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Food Security of Organic Rice Farmers in Central Java and Yogyakarta in Indonesia

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Abstract: Food security continues to be a critical concern for farming households that rely on agricultural production as their primary source of livelihood. Understanding the status of food security among organic rice farmers is essential to developing effective policies that support sustainable agriculture and improve household well-being. This study examined the food security status of organic rice farming households in Central Java and Yogyakarta, Indonesia. Data were collected by conducting interviews with 150 organic rice farmers from Magelang, Sragen, Karanganyar, Sleman, and Bantul Regencies. Food security was analyzed using a 2 × 24-hour Food Recall to determine the level of energy and protein adequacy, and the Household Food Insecurity Access Scale (HFIAS) to determine the level of food insecurity. The level of energy adequacy was categorized as good but the level of protein adequacy was still slightly deficient, hence indicating the demand for food diversification. The HFIAS analysis showed that most farmers were food secure although some experienced moderate food insecurity. Recommendations from this study included promoting education on food diversification, strengthening government support for access to sources of protein, and formulating strategies via further research to improve the welfare of farmers.

Keywords: Food security; Farmers household; Organic rice; Sustainable agriculture

1. Introduction

The high population density in Indonesia poses a severe challenge to achieving sustainable food security (Gandharum et al., 2024). As a crucial element in the survival of society, food is a central issue in the life of the nation and state, thus food security forms the focus of policy (Zhang & Lu, 2024). Food is a basic human need (Bapolisi et al., 2024), yet this basic need demands adequate availability, both in quantity and quality, that meets health and food safety standards, as well as long-term sustainability (Raposo et al., 2021). Food security means a condition in which sufficient food is fulfilled for the community in quantity and quality (Lam, 2024). Food security encompasses several subsystems, namely food availability, access, and utilization, which integrates nutrition and food safety (Gillani et al., 2024).

The dominant staple food commodity in Indonesia is rice (Sumarwati, 2022). Based on a report from BPS-Statistics Indonesia (2024), national rice production from January to December 2023 was recorded at 53.98 million tons of Dry Milled Grain (DMG), decreasing from the 54.75 million tons in the previous year. Central Java province ranks third, and Yogyakarta ranks 17th among the rice-producing regions in Indonesia (Gharsallah et al., 2021). Although the overall food production and availability are relatively large, this situation does not guarantee that every region or household has equal access to sufficient, nutritious, and safe food.

Indonesian society is becoming increasingly aware of the importance of a healthy lifestyle (Wisnuwardani et al., 2024). This can be seen from the increasing demand for healthy food and organic agriculture, necessitating the

continued use and development of organic nutrients to support it (Patra et al., 2024). Organic farming, especially organic rice cultivation, has gained attention as a potential approach to addressing food security challenges and rising demand for healthy food. Organic rice is a cultivated agricultural product that does not use chemical fertilizers, pesticides, or other synthetic substances in the planting, harvesting, and post-harvest processes (Balkrishna et al., 2023). Organic rice production in Java contributes significantly to national organic rice production (Pramono et al., 2024). Data from the Central Java Provincial Government (2023) showed that organic rice production in Indonesia was dominated by the Magelang Regency of Central Java, which has more than 2,000 hectares of organic land.

Various obstacles and challenges in organic rice farming affect the farmers' welfare, which is not necessarily superior than non-organic rice farmers (Triyono et al., 2024). Food insecurity occurs when farming households cannot provide sufficient food to meet their daily needs (Gallegos et al., 2022), which can be measured by the percentage of Energy Adequacy Rate (EAR) and Nutrient Adequacy Rate (NAR) from the food consumed by farming households over a 2 × 24-hour period. In this study, the Household Food Insecurity Access Scale (HFIAS) asked nine questions that would be calculated at the end for grouping into the categories of severe, moderate, and mild food insecurity (Syafiq et al., 2022).

Previous research extensively examined food security in conventional rice farming systems; however, the literature concerning the food security of organic rice farmers remained limited. This study aimed to examine the food security status of organic rice farming households in Central Java and Yogyakarta and to identify the key factors influencing their access to food, with the objective of formulating effective strategies to enhance food security. This study was motivated by numerous challenges in organic rice production and marketing channels as these difficulties would significantly affect farmers' income and considerably impact food security.

2. Methodology

2.1 Locations of Research

A purposive sampling approach was employed for site selection, taking into account several criteria, including the number of organic rice farmer groups, the extent of organic rice cultivation areas, and the availability of organic certification. Based on these criteria, the selected locations in Central Java Province were Magelang, Sragen, and Karanganyar Regencies, while Sleman and Bantul Regencies were chosen in Yogyakarta in Figure 1.

