Impact of Farm Size and Sociodemographic Characteristics on Agricultural Households' Food Security

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Abstract

Most agricultural households in Indonesia are small-scale farmers making them prone to food insecurity. Until recently, no study has assessed the impact of farm size and sociodemographic characteristics on the food insecurity status of agricultural households using a nationwide agricultural household survey in Indonesia. Our study aims to address this gap by utilizing the results of the first Indonesian Agricultural Integrated Survey conducted by BPS in 2021. Applying the Rasch Model and Multinomial Logistic Regression, we found that the farm size has a positive impact in lowering the probability of agricultural households experiencing moderate or severe levels of food insecurity. Our study also found that agricultural households with a higher probability of being food insecure are characterized by having higher members of households, relying only on agricultural activities for their livelihood, lower education attainment of household heads, and being led by female farmers. Our study recommends improving the farmers' agricultural scale by focusing on the improvement of the yield. It can be done through the adoption of mechanization and digital technology. Moreover, we also recommend a social assistance programme for food security targeting agricultural households with characteristics identified in our findings.

Keywords: food insecurity; agricultural households; small-scale farmers
JEL Classification: I3; J1; Q1

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1. Introduction

Agriculture still plays a significant role in the Indonesian economy by accounting for around 12 percent of the total GDP in 2022 (BPS, 2023). However, agriculture cultivation in Indonesia is dominated by small-scale farmers. Over half of Indonesian agricultural households managed less than 0.5 hectares of agricultural land in 2018 (BPS, 2018). The circumstances may put their food security and sustainability undertreat. A wide range of studies pointed out that the farm size affects the food security of agricultural households (Omotesho et al., 2006; Bogale, 2012; Kassie et al., 2014; Feyisa, 2018; Muraoka et al., 2018; Opaluwa et al., 2018; Ayele, 2020). Food insecurity in agricultural households may also be impacted by the sociodemographic characteristics of the head of the agricultural households, such as age, gender, education, and participation in non-farm economic activities (Bashir et al., 2012; Sekhampu, 2013, Felker-Kantor & Wood, 2012; Mango et al., 2014; Bhuyan & Sahoo, 2017; Feyisa, 2018; Abdullah et al., 2019; Ayele, 2020, Awoke et al.; 2022; Assefa & Abide, 2023).

Food security is defined as a state in which all people at all times have both physical and economic access to sufficient safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life (FAO, 1996). Some indicators have been developed to measure the state of food security based on that definition, among others, the Food Consumption Score, Household Food Insecurity Access Scale, and Food Insecurity Experience Scale (FIES) (Manikas et al., 2023). Among these methods, FIES developed by the Food and Agriculture Organization (FAO) is widely used as a food security indicator globally (Kadir & Prasetyo, 2021)[1]. The indicator can measure food security at the household level through a set of questions reflecting household experiences toward food insecurity (Cafiero et al., 2018).

The definition of small-scale varies across studies. In general, there are two proxies widely used, namely absolute and relative thresholds (Khalil et al., 2017). Almost all studies investigating the influence of farm size on the food insecurity status of agricultural households in the Indonesian context have made use of the size of cultivated land to reflect the farm size (absolute thresholds). In this regard, small-scale farmers are defined as those who managed less than a certain area of land, like less than 0.5 hectares usually referred to as *petani gurem* (BPS, 2018).

The main drawback of this approach is that over time it could result in an adverse selection bias, which would lead to monitoring the productivity or the income of the worst performers (Khalil et al., 2017). Our study tries to address this issue by introducing a new approach by applying a method proposed by the FAO in determining what so-called small-scale food producers are. With this method, the farm size is determined by the physical size of the farm (agricultural

[1]SDG indicator 2.1.2 is the prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale. SDG indicator 2.4.1 is the proportion of agricultural area under productive and sustainable agriculture.

land area and number of livestock) and the total revenue obtained from running agricultural activities (Khalil et al., 2017).

In the Indonesian context, studies focusing on the influence of farm size and sociodemographic characteristics of agricultural households on food security status at the agricultural household level using the results of a nationwide agricultural survey are not yet available. Therefore, there is a lack of sufficient findings about their impacts on their state of food security examined based on a nationwide agricultural survey. Our study aims to address the gap by using the current data from the results of the 2021 Agricultural Integrated Survey (AGRIS) conducted by Statistics Indonesia (BPS). The survey captured information needed to determine the food insecurity status of agricultural households in Indonesia and the sociodemographic characteristics that can explain it.

