 3, it is known that households of rainfed rice farmers are divided into 2 categories out of 4 categories available. There were 76.67% of households in the high category and 23.33% of households in the medium category. This data shows that although most households fall into the good category, some households still need to be improved in achieving a better energy consumption level to achieve food security.

3.2. Food security

Food security in this study was seen through the quantity of household food consumption, namely the level of energy consumption. The energy consumption level is obtained from the average value of household energy consumption divided by households' average energy sufficient value. The level of energy consumption obtained, then crossed with the proportion of food expenditure to know households' level of food security. The proportion of household food expenditure of rainfed farmers is one of the indicators in measuring food security. The proportion of food expenditure is calculated by comparison of food expenditure with total expenditure. Data on the proportion of food and non-food expenditures can be seen in Table 4.

| Expenditure          | Sum (Rp/cap/month) | Proportion (%) |
|----------------------|--------------------|----------------|
| Food Expenditure     | Rp 653,924         | 58.00          |
| Non-food expenditure | Rp 472,082         | 42.00          |
| Total Expenditure    | Rp 1,126,006       | 100.00         |
Based on Table 4, the total expenditure of Rp. 1,126,006.00 with food expenditure of Rp. 653,924.00 obtained food proportion of 58%. Meanwhile, non-food expenditure amounted to Rp. 472,082.00, obtained by a proportion of non-food expenditure of 42%. Household food expenditure is an expenditure used to meet consumption needs, such as rice, eggs, meat, vegetables, nuts, fruits, oils and fats, beverages, spices, and finished foods and beverages. While non-food expenditures are expenditures used to meet non-food needs, such as home needs, education costs, health costs, taxes and insurance, and social needs. Based on Table 4, the proportion of food expenditure is 58% and non-food expenditure is 42%. This is inseparable from Engel's law, where the proportion of food expenditure becomes greater even though absolute spending on food is falling due to the low total amount of food expenditure due to declining household income levels. Thus, the greater proportion of food expenditure from non-food shows a decrease or low household income level of farmers in rainy rice fields.

Food security is measured through a cross-indicator between the energy consumption level and the proportion of household food expenditure. Based on this method, 4 categories were obtained to determine the level of household food security: food resistance, food vulnerability, food deprivation, and food insecurity. The food resistant category occurs when the energy consumption level $\geq 80\%$ of energy sufficient value and the proportion of food expenditure $< 60\%$ of total expenditure. Food vulnerable categories occur when the energy consumption level $\geq 80\%$ of energy sufficient value and the proportion of food expenditure $\geq 60\%$ of total expenditure. The category of food deprivation occurs when the energy consumption level $< 80\%$ of energy sufficient value and the proportion of food expenditure $< 60\%$ of the total expenditure. Meanwhile, the food insecurity category occurs when the energy consumption level $< 80\%$ of energy sufficient value and the proportion of food expenditure $\geq 60\%$ of total expenditure. The distribution of household food security level of rain-sized rice fields farmers in Sragen Regency can be seen in Table 5.

| No.  | Food Security Level   | %   |
|------|----------------------|-----|
| 1.   | Food Resistant       | 53.33 |
| 2.   | Food Vulnerable      | 46.67 |
| 3.   | Food deprivation     | 0    |
| 3.   | Food Insecurity      | 0    |
| Total|                      | 100.00 |

The energy consumption level and the proportion of expenditure greatly affect food security, as this study uses a cross of the two indicators. Based on Table 5, 53.33% of households fall into the food resistant category, and 46.67% are in the vulnerable food category. This shows that, although most households of rainfed rice fields have been included in the food resistant category, there are still households that are not yet in that category. Thus, efforts to improve food security must continue to be made in terms of income and food consumption. Increasing the income of farmers' households needs to be done to improve the food security of food-vulnerable households. Assistance in the procurement of special seeds that can survive in drought conditions can increase productivity and reduce production costs to increase farmers' incomes. High incomes will reduce the proportion of food expenditure and give families the option to increase food consumption (energy); thus, food-resistant households will be achieved.

4. Conclusion
Based on the study results, it can be known that household energy consumption is 6,041 kcal/day with an energy sufficiency value of 5,368 kcal/day. The energy consumption level of households of rainfed rice farmers in Sragen District is 113%, classified as a good level because energy consumption level $\geq 100\%$. The results of the food security analysis showed the households of farmers in the rainfed rice fields that are classified as food resistant by 53.33% and food vulnerable by 46.67%. Food-prone
(vulnerable) situations can be addressed by increasing the amount of production and household income by optimizing drill wells to ensure the availability of water or procurement of seeds that are resistant to the situation of rainfed rice land. The increasing amount of production increases farmers' incomes to improve the vulnerable food situation.

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