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Farmers' Food Security in Forest and Peatland Fires Prone Areas of South Kalimantan, Indonesia

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ABSTRACT

Forest and peatland fires in Indonesia affect the lives of farmers near the prone areas, and their food security is impacted. This research aimed to examine the level of food security and identify the factors influencing it in the forest and peatland fires of South Kalimantan. One hundred farmers, considered vulnerable to peatland fires, from two subdistricts, namely Gambut District and Sungai Tabuk District, were interviewed. The study employed the Household Food Insecurity Access Scale (HFIAS) method, consisting of nine food conditions questions and logistic regression analysis. This study shows that the majority of farmers experience mild food insecurity. Land status, family size, fire rate, and land size affected the farmers' food security. Disaster mitigation education may help reduce the impact of forest and peatland fires on farmers' food security. Additionally, support from various stakeholders will strengthen food security efforts.

1. Introduction

Indonesia still experiences various disasters, and one of the frequently occurring ones is forest fires (Purnomo et al. 2017). Regions like Kalimantan, for example, still frequently face this disaster, whether due to natural causes or the impact of human activities (Edwards et al. 2020). Forest fires often impact peatland fires, and in this region, the extent of peatland is still relatively high (Kissinger et al. 2022), with a recorded 280,387 ha of peatland in South Kalimantan. Therefore, the potential for forest and peatland fires in South Kalimantan is considered high.

The agriculture sector in South Kalimantan still becomes the sector that absorbs the biggest employment (Surahman et al. 2017). Even though rubber and palm oil are the primary commodities, rice is being planted in some areas, especially to support the government program to produce food such as from rice (Sanders et al. 2019). Some farmers are using peatland for rice or horticulture cultivation. The risk and hazard of forest and peatland fires do not stop farmers from farming (Rozaki et al. 2022).

Peatland is a part of swampy land that occupies a transitional position between the land and the aquatic system (Wahyunto et al. 2013). This land is always waterlogged or flooded throughout the year or for an extended period; thus, it is called peatland. Government Regulation No. 27 of 1991 states that swampy land is scientifically defined as continuously or seasonally waterlogged

due to natural drainage obstruction and possesses specific physical, chemical, and biological characteristics (Qamariyanti et al. 2023).

The forest and peatland fires that occurred in 2015 were declared a disaster, causing a haze and drawing international attention. It was recorded that more than 2.61 million ha of forests and land in Indonesia were burned, 33% of which were peatlands, covering an area of 869,754 ha (Pratama et al. 2022; Roengtam and Agustiyara 2022). The losses resulting from the forest and peatland fire disaster and the impact of haze amounted to IDR 221 trillion. This fire destroyed biodiversity, disrupted the economy and education, threatened public health, and even claimed lives (Sharma and Thapa 2021).

Peatland agriculture tends to focus on conventional farming that only considers meeting needs and economic aspects (Wahyunto et al. 2013). The utilization of peatland encourages the expansion of converting natural peat forests into cultivated land (Astiani et al. 2021). Sungai Tabuk District and Gambut District, located in Banjar Regency, are the two regions with extensive peatland and a potential for wildfires. The dangers of forest and peatland fires in these two areas make the lives of farmers more uncertain due to various challenges in the agricultural sector, ranging from climate, pests, diseases, and fluctuating prices (Ramadhan et al. 2022). Their food security also becomes a unique issue to be studied, as most farmers practice subsistence farming, making their food security worth researching. Food security has become a local and national issue, and the farmers, as the main actors capable of contributing to food security through food production, also experience food security issues (O et al. 2020; Surahman et al. 2017).

Many factors influence the food security of farmers, such as small land sizes that cannot be significantly increased in production (Boughton et al. 2021). Although there is agricultural intensification, the increase in production may not be substantial (Haggar et al. 2020). Food security encompasses the conditions of farmers regarding their access to food, which is known to have three aspects: food availability, food accessibility, and food utilization (Darma et al. 2020). By understanding farmers' food security, appropriate measures and policies can be created to enhance their resilience, especially in forest and peatland fires prone areas. However, currently, there are few studies regarding farmers' food security in forest and peatland fires prone areas. Therefore, this research aimed to study farmers' food security in areas at risk of forest and peatland fires in South Kalimantan.