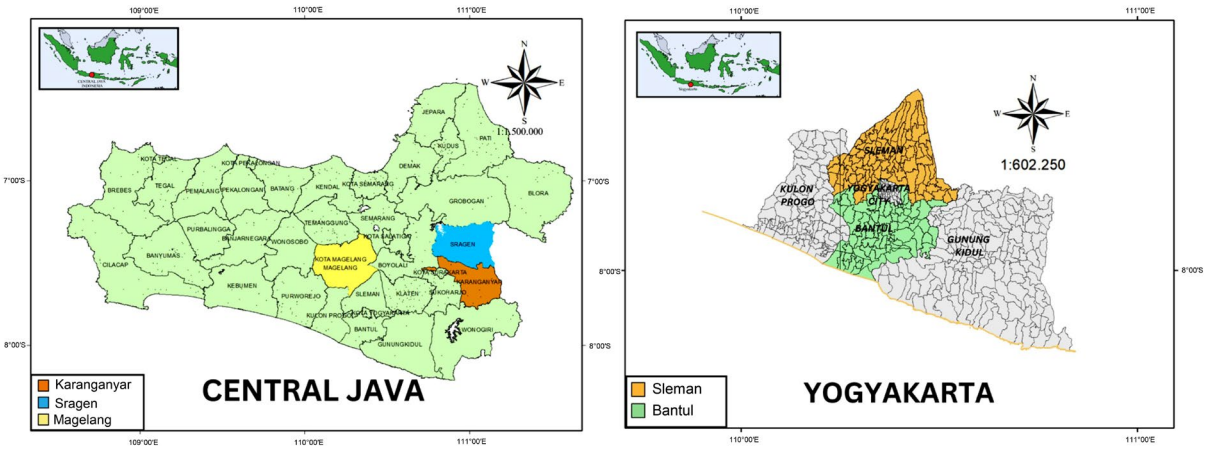

Figure 1. Locations of research

2.2 Procedures of Data Collection

This study employed a quantitative research method with a survey design involving interviews and questionnaires administered to a sample drawn from a larger population. A proportional stratified random sampling technique was utilized and divided the research area into five regency regions. The sample size for each region was determined in proportion to the population size of the region. Thirty respondents were selected from each regency in proportion to the number of households, and resulted in a total sample size of 150. Data collection focused on understanding the food security of organic rice farming households in Central Java and Yogyakarta in Indonesia as in Table 1. The collected data included the characteristics of farmers, such as their education level, age, family size, gender, land ownership, land area, experience of conventional rice farming, and experience of organic rice farming as in Table 1. To measure food security, data were collected on dietary patterns, food quantity,

and food availability within the households.

Table 1. Locations of research and number of respondents

Locations of Research	Number of Respondents
Sragen, Central Java	30
Karanganyar, Central Java	30
Magelang, Central Java	30
Sleman, Yogyakarta	30
Bantul, Yogyakarta	30
Total	150

Assessment of food security involved a comprehensive approach using quantitative and qualitative indicators. Two methods, the 2 × 24-hour Food Recall and the HFIAS, were adopted to evaluate dietary intake, uncertainties of food access, and experiences of hunger. Table 2 summarizes the key indicators used to assess food security in this study.

Table 2. Food security indicators

Food Recall	Household Food Insecurity Access Scale (HFIAS)
Types of food consumed in the last 2 × 24 hours; frequency of consumption of energy sources (kcal/cap/day); protein (g/cap/day); per individual.	Uncertainty in food access; decline in food quality and diversity; reduction in food consumption; acute hunger and frequency of occurrences.

2.3 Techniques of Analysis

Food security of organic rice farming was analyzed by two types of analytical tools, namely:

(1) Food Recall

This section required respondents to document the types and quantities of foods consumed during two separate 24-hour recall periods. Dietary data were then analyzed using the Nutrisurvey software to estimate daily energy and nutrient intake and to assess adequacy against the Recommended Dietary Allowance (RDA). RDA values vary by age and gender; therefore, intake was compared with the Indonesian RDA standards (Ministry of Health Republic of Indonesia, 2019) to obtain the nutritional adequacy level (NAL). To minimize recall bias commonly associated with the 2 × 24-hour recall method, interviews were conducted by trained enumerators using visual aids (food portion-size photographs).