The rest of the paper is organized as follows. Section 2 presents the methodology and the data used. Section 3 provides the empirical results and the analysis, and Section 4 gives the conclusion and recommendations.

2. Methodology

Our study made use of the results of the AGRIS conducted for the first time by BPS in 2021. The survey observed around 212,644 agricultural household samples in the 34 provinces and provided information on socioeconomic agricultural household characteristics, including the information needed to determine the food insecurity status of the households.

The food insecurity status is determined by applying the FIES to the results of the AGRIS. FIES captures food insecurity at the individual or household level by interviewing agricultural household samples with eight questions capturing their experience related to food insecurity. Eight questions of FIES are used in this study as presented in Table 1.

The eight questions in Table 1 are asked in sequence to assess the severity level of food insecurity (FAO, 2020). Each question item in the FIES represents different circumstances based on food insecurity experienced by households (Ballard et al., 2014). They focus on food-related behaviours and food access difficulties due to constraints in resources based on information directly provided by the household (Anwar & Nasrudin, 2021).

As in Kadir et al. (2023), we calculated the probability of being moderately or severely food insecure ($p_{mod+sev}$) and the probability of being severely food insecure (p_{sev}) for each agricultural household based on the response to the eight questions in FIES. In doing so, we applied the Rasch model (Snyder & Sheehan 1992; Bond & Fox, 2015) to the 2021 AGRIS results. The model assumes that the position of a respondent and that of the items can be located on the one-dimensional scale of severity and postulates that the probability of respondent i answering "yes" to item j is the logistics function of the difference between the severity of the food insecurity condition experienced by respondent i and the severity of item j (Cafiero et al., 2018). Assuming that $X_{i,j}$ is the answer given by

Table 1: Questions Related to FIES Measurement

During the last one year, was there a time when?	
Q1	You or others in your household worry about not having enough food to eat because of a lack of money or other resources.
Q2	You or others in your household are unable to eat healthy and nutritious food because of a lack of money or other resources.
Q3	You or others in your household ate only a few kinds of foods because of a lack of money or other resources.
Q4	You or others in your household had to skip a meal on a particular day because of a lack of money or other resources.
Q5	You or others in your household ate less than you thought you should because of a lack of money or other resources.
Q6	You or others in your household ran out of food because of a lack of money or other resources?
Q7	You or others in your household were hungry but did not eat because of a lack of money or other resources.
Q8	You or others in your household do not eat for a whole day because of a lack of money or other resources.

Source: Statistics Indonesia (BPS, 2022)

respondent i to item j that is coded as 1 for "yes" and 0 for "no", we have

$$p \equiv Prob(X_{i,}) = 1) = \frac{exp(\theta_i - \beta_j)}{1 + exp\left(\theta_i - \beta_j\right)} \iff ln\left(\frac{p}{1-p}\right) = \theta_i - \beta_j \qquad (1)$$

In Equation (1), θ_i represents the position of the respondent (household) i on an underlying severity scale while β_j represents the position of item j in the same severity scale. Both parameters are estimated by the conditional maximum likelihood procedure conditioning on the sum of affirmative answers given by each respondent to the FIES questions (raw score).

We also estimated the percentage of agricultural households encountering moderate to severe food insecurity ($F_{mod+sev}$) and the percentage of agricultural households experiencing severe food insecurity (F_{sev}). The two indicators were calculated as the weighted sum of $p_{mod+sev}$ and p_{sev} respectively for all agricultural households in the sample.

We adopted the FAO's framework for the computation of SDG indicator 2.4.1, by which the probability of being food insecure obtained from FIES used as an indicator to measure agricultural sustainability in terms of food security. The food insecurity status of each household is categorized as follows: mild food insecurity (desirable) if $p_{mod+sev} < 0.5$ and $p_{sev} < 0.5$; moderate food insecurity (acceptable) if $p_{mod+sev} > 0.5$ and $p_{sev} < 0.5$; severe food insecurity (unsustainable) if $p_{sev} > 0.5$ (FAO, 2023).