2. Materials and Methods

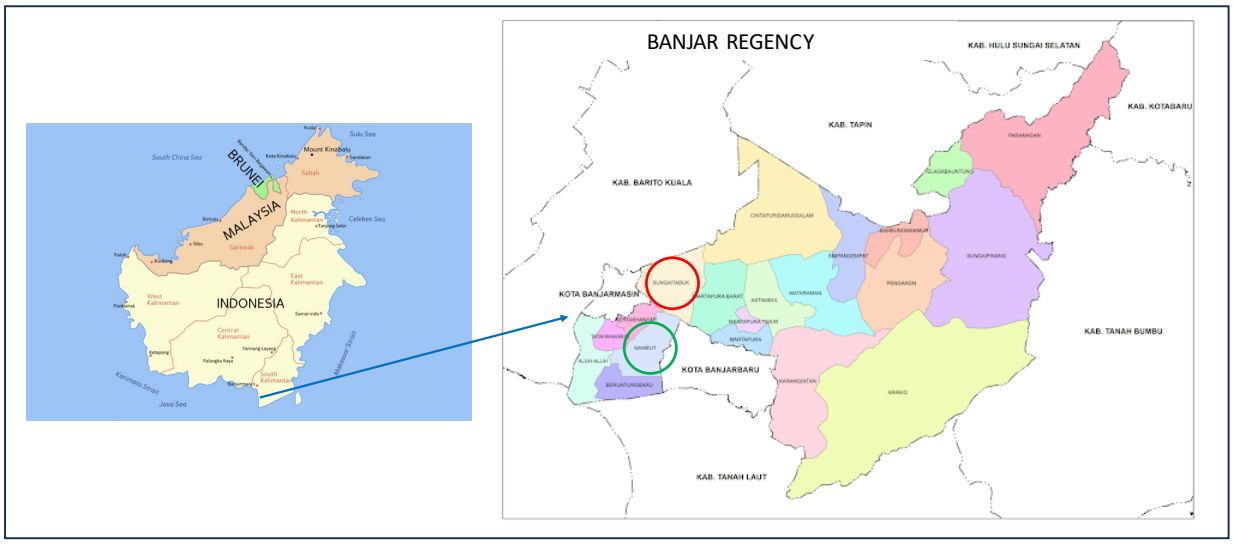
2.1. Study Area

This study was conducted in two districts affected by forest and peatland fires in South Kalimantan, specifically in Gambut and Sungai Tabuk, located in the Banjar Regency (**Fig. 1**) from April to December 2021. The selection of these locations was based on their high potential for danger and risk of forest and peatland fires, as well as the farmers' lives that have to struggle to adapt to the situation of these fires.

2.2. Sampling Procedure and Data Collection

This study used an analytical descriptive approach to present its findings. Data was collected using a questionnaire to understand farmers' food security in-depth. The questionnaire includes characteristics of the farmers that were modified from Rondhi et al. (2019), such as age, gender,

education, income, land area, farming experience, soil fertility, and land ownership status. Those variables are essential in understanding the farmers' condition and might affect food security (Teklewold et al. 2019). Additionally, the main focus is on the 'farmers' food security conditions, where the variables and indicators in this study use HFIAS as a guideline. Sampling is conducted by selecting 50 respondents from each district purposively through the village chief or related stakeholders, resulting in 100 respondents. The criterion of those samples is farmers who have experience facing forest or peatland fires near or on their land. Observations are also made to support the research findings.



Map source: https://pramukaminsungaisipai.blogspot.com/2019/09/mengenal-peta-buta-kabupaten-banjar.html

Fig. 1. Study Location in Sungai Tabuk (red circle) and Gambut (green circle).