(2) HFIAS

This method of food security analysis comprised nine questions (Rozaki et al., 2023): (Q1) During last month, did you feel concerned that your family might run out of food? (Q2) In last month, did you or anyone in your household have to skip eating your preferred foods because you could not afford them? (Q3) During the past four weeks, did limited financial resources lead you or any household member to consume a less diverse range of foods? (Q4) In last month, were you or others in your home compelled to eat undesirable food due to an inability to access other options? (Q5) In the past 30 days, were there times when meals were smaller than needed because the amount of food was inadequate? (Q6) In last month, did you or anyone in your household eat fewer meals per day due to a shortage of food? (Q7) At any time last month, did your household completely run out of food because you lacked the means to purchase or obtain more? (Q8) During the past month, did you or any household member go to bed feeling hungry due to insufficient food availability? (Q9) During the previous four weeks, was there an occasion when you or someone in your household did not eat for an entire day and night due to a lack of food?

Each question was rated on a scale from 0 to 3, where a score of 0 denoted “never,” 1 indicated “rarely” (once or twice during the past four weeks), 2 represented “sometimes” (three to ten times during the past four weeks), and 3 signified “often” (more than ten times during the past four weeks). Based on the total scores, household food security was subsequently classified into four levels, as presented in Table 3.

Table 3. Categories of food security

Levels of Food Security	Range of Total Scores
Food secure	0–1
Mildly food insecure	2–7
Moderately food insecure	8–14
Severely food insecure	15–27

3. Results

3.1 Characteristics of Respondents

The characteristics of the respondents analyzed in this study include farmers' age, gender, level of education, household size, farming experience, experience in organic rice farming, farm size, and land tenure status. These characteristics are considered to have indirect effects on organic rice production and the efficiency of production inputs. This study involved 150 organic rice farmers as respondents, as seen in Table 4.

Table 4. Characteristics of respondents

Characteristic	Frequency	%	Characteristic	Frequency	%
Age (years old)			Land Ownership		
28–40	11	7.3	One's own	102	68.0
41–60	80	53.3	Rent	8	5.3
61–76	59	39.3	Profit sharing	40	26.7
Total	150	100.0	Total	150	100.0
Gender			Size of Agricultural Land (hectare)		
Male	109	72.7	<0.5	131	87.3
Female	41	27.3	0.5–1.5	19	12.7
Total	150	100.0	Total	150	100.0
Education Level			Farming Experience (by year)		
Uneducated	9	6.0	1–10	27	18.0
Elementary school	51	34.0	11–20	32	21.3
Primary school	40	26.7	21–30	29	19.3
High school	46	30.7	31–40	28	18.7
Higher education	4	2.7	>40	34	22.7
Total	150	100.0	Total	150	100.0
No. of Household Members			Organic Farming Experience (by year)		
<3	38	25.3	1–10	122	81.3
3–6	104	69.3	11–20	25	16.7
>6	8	5.3	21–30	3	2.0
Total	150	100.0	Total	150	100.0

3.1.1 Age

The age of the respondents was measured based on the maximum age of 76 and the minimum age of 28, and then divided into three ranges. The age of farmers can affect the success of farming (Purwidyaningrum et al., 2021). The older the farmer is, the more diminished his physical ability becomes (Beseler & Rautiainen, 2023). Based on Table 4, the average age of most organic rice farmers was in the middle age category, with 80 people aged between 41 to 60, and 59 out of 150 organic rice farmer respondents were in the elderly category, i.e., within the age range of 61–76. These data demonstrated that more than 90% of farmers were middle-aged or elderly. This age profile suggested that organic rice farming in the region might rely heavily on older farmers, who could affect the sustainability and generational transition of organic farming practices in the future.

3.1.2 Gender

There were significant differences in the performance of organic rice farming between male and female farmers (Bello et al., 2021). This study indicated that female farmers tended to have lower productivity than male farmers, which were influenced by physical and socio-cultural factors (Tufa et al., 2022). As shown in Table 4, male farmers represented 72.7% of the respondents, hence suggesting gender imbalance in organic rice farming. The role of women in the agricultural sector is often limited to supporting tasks, so they are not fully recognized as the main actors in farm management.

3.1.3 Education

Education is crucial social capital for farmers to develop organic rice farming (Tsai et al., 2021). Higher education enhances farmers' ability to access and utilize relevant information and agricultural technologies (Mwaura et al., 2021). In this study, 34% of the respondents only completed elementary school and did not pursue further education, while only 2.7% attained higher education. According to the data obtained from the interviews, most farmers who had bachelor or diploma degrees were retirees engaging in organic farming during their retirement.