In defining the farm size our study applies the concept of small-scale food producers proposed by FAO, by which the farm size is the intersection between the physical size of the farm, expressed by land size and the number of livestock, and the economic size of the farm expressed by the total revenues measured in

Purchasing Power Parity terms. As illustrated in Figure 1, small-scale farmers can be defined as the food producers belonging to both the bottom 40 percent of the cumulated distribution of physical size and the bottom 40 percent of the cumulated distribution of total revenues.

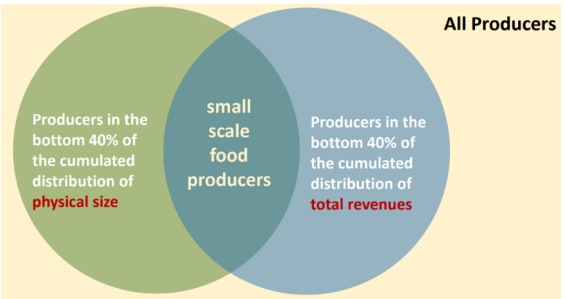


Illustration of the Definition of Small-scale Food Producers
Source: FAO (2020)

The multinomial logistic regression (MLR) then was used to analyse the influence of farm size and sociodemographic agricultural household characteristics on food insecurity. An MLR was used since our dependent variable is a categorical variable with three categories of food insecurity: mild food insecurity, moderate food insecurity, and severe food insecurity. The regression model used for analysis is represented as follows:

$$Y_{ij} = \alpha_j + X_{ij}^{'}\beta_j + \varepsilon_{ij} \tag{2}$$

In Equation (2), Y_{ij} is the sustainability status of the $i-th$ household in the $j-th$ category; $X_{ij}^{'}$ is a vector of characteristics of the $i-th$ household in the $j-th$ category, which consists of farm size and other sociodemographic independent variables described in Table 1; β_j a vector of regression coefficients for each household characteristic in the $j-th$ category; and ε_{ij} is error component. The MLR then may be represented as:

$$logit(Y_j) = ln\left[\frac{P(Y=j|X)}{P(Y=J|X)}\right] = \alpha_j + X_{ij}^{'}\beta_j \tag{3}$$

where $J = 3$ and $j = 1, 2$. In such a way, there are two logit equations. Each of the logit equations is a linear function that models the logarithm of the odd as having response j to baseline category J (Agresti, 2002). In Equation (3), all logits are defined relative to a predetermined base category, which is mild secure food insecurity. The estimation of the regression coefficient (β_j) provides information on how much the change in logit occurred due to one unit increase of the value of particular household characteristics holding other variables remaining constant.

For the convenience of the analysis, we also estimate the relative risk ratio (RRR), which is the exponential function of a regression coefficient, for each characteristic. The mathematical representation for RRR can be written as follows

$$\frac{P(Y = j|X)}{P(Y = J|X)} = exp(\alpha_j + X'_{ij}\beta_j) \tag{4}$$

The interpretation of RRR is quite simple, where RRR greater than 1 means that the probability of the $j - th$ category to occur is larger than the probability of obtaining the baseline category J. Given the sum of all probabilities $P(Y = j|X)$ for $j = 1, 2, 3$ equals to 1, the following expressions can be established.

$$P(Y = j|X) = \frac{exp(\alpha_j + X'_{ij}\beta_j)}{1 + \sum_{j=1}^{J-1} exp(\alpha_j + X'_{ij}\beta_j)} \tag{5}$$

$$P(Y = J|X) = \frac{1}{1 + \sum_{j=1}^{J-1} exp(\alpha_j + X'_{ij}\beta_j)} \tag{6}$$

The descriptions of all variables used in the model specification are presented in Table 2.

