Food security of paddy farm households based on the proportion of food expenditure and energy consumption level in Jogorogo Ngawi

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Abstract. Ngawi is the sixth paddy producer in Indonesia and certainly has an influence on the food security of paddy farm households. This study aimed to analyze the proportion of food expenditure (PFE), energy and protein consumption, the relationship between food expenditure and energy consumption, and the condition of food security. The basic method used descriptive analytic. The number of respondents based on the slovin formula was 87 households. The sample selection used stratified random sampling. The data analysis method used correlation with SPSS 22 and cross indicator between PFE and energy consumption level. The results showed that the average of PFE was 58.81%. The average energy consumption was 4,272.2 kcal/household/day with an energy consumption level of 81.93% while the average protein consumption was 122.1 grams/household/day lower than the average household RDA consumption. Food expenditure had a significant relationship to energy consumption with a correlation coefficient of 0.925 including a very strong and unidirectional relationship. The contribution of household food security conditions were 28.7% secure; 32.2% vulnerable; 10.3% less secure; 28.8% insecure.

1. Introduction

Human beings need energy to carry out daily activities. This energy can be obtained from food consumption. Over time, the rate of population growth increases followed by an increase in food demand [1]. Food demand must be balanced with food availability so that it can support the achievement of food security. The food security of an area can be determined by using the Food Security Index which includes supporting factors such as availability, affordability, and food consumption [2]. These three aspects must be noticed so as to reduce food problems in a region. Food security problems often occur such as the amount of food is not enough, less diverse, even lack of nutrition. The solutions are by producing enough food, consuming varied food, and accessing food economically [3].

One of the regencies known as the national food buffer is Ngawi. In 2019, Ngawi was the second paddy producer in East Java and the sixth paddy producer in Indonesia in 2020 [4]. This condition shows that most people in Ngawi depend on paddy farming to meet their needs. Paddy plants are converted into rice to meet people's food consumption. Rice is the staple food and source of the highest energy provider with an average household consumption in 2019 of 94.9 kg/capita/year [5]. However, other food crops are no less important to be consumed so that the nutritional adequacy of the community can be met. Food security in Ngawi is seen from the food availability subsystem experiences a surplus every year [6]. This shows that Ngawi has been able to meet the food needs of its population. Food security...
from the food consumption subsystem in Ngawi can be seen from the level of calorie and protein consumption that has exceeded the recommended dietary allowance (RDA). The amount of expenditure used by the community to meet food consumption is influenced by income. The average income of Ngawi has increased every year but it is still lower than the average income of East Java in 2017 and 2018 [7]. Low family income can affect food quantity, food quality, and family nutritional adequacy. If nutritional intake is not met properly it can cause nutritional problems. The number of cases of malnourished toddlers under five in Ngawi in 2017 was 61 cases, while in Jogorogo there were 7 cases of malnourished toddlers or ranked third in Ngawi [8].

Food security at the national or regional level does not guarantee food security at the household level. Likewise, the availability of surplus food, energy and protein consumption that has exceeded the recommended dietary allowance in Ngawi does not necessarily reflect household conditions. This fact encourages the need for research on food security. This study aimed to determine the condition of food security of paddy farm households based on the proportion of food expenditure (PFE) and energy consumption level (LEC) and how the relationship between food expenditure and energy consumption in the research area.

2. Methods

2.1. Location and sampling of research

This research was conducted using a purposive method from January to February 2021 in Jogorogo which is one of the paddy producers in Ngawi. The number of respondents based on the solved formula was 87 respondents. The respondents were paddy farm households belonging to 6 farmer groups in Jogorogo which were taken using proportional stratified random sampling. The name of the respondent was chosen randomly by lottery.