3.1.4 Household members

Based on the three categories of household size in Table 4, all were dominated by households with three to six

members. Variations in the number of household members would result in differences in food security among households and the differences could have indirect implications for household economic conditions (Habib et al., 2023). An increase in the number of household members can burden the household with extra expenditure to meet food needs (Doglikuu et al., 2023). However, contributions of income from household members other than the head of the household could enhance food security by strengthening the overall household economic condition (Asih et al., 2023).

3.1.5 Land ownership

The status of land ownership largely influences farmers' motivation to produce (Darmawan et al., 2023). Farmers with land ownership tend to be less motivated because they feel complete freedom over the use of their land (Stevens, 2022). Conversely, farmers renting land are more driven to maximize production, so the profits earned are more significant than the rental costs (Adenuga et al., 2023). Based on Table 4, 68% of respondents were farmers with their own land; 26.7% used a profit-sharing system whereas only 5.3% rented land for organic rice farming. This indicated that most organic rice farmers possessed complete autonomy and control over their farms, hence having flexibility in decision-making regarding cultivation practices, selection of varieties, and marketing strategies. However, the dominance of land ownership suggests a potential lack of incentives to maximize land productivity. Farmers with their land may adopt a "subsistence farming" strategy that prioritizes meeting household food needs over market orientation that pursues profitability. The low proportion of tenant farmers (5.3%) implied prospective organic farmers had limited access to farmland, hence hindering the development and scale of organic rice production in the region.

3.1.6 Size of agricultural land

Land is a complex system of various interacting biophysical and socioeconomic components (Gambella et al., 2021). This system, influenced by land-use history and natural processes, has dynamic characteristics (Chen et al., 2024). The size of agricultural land area has a positive correlation with the scale of farming, which in turn will have implications for the level of production efficiency. According to Table 4, as many as 87.3% of respondents had fewer than 0.5 hectare of agricultural land, thus implying that most organic rice farmers only had small production output.

3.1.7 Farming experience

Farming experience is significantly correlated with the efficiency of using production factors (Jumiati et al., 2023). Farmers with more extended service in the agricultural sector tend to allocate resources more optimally (Borda et al., 2023). In Table 4, 34 farmers had the most extended farming experience, with 22.7% having more than 40 years of farming experience. Only 27 people, i.e., 18%, had farming experience of 1–10 years. This was closely related to the age of farmers as the majority of them are middle-aged and elderly who already have quite a lot of farming experience.

3.1.8 Organic farming experience

Experience in organic farming shows a significant association with the efficiency of input utilization (Kashiwagi & Kamiyama, 2023). Farmers with longer tenure in the organic farming sector tend to allocate resources more optimally (Salotagi & Mallapur, 2024). As shown in Table 4, 122 farmers, representing 81.3%, had less than 10 years of experience in organic rice farming. Although most farmers responded with having considerable farming experience, they had relatively short experience in implementing organic farming practices. This implied that many farmers or related stakeholders had only become aware of organic products in the last 10 years.

3.2 Food Recall

Food consumption in this study was measured using energy intake and protein intake. The energy consumption of a person is calculated on the basis of total calories derived from daily food and beverages consumed (Castillo et al., 2022). Protein consumption was measured by estimating the total amount of protein derived from foods consumed per person per day (Arini et al., 2024).

The dietary recall data were subsequently classified according to guidelines by Ministry of Health Republic of Indonesia (2019). Energy adequacy levels were categorized as severely deficient (<60%), moderately deficient (60–69%), mildly deficient (70–79%), adequate (80–119%), and excessive (≥120%). Meanwhile, the adequacy levels of protein intake were classified as severely deficient (<70%), moderately deficient (70–79%), mildly deficient (80–89%), adequate (90–119%), and excessive (≥120%).

Table 5 shows that the energy adequacy ratio is 83.98% (adequate), while the protein adequacy ratio is 83.66% (mildly deficient). The energy consumption of farming households in the study area mainly relied on rice as a source of carbohydrates. Although this protein deficiency was mild, if it persisted over time, it had the potential to affect the health and productivity of household members, particularly children and adults engaged in physically

demanding work. This was in line with the findings of Wijaya (2019), which stated that the average quality of food consumed by Indonesians was still low and lacked diversity. In addition, local food commodities such as corn, cassava, and taro were not yet optimally utilized as staple foods or processed food ingredients. This indicated that food diversification should be improved to meet the nutritional needs in the community, especially among rice farmers. Diverse and balanced food consumption would help increase the intake of protein and other essential nutrients, thus preventing protein deficiency and improving the quality of life among farmers.