2.3. Analytical Technique

The data analysis technique used in this study is the HFIAS method to measure farmers' households' perceptions or experiences regarding their physical and economic access to food (Ayinu et al. 2022; Mncube et al. 2023). This method involves nine main questions, and the results are divided into categories: food secure, mildly food insecure, moderately food insecure, and severely food insecure. Additionally, binary logistic regression is employed to analyze the factors influencing food security, where factors such as age, gender, family dependents, education, income, land area, farming experience, fertility level, fire incidents, and land status are included. Equation 1 was used to determine binary logistic regression.

$$Ln\ (Pi/1\text{-}Pi) = Zi = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \beta 6X6 + \beta 7X7 + \beta 8X8 + \beta 9X9 + \beta 10X10 \quad (1)$$

where *Pi* is the probability (0 = food insecure, 1 = food secure), *β0* is constanta, *β1 β2 β3 β4 β5 β6 β7 β8 β9 β10* is the regression coefficient, *X1* is age (year), *X2* is gender (*1* = male, *2* = female), *X3* is family member (people), *X4* is education (*1–4* from elementary school to higher education), *X5* is income (IDR), *X6* is land size (m^2), *X7* is farming experience (year), *X8* is land fertility (*1–5* from highly infertile to highly fertile), *X9* is fires rate (*1–5* from highly rare to highly often), and *X10* is land status (*0* = rent, *1* = own land).

3. Results and Discussion

3.1. Food Security

In general, food security is divided into three aspects: food availability, food accessibility, and food utilization. However, the HFIAS approach focuses more on the perception of food insecurity experienced by respondents, and this method is known for its simplicity in measuring food security. Based on the results of the HFIAS questionnaire (**Table 1**), it is evident that the question with the highest score is about "concerns about food" answered by 100% of farmers. This result indicates that all respondent farmers have concerns about whether their food supply is sufficient daily. Furthermore, question number 3 received the highest number of "Yes" answers, accounting for 50% of respondents. This result means that 50 farmers feel compelled to eat with limited diversity in their diets. It shows that the community is likely unable to meet their food needs, ideally due to the high number of "Yes" responses to questions 1 and 3. The highest "Yes" response is for question number 3, with a percentage of 72.8%. Questions 6, 7, 8, and 9 received 100% "No" answers, indicating that farmers can still fulfill their family's daily food needs even under limited conditions.

Table 1. The results of the HFIAS assessment

No.	Question	No (%)	Yes (%)			Total "Yes"
			Rarely	Sometime	Often	
1	Worry that the household would not have enough food	0.0	37.0	63.0	-	100.0
2	Household members were not able to eat the kinds of food that they preferred due to lack of resources	88.0	10.0	1.0	1	12.0
3	Household members have to eat a limited variety of foods due to a lack of resources	50.0	48.0	1.0	1	50.0
4	Household members have to eat some foods that they do not want to eat because of a lack of resources to obtain other types of food	88.0	10.0	1.0	1	12.0
5	Household members have to eat smaller meals than they need due to not having enough food	88.0	10.0	1.0	1	12.0
6	Household members have to eat fewer meals in a day due to not having enough food	100.0	-	-	-	-
7	No food to eat in the household because of lack of resources to get food	100.0	-	-	-	-
8	Household members go to sleep at night hungry because there is not enough food	100.0	-	-	-	-
9	Household members go a whole day and night without eating anything because there was not enough food	100.0	-	-	-	-

Table 2 shows that only 26% are classified as food secure, while the remaining 62% are mildly food insecure, and 12% are moderately food insecure. This result indicates that although there is no severe food insecurity, most still experience some level. The absence of severe food insecurity suggests that farmers do not have to reduce their food intake significantly (Myers et al.

2014). They still have access to limited sustenance within their households (Shiferaw et al. 2013). Farmers in forest and peatland fires prone areas can still meet their daily food needs (Alamanda et al. 2022).