2.2. Analysis methods

2.2.1. Household food security. Food security was identified using a cross indicator between the proportion of food expenditure and the level of energy consumption. The proportion of food expenditure used the following method:

$$PFE = \frac{Ea}{Et} \times 100\%$$

Where:
PFE = The proportion of food expenditure
Et = Total expense of household
Ea = Expense for food consumption

The level of nutrition consumption started from how much food consumption was consumed by households with the following method:

$$K_{gij} = \frac{Bj}{100} \times \frac{Bddj}{100} \times G_{ij}$$

Where:
Kgij = Energy or protein from food j
Bj = Weight of food j
Bddj = The edible portion of 100 grams of food j
Gij = Energy or protein content per 100 grams of food j

The level of nutrition consumption (LNC) was assessed by comparing the actual nutrition consumption with the recommended nutrition consumption. The level of energy consumption in this study consisted of the level of energy consumption (LEC) and the level of protein consumption (LPC). The classification of nutrition consumption levels according to the Ministry of Health is divided into 4,
namely: 1) Good with LNC 100%, 2) Medium with LNC 81–99%, 3) Less with LNC 71–80%, 4) Deficit with LNC < 70%.

\[ \frac{LEC}{LPC} = \frac{Kgij}{RDA} \times 100\% \]

Where:
LEC = Level of energy consumption
LPC = Level of protein consumption
RDA = Recommended dietary allowance

The food security of a household was divided into 4 categories, namely food security if the proportion of food expenditure is low (≤ 60%) and the level of energy consumption is sufficient (> 80%). Vulnerable household if the proportion of food expenditure is high (> 60%) and the level of energy consumption is sufficient (> 80%). Less secure household if the proportion of food expenditure is low (≤ 60%) and the level of energy consumption is less (≤ 80%). Food insecurity if the proportion of food expenditure is high (> 60%) and the level of energy consumption is less (≤ 80%).

2.2.2. Correlation test. The variables are household food expenditure total (X) and household energy consumption total (Y). The basis of decision making was if the research result Sig < 0.05 then \( H_0 \) is rejected or the research result sig > 0.05 then \( H_0 \) is accepted. The strength of the relationship and the direction of the variables was seen in the value of the coefficient (r). If coefficient between 0 – 0.199, the relationship is very weak. If coefficient between 0.20 – 0.399, the relationship is weak. The coefficient between 0.40 – 0.599 means the relationship is moderate. The coefficient between 0.60 – 0.799 means a strong relationship. The coefficient between 0.80 – 1 means the relationship is very strong [9]. A positive r value means that the two variables have a unidirectional relationship, namely if the value of the X variable is high, then the value of the Y variable will be high and vice versa [10].

3. Results and discussion

3.1. Characteristics of respondent farmers
The average age of family members consisting of husband, wife, children, and other family members, respectively were 59 years, 55 years, 22 years, and 35 years. Age affects physical strength to carry out activities so that income increases compared to non-productive age [11]. After passing the productive age, the energy requirement decreases because the metabolic rate decreases. The education level of husband, wife, and other family members was more dominant in elementary school level while children's education level was more dominant in high school. The low level of education can affect knowledge both about farming and the fulfillment of food and nutrition. Lack of knowledge and education of mothers will affect the nutritional status of their families [12].

Respondents had an average experience of running a paddy farm business for 21 years. The longer the experience of farmers managing farming, the more expertise and knowledge on how to increase production they are [13]. The average number of respondents' family members of 3 people in a household affect food consumption, expenditure, and household income. The factors that influence food security of rural households including the age, gender, education of the head of the household, number of family members, assets, income, food expenditure, and rice prices while side jobs, remittances, and egg prices have no effect on respondents' food security [14].

3.2. Household expenditure
This study refers to the group of food and non-food expenditures issued by the Central Bureau of Statistics. The average total household expenditure per month was Rp2,224,506.- consisting of food expenditure of Rp1,308,281.- and non-food expenditure of Rp916,225.- (Table 1). The largest average expenditure was in the tobacco and betel group at 18.45% because people were used to smoking and they were considered as a substitute for eating. The smallest average expenditure for food was in the tubers group at 2.57%. The largest average non-food expenditure was in the group of finished goods.
and services at 27.55% such as household goods, cost of education and health cost. The smallest average non-food expenditure was in the durable goods group at 8.90%.