Table 2: Variable Description

Dependent variable:	
Food insecurity status consisting of mild food insecurity (reference category), moderate food insecurity, and severe food insecurity	
Independent variable:	
Farm scale	Agricultural households were grouped into two categories: small-scale food producers and non-small-scale food producers (reference category)
Gender	Gender of the head of the household consisting of male and female (reference category)
Age	MRL model: The age group of the head of the household consists of five categories: less than 35 years old (reference category), 35–44 years old, 45–54 years old, 55–64 years old, and more than 64 years old.
Education	Highest educational level completed by the head of the household consists of six categories: not completing elementary school (reference category), completing elementary school, completing junior high school, completing senior high school, completing diploma, and completing higher education.
Non-agriculture job	The job of the head of the household other than agriculture as the source of income consists of two categories: having a non-agricultural job and only agriculture (reference category)
Household size	Number of household members (continuous variable)
Region	Region of residential consisting of two categories: Java and outside Java (reference category)

3. Result and Analysis

3.1. Agricultural Household Characteristics

Agricultural cultivation in Indonesia is mostly run by small-scale farms. Small-scale food producers make up around 70 percent of the total agricultural households. In Java Island, which is the resident of about 53 percent of the country's agricultural households, the proportion of small-scale food producers is around 78 percent which is higher compared to outside Java Island with about 61 percent of small-scale food producers. The figures are in line with the average agricultural land cultivated by agricultural households. On average, agricultural households only cultivate a relatively small area of agricultural land (around 0.75 hectares per household). However, agricultural households outside Java Island manage around 1,2 hectares of agricultural land on average, which is much larger than agricultural households in Java Island that on average only manage 0.38 hectares of agricultural land.

Agricultural households in Indonesia are led by old farmers (around 53 years old on average) and consist of around 4 household members. These characteristics apply to both Java and outside Java regions. However, farmers outside Java Island are younger, which is about 51 years old compared to Java farmers of around 55 years old. In terms of education, most of our farmers (around 68 percent) do not have/complete formal education or only complete elementary school. Nevertheless, farmers (the head of the agricultural households) outside Java Island have a slightly better education than farmers in Java Island. Concerning gender, our agriculture is still dominated by females, where almost 90 percent of agricultural households are led by female farmers. Meanwhile, more than half of the heads of agricultural households engage in non-agricultural jobs to earn additional income. In Java Island around 56 percent of farmers have non-agricultural jobs, which is higher than outside Java of 49 percent.

3.2. Food Insecurity Prevalence

The probability of agricultural households in Java Island experiencing food insecurity at moderate or severe levels is lower than agricultural households outside Java Island. It seems that the food insecurity accidents outside Java Island are the Eastern part of Indonesia's phenomenon. The eastern part of Indonesia, particularly Maluku, Papua, and East Nusa Tenggara has the highest percentage of agricultural households experiencing food insecurity at moderate or severe levels (Figures 2 and 3). It is consistent with the fact that those provinces are lagging behind other provinces in Indonesia in terms of socio-economic development.

Agricultural households experiencing food insecurity at moderate or severe levels are characterized by small-scale farms, having higher members of households, relying more on agricultural activities for their livelihood, lower education attainment of household heads, and being led by female farmers (Table 4). These

Table 3: Summary of the Variables

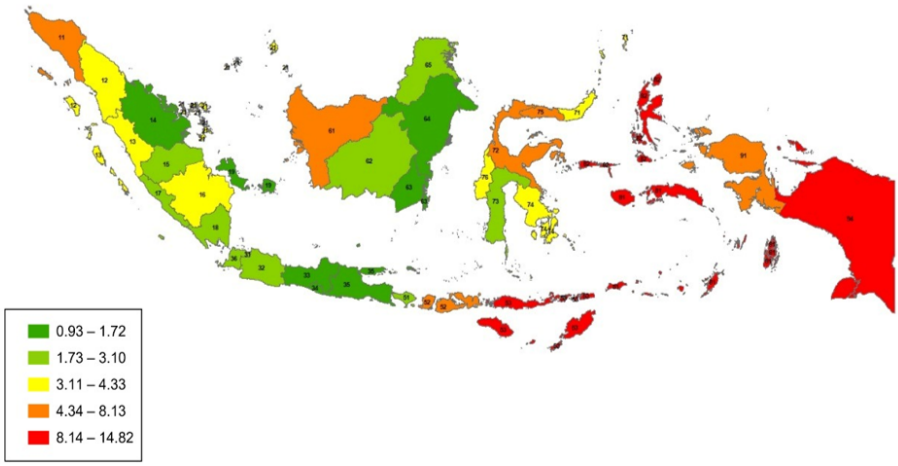
Variable	Java Island	Outside Java Island	Total
Continuous variable (mean)			
Agricultural land cultivated (hectare)	0.38	1.17	0.75
Number of household members (person)	4.08	4.26	4.16
Age of household head (year)	55.04	50.66	52.97
Probability of experiencing moderate or severe food insecurity/100	1.71	5.00	3.27
Probability of experiencing severe food insecurity/100	0.12	0.47	0.29
Categorical variable (percent)			
- Farm scale			
Non-small-scale food producers	22.02	38.52	29.81
Small-scale food producers	77.98	61.48	70.19
- Age group			
under 35 years old	4.19	9.37	6.64
35–44 years old	15.26	23.58	19.19
45–54 years old	28.58	29.64	29.08
55–64 years old	29.71	23.18	26.63
65+ years old	22.26	14.23	18.47
- Gender			
Female	13.80	13.56	13.69
Male	86.20	86.44	86.31
- School attainment			
No completing elementary school	21.13	20.91	21.03
Elementary school (SD)	53.96	39.70	47.22
Junior high school (SMP)	13.59	17.36	15.37
Senior high school (SMP)	9.30	18.38	13.59
Diploma	0.51	1.01	0.75
Higher education (S1/S2/S3)	1.50	2.64	2.04
- Non-agricultural job			
Only agriculture	43.42	50.71	46.86
Having non-agriculture job	56.58	49.29	53.14
- Region	52.78	47.22	100.00