Table 2. Food security levels

No.	Status	Frequency (People)	Percentage (%)
1	Food secure	26	26
2	Mildly food insecure	62	62
3	Moderately food insecure	12	12
4	Severely food insecure	-	-
	Total	100	100

3.2. Farmers' Characteristics Related to Food Security

3.2.1. Age

The age interval was designed based on a maximum age (61) deducted from the minimum age (28), then divided into five categories (Rostiati et al. 2019). Farmers classified as food secure and mildly food insecure are most prevalent in the age range of 35–41 years, with percentages of 30.8% and 32.3%, respectively (**Table 3**). On the other hand, those classified as moderately food insecure are most prevalent in the age range of 42–48 years, accounting for 33.3%. This result indicates that farmers in forest and peatland fires with moderate food insecurity tend to be relatively older than those who are food secure and mildly food insecure (Amanto et al. 2019). Generally, farmers in the age range of 30–48 possess physical capabilities that support agricultural activities, and they are dynamic, creative, and receptive to adopting new technological innovations (Catacutan and Naz 2015; Hashim 2017). Farmers' regeneration in the forest and peatland fires prone areas might increase the possibility of addressing the disaster better (Kaburuan et al. 2019).

Table 3. Age and food security

Age	Food secure		Mildly food insecure		Moderately food insecure		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
28–34	5	19.2	10	16.1	2	16.7	17	17.0
35–41	8	30.8	20	32.3	2	16.7	30	30.0
42–48	7	26.9	13	21.0	4	33.3	24	24.0
49–54	5	19.2	8	12.9	3	25.0	16	16.0
55–61	1	3.8	11	17.7	1	8.3	13	13.0
Total	26	100.0	62	100.0	12	100.0	100	100.0

Note: Freq. = frequency.

3.2.2. Gender

Based on **Table 4**, farmers classified as food secure are predominantly male, accounting for 53.9%. Similarly, among farmers classified as mildly food insecure, the majority are male, comprising 51.6%. On the other hand, among farmers classified as moderately food insecure, the majority are female, with a total of 7 individuals and a percentage of 58.3%. Gender issues also arise in the agricultural sector, where there is a tendency for men to dominate physically demanding activities that require more strength, while women are more dominant in post-harvest

management (Akter et al. 2017). In the context of food security, this study suggests that male farmers seem to be better able to maintain food security than female farmers. This result aligns with research conducted by (Glemarec 2017; Negin et al. 2009), which stated that gender significantly influences food security. Gender equality might support the forest and peatland fire adaptation by farmers' households, and collaboration within the family can support more efforts (Nguyen et al. 2021).

Table 4. Gender and food security

Gender	Food secure		Mildly food insecure		Moderately food insecure		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Male	14	53.9	32	51.6	5	41.7	51	51.0
Female	12	46.2	30	48.4	7	58.3	49	49.0
Total	26	100	62	100	12	100	100	100.0

Note: Freq. = frequency.

3.2.3. Family member

Among the three categories, all of them are dominated by households with five or more family members (**Table 5**). It might be due to the varying influence of the number of family members on the family's economy, affecting food security. The more family members there are, the more mouths there are to feed (Ramadhan et al. 2022; Ruhyana et al. 2020; Santoso et al. 2023). However, if multiple family members contribute to the household's income and not just the head of the family, it can help improve the family's food security since they are economically supported by more than one person (Sulistyo et al. 2022; Wijaya et al. 2020). Farmers' families in forest and peatland fires prone areas need more collaboration among family members for economic activities and disaster adaptation (Santoso et al. 2023).

Table 5. Family members and food security

Family member	Food secure		Mildly food insecure		Moderately food insecure		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
1	0	0.0	0	0.0	0	0.0	-	-
2	2	7.7	1	1.6	0	0.0	3	3.0
3	6	23.1	15	24.2	2	16.7	23	23.0
4	5	19.2	24	38.7	3	25.0	32	32.0
5	13	50.0	22	35.5	7	58.3	42	42.0
Total	26	100.0	62	100.0	12	100.0	100	100.0

Note: Freq. = frequency.