Table 1. The proportion of food expenditure to total expenditure of paddy farm households in Jogorogo.

| Categories          | Average (Rp) | Percentage (%) |
|---------------------|--------------|----------------|
| Food expenditure    | 1,308,281    | 58.81          |
| Non-food expenditure| 916,225      | 41.19          |
| Total expenditure   | 2,224,506    | 100            |

The proportion of food expenditure was 58.81% higher than the proportion of non-food expenditure (Table 1). The higher the proportion of food expenditure, the lower the level of household welfare is. It is in accordance with Engel's law which states that the proportion of total expenditure allocated to food will decrease with increasing income. This condition showed that the respondent's household used their income to meet basic needs first, such as food needs to overcome hunger and survive. The food needs that were bought were basic needs such as side dishes without paying attention to the diversity and quality of food.

3.3. Paddy farm household food consumption

The average energy consumption of members of a paddy farm household was 1,655.9 kcal/person/day and the energy consumption of paddy farm households was 4,272.2 kcal/household/day. Meanwhile, the average protein consumption of paddy farm households was 122.1 grams/household/day and the protein consumption of members of paddy farm households was 47.6 grams/person/day (Table 2). The average individual energy consumption is still below the RDA average of 1,983.5 kcal/person/day because most of the respondents' actual energy consumption was still below or has not reached the recommended dietary allowance (RDA).

There is a difference between the category of energy consumption level and the level of protein consumption where the level of energy consumption is in the moderate category and the level of protein consumption is in the less category. The level of energy consumption which is included in the medium category is fulfilled by the consumption of rice as a staple food. The level of protein consumption is included in the lower category because the research area is located in the mountains so that fish products are rarely found in the research area.

Table 2. The average of consumption, RDA, LNC for energy and protein of paddy farm households in Jogorogo.

| Description | Energy (kcal/household/day) | Energy (kcal/soul/day) | Protein (gram/ household/day) | Protein (gram/soul/day) |
|-------------|-----------------------------|------------------------|-------------------------------|-------------------------|
| Consumption | 4,272.2                     | 1,655.9                | 122.1                         | 47.6                    |
| RDA         | 5,214.3                     | 1,983.5                | 156.3                         | 61.1                    |
| LNC (%)     | 81.93                       | 83.48                  | 78.11                         | 77.9                    |

The distribution of the highest level of energy adequacy category with moderate status was 46% and the smallest category of energy consumption level with good status was 12.6%. The category of the largest level of protein consumption was less status and deficit status of 29.9% while the category of the smallest level of protein consumption with good status was 16.1% (Table 3). The distribution of energy consumption level categories of farm households showed that the nutritional status of each household was different. Most households have a level of energy consumption (LEC) in the medium category, meaning that farm households are able to meet the energy needs of 81% of the RDA. The difference in the categories of LNC for each household is due to differences in the type of food, the quantity of food consumed by each household, and household components such as gender and age.
Table 3. Distribution of LEC and LPC categories of paddy farm households in Jogorogo.

| LNC Categories | Energy Total Households | Energy Percentage (%) | Protein Total Households | Protein Percentage (%) |
|----------------|------------------------|-----------------------|-------------------------|------------------------|
| ≥100 Good      | 11                     | 12.6                  | 14                      | 16.1                   |
| 81-99% Medium  | 40                     | 46                    | 21                      | 24.1                   |
| 71-80% Less    | 21                     | 24.1                  | 26                      | 29.9                   |
| <70% Deficit   | 15                     | 17.2                  | 26                      | 29.9                   |