Note: The number of observations is 212.664 agricultural households (including those not only responding completely to FIES questions); sample weights were used.

characteristics will anticipate the results of the MLR model estimation that an agricultural household with those characteristics is more likely to experience food insecurity at either moderate or severe levels. Interestingly, the percentage of agricultural households led by younger heads of household, which are experiencing food insecurity at moderate or severe levels, is lower than those led by older household heads. It will anticipate that the age of agricultural households will have a negative impact on the probability of the household experiencing food insecurity at moderate or severe levels.

3.3. Sociodemographic Determinants of Food Insecurity

As anticipated, the farm size has a negative and significant impact on the odds of agricultural households experiencing food insecurity at moderate or severe levels. Holding other variables remain unchanged, the multinomial logit estimate



Percentage of Agricultural Households Experiencing Food Insecurity at Moderate to Severe Levels by Province

Percentage of Agricultural Households Experiencing Food Insecurity at A Severe Level by Province

of agricultural households belonging to small-scale food producers is 0.41 units higher in moderate food insecurity relative to mild food insecurity, and 0.76 units higher in severe food insecurity relative to mild food insecurity.

In terms of the RRR, for small-scale food producers relative to non-small-

Table 4: Distribution of Variables by Food Insecurity Status of the Households

Variable	Mild	Moderate	Severe
Continuous variable (mean)			
Agricultural land cultivated (hectare)	0.76	0.58	0.61
Number of household members (person)	4.16	4.24	4.29
Age of household head (year)	53.02	51.14	50.89
Categorical variable (percent)			
- Farm scale			
Non-small-scale food producers	30.13	17.84	20.44
Small-scale food producers	69.87	82.16	79.56
- Age group			
under 35 years old	6.52	11.29	9.51
35–44 years old	19.12	21.39	23.69
45–54 years old	29.13	26.96	30.14
55–64 years old	26.71	24.05	20.77
65+ years old	18.53	16.32	15.89
- Gender			
Female	13.33	27.96	20.67
Male	86.67	72.04	79.33
- School attainment			
No completing elementary school	20.77	28.86	40.28
Elementary school (SD)	47.31	45.62	35.02
Junior high school (SMP)	15.43	13.36	13.19
Senior high school (SMP)	13.67	10.53	9.93
Diploma	0.75	0.58	0.57
Higher education (S1/S2/S3)	2.06	1.05	1.01
- Non-agricultural job			
Only agriculture	46.80	48.38	54.80
Having non-agriculture job	53.20	51.62	45.20
- Region			
Outside Java Island	46.76	61.08	82.57
Java Island	53.24	38.92	17.43

Note: The number of observations is 212,339 agricultural households (including those only responding completely to FIES questions); sample weights were used for estimation.

scale food producers, the relative risk for moderate food insecurity to mild food insecurity would be expected to increase by a factor of 1.5 and the relative risk for severe food insecurity to mild food insecurity would be expected to increase by a factor of 2,14 given the other variables in the model are held constant. In other words, the probability of agricultural households that are small-scale producers experiencing moderate or severe food insecurity is higher than experiencing mild food insecurity. The findings make sense since the food production of the agricultural households and their income earned from the agricultural activities will increase with the farm scale. Our findings were also supported by other studies' findings (Omotesho et al., 2006; Bogale, 2012; Kassie et al., 2014; Feyisa, 2018; Muraoka et al., 2018; Opaluwa et al., 2018; Ayele, 2020).