3.2.4. Education

The level of education does not vary significantly among farmers in the three categories and is predominantly represented by senior high school education. Overall, this level of education dominates at 59.0% (**Table 6**). The Indonesian government implements a compulsory nine-year education policy, which includes completing senior high school. The findings of this study show that the farmers' level of education is not relatively low as a secondary education level mainly

dominates it. Higher levels of education are likely to encourage farmers to have a more open mindset towards innovation and possess greater potential for knowledge in food utilization (Catacutan and Naz 2015; Guo et al. 2021; Kuswanto et al. 2019). This is because higher education may lead to increased awareness of the importance of nutritious and balanced food (Baga et al. 2023; Etshekape et al. 2018). Education for farmers in forest and peatland fires prone areas might also help them to increase their ability to address the risk and hazards of the fires (Carmenta et al. 2017).

Table 6. Education and food security

Education	Food secure		Mildly food insecure		Moderately food insecure		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
No education	-	-	-	-	-	-	-	-
Elementary school	0	0.0	4	6.5	2	16.7	6	6.0
Junior high school	9	34.6	19	30.6	5	41.7	33	33.0
Senior high school	17	65.4	37	59.7	5	41.7	59	59.0
Higher education	0	0.0	2	3.2	1	8.3	3	3.0
Total	26	100.0	62	100.0	12	100.0	100	100.0

Note: Freq. = frequency.

3.2.5. Income

The income category was designed based on maximum income (IDR 6,500,000), deducted minimum age (IDR 1,000,000), and then divided into five categories (Rostiati et al. 2019). This study shows that the categories of food secure and mildly food insecure are predominantly characterized by incomes ranging from IDR 2,100,000–IDR 3,200,000, accounting for 46.2% and 53.2%, respectively (**Table 7**).

Table 7. Farmers' income and food security

Income (IDR)	Food secure		Mildly food insecure		Moderately food insecure		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
1,000,000–2,100,000	4	15.4	4	6.5	4	33.3	12	12.0
2,100,001–3,200,000	12	46.2	33	53.2	3	25.0	48	48.0
3,200,001–4,300,000	8	30.8	18	29.0	3	25.0	29	29.0
4,300,001–5,400,000	2	7.7	6	9.7	2	16.7	10	10.0
5,400,001–6,500,000	0	0.0	1	1.6	0	0.0	1	1.0
Total	26	100.0	62	100.0	12	100.0	100	100.0

Note: Freq. = frequency.

On the other hand, the category of moderately food insecure is dominated by incomes ranging from IDR 1,000,000–2,100,000, making up 33.3% of the participants. The overall income significantly influences household food security since food acquisition largely depends on purchasing power (Achmad et al. 2022; Mlaviwa and Missanjo 2019). Only a portion of the food is self-produced by farmers (Villamor et al. 2015). Farmers still choose agriculture as their main job because this sector can support their income; improving farmers' welfare in forest and peatland

fires can help them to have stronger capital to address the hazard and risk, followed by suitable adaptation (Herawati and Santoso 2011; Rozaki et al. 2022).

3.2.6. Land size

The land size category was designed based on the maximum land size (3,000 m^2), deducted minimum age (300 m^2), and then divided into five categories (Rostiati et al. 2019). Among the three existing categories, food-secure individuals are predominantly farmers, with land areas ranging from 300–840 m^2, accounting for 38.5%. Mildly food-insecure individuals are mainly those with land areas of 841–1,380 m^2, making up 37.1%, while moderately food-insecure individuals have land areas of 1,381–1,920 m^2 and 1,921–2,460 m^2, each comprising 33.3% (**Table 8**). Larger land areas generally result in higher production and contribute to food security. However, in this study, land size is not the main factor for farmers' food security. In fire prone conditions, larger land areas also carry a higher risk of being affected by fires, potentially leading to greater losses (Helmi and Sasaoka 2018). The land size of farmers in forest and peatland fires prone areas might lead to higher yield and can boost farmers' welfare, but on the other hand, the effect scale may increase (Fujii et al. 2017).