Each type of food has a different contribution of energy and protein. The respondent's household consumes rice as the main food every day so that rice is the biggest energy contributor. The contribution of rice consumed by respondents to energy was 68%. Other types of food such as cassava, potatoes, corn, sweet potatoes, and others are not consumed regularly every day. Besides rice, the type of food that contributes to energy and is consumed almost every day is sugar. Sugar is used as a spice in cooking and as a sweetener in beverages. The majority of respondent households consume tempeh and tofu every day to meet their protein needs. Other types of food such as eggs, milkfish, salted fish, and catfish are not consumed every day. The list of food ingredients contains nutrients from various food groups, such as tempeh and tofu which have lower protein content than beef, chicken, and fish. This is what causes many households to have low levels of protein consumption or deficit level of protein consumption. The lack of variety in the food menu consumed is one of the factors of this problem.

3.4. Food security of paddy farm households in Jogorogo

Most of the household food security conditions were in the non-resistant category, namely 71.3% consisting of vulnerable food, less food, food security households (Table 4). Households with food security status is 28.7% which means the proportion of food expenditure owned is low and the level of energy consumption is met. Respondents do not only rely on income from farming but income from non-farming so that they can increase their income and be able to meet household nutritional needs. Households with vulnerable food status is 32.2% which means that the proportion of food expenditure is high and the level of energy consumption is fulfilled. The proportion of expenditure is high due to low income so that households prioritize food expenditure over non-food expenditure to survive. This household is more concerned with the quantity or type of food consumed coming from the type of food source of energy so that the level of energy consumption was sufficient.

Table 4. The contribution of paddy farm household food security in Jogorogo.

| Categories          | Total Households | Percentage (%) |
|---------------------|------------------|----------------|
| Food security       | 25               | 28.7           |
| Vulnerable food     | 28               | 32.2           |
| Less food           | 9                | 10.3           |
| Food insecurity     | 25               | 28.8           |
| Total               | 87               | 100            |

Households with less food status is 10.3% which means that the proportion of food expenditure is low and the level of energy consumption has not been met. Less food households have higher incomes than vulnerable food households but lack energy which must be regulated by the type of food consumed to meet their energy sufficiency. Households with food insecurity status is 28.8% which means the proportion of food expenditure is high and the level of energy consumption has not been met (Table 4). The high food expenditure shows that household income is limited so that households prioritize food expenditure and the types of food consumed are less diverse. Increased income both in the field of
farming and non-farming is needed to meet food needs with better quantity and quality of food. Households participating in off-farm activities have a better standard of living due to the additional income generated from off-farm activities [15]. The higher the income, the greater the household food production with better quantity and quality is [16].

3.5. Correlation test
The significance value in the correlation test is 0.000 so the decision is to reject H₀ because the significance value of the research results is smaller than 0.05 (Table 5). This shows that there is a significant relationship between food expenditure and energy consumption in paddy farm households in Jogorogo.

| Variables                        | Value  | Correlation coefficient | α     |
|----------------------------------|--------|-------------------------|-------|
| Food expenditure and energy consumption | 0.000  | 0.925                   | 0.05  |

The resulting correlation coefficient value is 0.925 (Table 5). This value is in the range of 0.80-1.00 so it is included in the category of a very strong relationship. The value of the correlation coefficient is positive, which means it has a unidirectional relationship, namely if the value of food expenditure is high then energy consumption is high or if the value of food expenditure is low then energy consumption is low. Income is used by households to meet food expenditures so that household energy consumption will be fulfilled. The higher the income, the higher the expenditure on food is, so that it will have an impact on the high energy consumption and vice versa. Keynes's theory states that if income increases, consumption will also increase. It's just that the increase in consumption is not as big as the increase in income.

4. Conclusion
The proportion of food expenditure is higher than non-food expenditure which shows that most of the income that is owned is still used to meet food needs. The average household energy and protein consumption is still low when compared to the average RDA of the respondent's household. Food expenditure has a very strong relationship with energy consumption (correlation coefficient of 0.925) with a unidirectional relationship which means that the higher the food expenditure, the greater the energy consumption and vice versa. The condition of food security of the respondent's household is still dominated by food-insecure households.

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