In contrast, the age of the household head has a negative impact on the odds of agricultural households experiencing moderate or severe food insecurity meaning that those led by younger household heads have a higher probability of being

moderate or severely food insecure than those led by older household heads. It is indicated by the value of the RRR for the older age groups relative to the reference category (under 35 years old) that are lower than one and getting lower as the age group gets older. It could be explained by the role of the farming experience leading to better performance in conducting agricultural cultivation (Awoke et al., 2022). With that experience, older farmers may have higher productivity than their younger counterparts. In other words, older farmers are more settled than younger ones. Our findings agree with many other studies (Bashir et al., 2012; Felker-Kantor & Wood, 2012; Kassie et al. (2014), Sekhampu, 2013; Abafita & Kim, 2014; Mango et al., 2014; Abdullah et al., 2019). However, the impact of the age of the household head in lowering the probability of being moderately or severely food insecure is diminishing as the head of the household gets older.

As expected, agricultural household led by female has a higher probability of experiencing moderate or severe food insecurity than those led by male. It is reflected by the RRR value for males that is lower than one. It is similar to the findings of, among others, Felker-Kantor & Wood (2012), Abafita & Kim (2014), Abdullah et al. (2019), and Awoke et al. (2022). It may happen since female farmers still have limited access to advanced farm techniques to improve their farm yield due to their position as female (gender-biased environment) Ibnouf (2011). Moreover, as the head of agricultural households, females face more challenges than their male counterparts, such as more limited time and the lack of freedom to perform non-farm economic activities (Awoke et al., 2022).

The estimation results of MLR confirm the crucial role of education for food security among agricultural households. It shows that the more educated the household head, the more likely the household to be food secure. It could be explained since the educational attainment of the head of the household could enable the household to diversify their source of income which, in turn, would increase their food supplies. Better education also would increase the heads' access to information, their decision-making process as well as their management technique on the food produced during the year around (Mango et al., 2014). Our findings were supported by the findings of Bashir et al. (2012), Mango et al. (2014), Feyisa (2018), Ayele (2020), and Assefa & Abide (2023). Unfortunately, most agricultural households are led by uneducated or low-educated heads making them prone to experience moderate or severe food insecurity.

Since most agricultural households are small-scale food producers, having additional income from non-agriculture economic activities will be very helpful in increasing the food security status of the households (Zerai & Gebreegziabher, 2011; Owusu et al., 2017). Diversifying agricultural households' livelihoods would make them more secure (Barrett et al., 2001; Welderufael, 2014; Echebiri et al., 2017), particularly at the time of food shortages during the period of crop failure. The more income that agricultural households earn, the more resources to be allocated to improve agriculture production and to access more quantity and quality food (Mannaf & Uddin, 2012). Our estimation results support this proposition. Our findings are similar to Mahadevan & Suardi (2012), Abafita &