Table 8. Land size and food security

Land size (m^2)	Food secure		Mildly food insecure		Moderately food insecure		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
300–840	10	38.5	14	22.6	3	25	27	27.0
841–1,380	5	19.2	23	37.1	1	8.3	29	29.0
1,381–1,920	8	30.8	7	11.3	4	33.3	19	19.0
1,921–2,460	2	7.7	12	19.4	4	33.3	18	18.0
2,461–3,000	1	3.8	6	9.7	0	0	7	7.0
Total	26	100.0	62	100.0	12	100.0	100	100.0

Note: Freq. = frequency.

3.2.7. Land fertility and land status

Table 9 shows that all three categories exhibit a similar trend, dominated by highly fertile land conditions. 100% of the respondents in the moderately food insecure category state that their land is highly fertile. Soil fertility is a crucial factor in cultivation, as fertile soil can significantly enhance land productivity, leading to increased income and improved food security for farmers in forest and peatland fires prone areas (Fiantis et al. 2019).

Apart from soil fertility, land ownership status also plays a role (Etshekape et al. 2018; Khandekar et al. 2019). Although it may not directly impact food security, land leased by farmers adds extra costs that they have to bear (Giller et al. 2021). This situation reduces "farmers' income, ultimately affecting their food security conditions. While all three categories predominantly consist of farmers who own their land, 41.8% of farmers in the mildly food insecure category lease their land. Supporting land ownership rights can also help farmers (Yuniarti et al. 2022). Meanwhile, the soil fertility in the area is categorized as very acidic, and the total N content is classified as low to medium (Kirnadi and Zuraida 2020).

Table 9. Land fertility, land status, and food security

Land characteristics	Food secure		Mildly food insecure		Moderately food insecure		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Land fertility								
Fertile	8	30.8	26	41.9	-	-	34	34.0
Strongly fertile	18	69.2	36	58.1	12	100.0	66	66.0
Total	26	100.0	62	100.0	12	100.0	100	100.0
Land status								
Rent	5	19.2	29	46.8	-	-	34	34.0
Own land	21	80.8	33	53.2	12	100	66	66.0
Total	26	100.0	62	100.0	12	100	100	100.0

Note: Freq. = frequency.

3.2.8. Fire rate

It can be observed that 76.9% of farmers in the food secure category, 85.5% in the mildly food insecure category, and 100% in the moderately food insecure category state that they experience frequent occurrences of fires (**Table 10**). This indicates that the frequency of forest and peatland fires significantly affects the lives of farmers, both in their agricultural activities and daily lives. The damage caused by forest and peatland fires can be severe, especially when large fires occur, resulting in both material and non-material losses (Syaufina 2018). The impact of such fires can extend widely to the surrounding areas, affecting economic activities and potentially causing multiple problems (Purnomo et al. 2017). Understanding the hazard level can be promoted to minimize the damage.

Table 10. Fire rate and food security

Fire rate	Food secure		Mildly food insecure		Moderately food insecure		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Very rare	-	-	-	-	-	-	-	-
Rare	-	-	-	-	-	-	-	-
Normal	6	23.1	9	14.5	-	-	15	15.0
Often	20	76.9	53	85.5	12	100	85	85.0
Very often	-	-	-	-	-	-	-	-
Total	26	100	62	100	12	100	100	100.0

Note: Freq. = frequency.

3.2.9. Farming experience

Based on **Table 11**, it can be observed that 46.2% of farmers in the food secure category and 41.9% of farmers in the mildly food insecure category have relatively less farming experience, specifically less than 10 years. About 50% of farmers in the moderately food insecure category have farming experience ranging from 21 to 30 years. The prevailing trend in Indonesia is that farmers are relatively older, having started farming young, which means they usually have extensive farming experience (Maulida and Subejo 2021). However, moderately food insecure people in this study have relatively longer farming experience. Farming experience generally contributes to the farmers' ability to engage in agriculture (Kuasa et al. 2015; Santoso et al. 2023).