Table 5. Energy and protein intake and nutritional adequacy of organic rice farming households

Content of Nutrition	Intake	Recommended Dietary Allowance (RDA)	Nutritional Adequacy (%)
Energy (kcal/cap/day)	1,717.1	2,044.7	83.98
Protein (g/cap/day)	52.9	63.2	83.66

3.3 Household Food Insecurity Access Scale

Household food security of organic rice farmers could be determined through food security analysis using the HFIAS method, with data drawn from household food security experiences over the past month (Bahta & Myeki, 2022). Food security analysis can measure a household's vulnerability to food insecurity (Sileshi et al., 2019). This is achieved through an in-depth understanding of household perceptions regarding the risk of food shortages and their behavioral responses to the risk.

Table 6. Results of the HFIAS questionnaires from organic rice farmers

Variables	"No"		"Yes"						Total "Yes"	
			Rarely (1–2 times)		Sometimes (3–10 times)		Often (>10 times)			
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Worried about food (Q1)	132	88.0	18	12.0	0	0.0	0	0.0	18	12.0
Unable to eat preferred food (Q2)	121	80.7	10	6.7	15	10.0	4	2.7	29	19.3
Eating only a few kinds of food (Q3)	149	99.3	1	0.7	0	0.0	0	0.0	1	0.7
Eating disliked foods (Q4)	145	96.7	1	0.7	4	2.7	0	0.0	5	3.3
Eating smaller meals (Q5)	109	72.7	20	13.3	21	14.0	0	0.0	41	27.3
Reducing the number of meals per day (Q6)	132	88.0	18	12.0	0	0.0	0	0.0	18	12.0
Absence of food in the household (Q7)	149	99.3	1	0.7	0	0.0	0	0.0	1	0.7
Going to sleep while hungry (Q8)	150	100.0	0	0.0	0	0.0	0	0.0	0	0.0
Going an entire day and night without food (Q9)	150	100.0	0	0.0	0	0.0	0	0.0	0	0.0

Note: "No" and "Yes" indicate respondents' answers; *n* denotes the number of respondents; percentages are based on N = 150.

As shown in Table 6, the HFIAS results that the majority of organic rice farming households in Central Java and Yogyakarta were classified as food secure. This was evidenced by more than 50% of respondents answered "no" to the nine core indicators assessing food insecurity.

However, there were indications of quantitative food insecurity, particularly reducing meal portions in Q5, whereas 27.3% of respondents reported occasionally consuming smaller portions in the past month. Although not a majority, this figure was an important indicator of quantitative food insecurity. It showed that around a quarter of organic farming households sometimes had to resort to coping strategies such as reducing the amount of food they consumed, a dimension of food insecurity. Additionally, the inability to consume preferred foods in Q2 had the highest affirmative responses from 19.3% of respondents, hence suggesting that some farmers faced challenges accessing their desired foods. Conversely, none of the respondents experienced severe hunger in reply to Q8 and Q9 as 100% reported never going to bed hungry or spending an entire day without eating. These findings suggested that while organic rice farmers generally maintained food security, a subset still faced periodic food quantity and limitations of diversity.

Although organic rice farmers were generally food secure, a small proportion still faced limitations of both food quantity and diversity. Sustainable agricultural policies should ensure stable food access for vulnerable groups, enhance farmers' well-being through subsidies, stabilize the prices of organic rice, and implement income diversification to strengthen food security.

Of the 150 respondents, 60% of organic rice farmers were classified as food secure, 31.3% moderately food insecure, 8.0% mildly food insecure, and 0.7% severely food insecure. Based on the analysis of the HFIAS questionnaires in this study, one organic rice farmer was found to be severely food insecure, as shown in Table 7, since only one farmer answered "yes" to Q7. However, the data indicated that most organic rice farmers in Central Java and Yogyakarta did not have to reduce their food portions, either because they still had food available within

their families, albeit limited, or could borrow money from neighbors to buy food. The farmers did not go to bed hungry and still could meet their food needs daily.

Table 7. Status of food security among organic rice farming households

Food Security Status	Households	%
Food secure	90	60.0
Mildly food insecure	12	8.0
Moderately food insecure	47	31.3
Severely food insecure	1	0.7
Total	150	100.0

4. Discussion

The results indicate that the majority of organic rice farmers in Central Java and Yogyakarta were food secure, but 27.3% occasionally reduced meal portions, indicating that some households might experience food insecurity. These findings aligned with previous studies by Bebber & Richards (2022), which emphasized that organic farmers still suffered from risks connected to seasonal variations and market access, even though they frequently attained greater food security due to stable revenue from premium pricing.