Table 5: Estimation Results of Multinomial Logistic Regression

Independent variable	Regression coefficients		Relative risk ratio (RRR)	
(baseline: mild food insecure)	Moderate	Severe	Moderate	Severe
- Farm scale				
Small-scale food producers	0.4070***	0.7599***	1.5023***	2.1381***
Small-scale food producers	(0.0460)	(0.0932)	(0.0691)	(0.1993)
- Age group				
35–44 years old	-0.2351***	0.0178	0.7905***	1.0179
	(0.0850)	(0.1436)	(0.0672)	(0.1462)
45–54 years old	-0.3973***	-0.1170	0.6721***	0.8896
	(0.0825)	(0.1399)	(0.0554)	(0.1244)
55–64 years old	-0.4940***	-0.5112***	0.6102***	0.5998***
	(0.0851)	(0.1504)	(0.0519)	(0.0902)
65+ years old	-0.4902***	-0.5572***	0.6125***	0.5728***
	(0.0897)	(0.1612)	(0.0549)	(0.0924)
- Gender				
Male	-0.4071***	-0.2842***	0.6656***	0.7526***
	(0.0541)	(0.0999)	(0.0360)	(0.0752)
- School attainment				
Elementary school (SD)	-0.5336***	-0.8693***	0.5865***	0.4192***
	(0.0518)	(0.0955)	(0.0304)	(0.0400)
Junior high school (SMP)	-0.8972***	-0.9994***	0.4077***	0.3681***
	-0.8972***	-0.9994***	0.4077***	0.3681***
Senior high school (SMP)	-1.0053***	-1.2812	0.3659***	0.2777***
	(0.0771)	(0.1410)	(0.0282)	(0.0392)
Diploma	-1.2118***	-1.1723***	0.2977***	0.3096***
	(0.3581)	(0.4206)	(0.1066)	(0.1302)
Higher education (S1/S2/S3)	-1.6795***	-1.5335***	0.1865***	0.2158***
	(0.2505)	(0.3844)	(0.0467)	(0.0829)
- Non-agricultural job				
Having non-agriculture job	0.0353	-0.2052**	1.0360	0.8145**
	(0.0442)	(0.0796)	(0.0458)	(0.0649)
- Number of household members	0.2450***	0.1296***	1.2777***	1.1384***
	(0.0204)	(0.0405)	(0.0260)	(0.0461)
- Region				
Java Island	-1.1724***	-1.7092***	0.3096***	0.1810***
	(0.0627)	(0.1359)	(0.0194)	(0.0246)
- Constant	-3.7504***	-4.8407***	0.0235***	0.0079***
	(0.1235)	(0.2374)	(0.0029)	(0.0019)

Note: The number of observations is 212,339 agricultural households (only those responding completely to FIES questions); robust standard errors to model miss-specification in the parentheses; sample weights were used for estimation; *** is significant at 1 percent level of significance and ** is significant at 5 percent of the level of significance.

Kim (2014), Awoke et al. (2022), and Assefa & Abide (2023) findings.

In addition, having more household members could increase the probability of households being moderately or severely food insecure. It is reflected by the value of the RRR for the number of households variable that is larger than one and significant at a 5 percent significance level. The finding aligns with Bogale (2012), Mahadevan & Suardi (2012), Abafita & Kim (2014), Awoke et al. (2022), and Assefa & Abide (2023) findings. It could be explained since with a larger number

of households, there will be more quantity and quality food should be allocated and distributed among household members. In other words, the per capita food supplies decrease as the agricultural household size increases. Although at the same time more household members mean more availability of labour for agriculture and non-agricultural activities, the pressure on consumption would be higher, particularly for small-scale food producers or subsistence farmers with limited engagement in non-agricultural economic activities.

As anticipated, our findings also confirmed that agricultural households outside Java Island are more prone to be food insecure than agricultural households in Java Island. It is an interesting finding since agricultural households in Java Island on average have a smaller scale of farms compared to farmers outside Java Island. It may indicate that farmers in Java Island have higher productivity than their outside Java Island counterparts giving them relatively more production and income for the same area of agricultural land. The difference in sociocultural variables between the two regions may also play a role in these circumstances that need further study to be elaborated.

3.4. Conclusion and Implication

Our study aims to fill the gap of the lack of study focusing on the impact of farm size and sociodemographic characteristics on agricultural households' food insecurity in Indonesia using a dedicated nationwide agricultural household survey. Our study pointed out the importance of farm size, education, and sources of income other than agricultural activities to improve agricultural households' food security.

Using the results of the first AGRIS conducted by BPS in 2021, we found that farm size has a positive impact in lowering the probability of agricultural households experiencing moderate or severe levels of food insecurity. Our study also found that agricultural households with a higher probability of being food insecure are characterized by having higher members of households, relying only on agricultural activities for their livelihood, lower education attainment of household heads, and being led by female farmers. Our study recommends improving the farmers' agricultural scale by focusing on the improvement of the yield. It can be done through the adoption of mechanization and digital technology. Moreover, we also recommend a social assistance programme for food security targeting agricultural households with characteristics identified in our findings.

Given the food insecurity status of agricultural households is influenced by multiple socioeconomic factors, our study may overlook some important variables that better explain food insecurity. The limitation can be room for improvement for the next study with the same locus.

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