Comparable findings have been documented by My et al. (2021) in Vietnam, where organic rice farmers demonstrated relatively high food security. According to their study, despite higher incomes, the absence of diverse food choices in rural areas suggested that farmers continued to experience limited dietary variety. The current study supported these conclusions, given that a tiny portion of respondents said they were eating fewer different kinds of food or were forced to eat meals they did not enjoy. This finding appeared to be significant when compared to the condition of conventional rice farmers.

Although not the focus of this study, it can be assumed that organic farmers face different challenges. If conventional farmers rely heavily on chemical fertilizer and subsidies and are vulnerable to price fluctuations, organic farmers face different market risks, such as premium price volatility and the need for access to specialized markets. Another challenge is the higher risk of crop failure due to pest infestations without chemical pesticides. These differences in risk profiles are likely to shape different food security strategies among the two groups of farmers.

Additionally, the observed trend that 19.3% of respondents could not always access their preferred foods was comparable to the findings by Ramakrishnan et al. (2021), who reported that rural farming households often compromised dietary preferences due to economic constraints and market limitations. This suggested that while organic rice farming contributed to food security, external economic factors still played a crucial role in shaping dietary choices and nutritional adequacy.

The absence of extreme food insecurity cases, as indicated by a lack of respondents experiencing whole-day fasting due to food unavailability, supported the findings of Azadi et al. (2023). Their research on smallholder farmers in Bangladesh demonstrated that self-sufficient food production significantly reduced severe hunger risks, even in economically disadvantaged households.

In light of these results, governmental initiatives should concentrate on improving market accessibility, maintaining stable pricing for organic rice, and diversifying revenue streams to increase the food security of farmers. Implementing government support, such as input subsidies and price stabilization mechanisms suggested by Tran et al. (2024), could further improve resilience against food insecurity in organic farming communities.

In addition, the government could facilitate direct partnerships and form contract farming between organic farmer groups and the HoReCa sector including hotels, restaurants, and cafés/catering, or modern retail to create a stable supply chain. To address protein deficiency and encourage food diversification, concrete programs such as incentives for the mina-paddy system, i.e., integration of fish and rice, and cultivation of protein-rich vegetables in rice paddies can be introduced. Subsidies for the expensive cost of organic certification could ease the burden on farmers and encourage wider adoption of organic practices.

The long-term effects of organic rice farming on household food security should be investigated in future studies using a wider range of indicators, such as socioeconomic status and nutritional consumption. By combining these factors, policymakers could create more focused plans to improve the welfare of organic rice growers and guarantee sustainable food security in rural regions.

5. Conclusions

The findings of this study offer valuable insights into the food security status of organic rice farming households in Central Java and Yogyakarta, Indonesia. Understanding the demographic and socioeconomic characteristics of these farmers was essential for designing effective policies to enhance their nutritional well-being and food

security. Based on the results of the current study, it was concluded that the characteristics of organic rice farmers were dominated by middle-aged to elder men, with relatively low levels of education, relatively small land, and limited experience in organic farming. The level of energy adequacy was categorized as good, but the protein adequacy still showed a slight deficiency. Food diversification needed to be improved to meet the nutritional needs of farmers. The results from the HFIAS analysis showed that most farmers were food secure, yet some experienced moderate food insecurity, as indicated by reducing meal portions due to limited food availability. To ensure the sustainability of organic rice production and improve the welfare of the stakeholders, the designed policy should not only focus on the cultivation aspect. Policies should be integrated to (i) simultaneously address issues of market access through partnerships; (ii) provide education about nutrition in respect of food diversification; and (iii) provide real incentives for the cultivation of local protein sources. Thus, the challenges of protein deficiency and periodic food vulnerability identified could be effectively addressed, so as to ensure that organic rice farmers are not only productive but also healthy and prosperous.

Author Contributions

Conceptualization, Z.R., N.A., T., and N.R.; Methodology, Z.R., T., N.M.Z., and R.W.; Writing—review and editing, Z.R. and N.A.; Writing—original draft preparation, Z.R. and M.L.T.; Investigation Z.R. and M.L.T.; Funding acquisition, Z.R. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement

Written informed consent was obtained from all participants.

Data Availability

The data used to support the research findings are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

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