Nevertheless, in the current times, farmers also need to be open to innovation to progress their farming activities (Wang et al. 2023). The experience is not only for developing farming but also to increase the farmers' adaptation toward the fire that can damage their farming.

Table 11. Farming experience and food security

Farming experience	Food secure		Mildly food insecure		Moderately food insecure		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
< 10	12	46.2	26	41.9	3	25.0	31	31.0
11–20	8	30.8	25	40.3	1	8.3	34	34.0
21–30	5	19.2	6	9.7	6	50.0	17	17.0
31–40	1	3.8	5	8.1	2	16.7	8	8.0
Total	26	100	62	100	12	100.0	100	100.0

Note: Freq. = frequency.

3.3. Factors Affecting the Food Security

There are several factors influencing the resilience of farmers in fire prone disaster areas. These factors include Land Status (X3), Family Member (X4), Land Size (X7), and Fire Rate (X10) (**Table 12**). The odds ratio value for the land status variable is 11.50, with a positive B value of 2.44. This result indicates a positive relationship between land ownership status and food security (Rahayu et al. 2014). If farmers cultivate their land rather than leasing it, it significantly increases the chances of food security, elevating the likelihood of farmers' food security by 11,500 times.

Table 12. Factors affecting food security

Variable	B	S.E	Wald	Sig.	Exp (B)
X1 (Age)	0.00	0.04	0.00	0.95	1.00
X2 (Gender)	0.04	0.53	0.01	0.94	1.04
X3 (Land Status)	2.44	1.15	4.49	0.03	11.50
X4 (Family Member)	0.57	0.30	3.70	0.05	1.77
X5 (Education)	-21.60	22701.30	0.00	1.00	0.00
X6 (Income)	65.49	68103.90	0.00	1.00	1.76
X7 (Land Size)	-0.00	0.00	3.30	0.07	1.00
X8 (Farming Experience)	-0.02	0.08	0.46	0.50	0.98
X9 (Land Fertility)	0.90	1.01	0.79	0.37	2.47
X10 (Fire Rate)	-3.21	1.28	6.31	0.01	0.04
Constant	67.13	68103.90	0.00	1.00	1.42

Notes: B = Beta Coefficient, S.E = Standard Error, Wald = value of Wald test, Sig.= Significancy, Exp (B) = Exponential value of B.

Next, the variable of family members has an odds ratio value of 1.77, with a positive B value of 0.57. This result signifies a positive impact of the number of family members on food security. More family members imply a higher likelihood of food security, increasing farmers' food security chances by 1.77 times. However, family size can have diverse effects. On the one hand, a larger family size might decrease household food security due to increased food needs, but on the other hand, having more family members working can also enhance food security (Gelinas et al. 2015; Wahlqvist et al. 2012).

Regarding the land size variable, the odds ratio value is 1.00, with a negative B value of -0.00. This result indicates a negative impact of land size on food security. A smaller land size

increases farmers' food security, elevating the likelihood of farmers' food security by 1.00 times. Smaller land areas mean lower risks of losses during fires, and the higher the risk caused by fires, the greater the losses or damages incurred (Rozaki et al. 2022). Finally, the Fire Rate variable has an odds ratio of 0.04, with a negative B value of -3.21. It means the Fire Rate variable negatively influences farmers' food security. A lower fire rate corresponds to higher food security levels for farmers, increasing the likelihood of farmers' food security by 0.04 times. Forest fires have ecological impacts, leading to a loss of biodiversity and adversely affecting human health on a larger scale. However, the disaster seems to be a priority for many parties in saving farmers' lives in the fires prone area.

3.4. Food Security and the Sustainability of Forests and Peatlands

Forests and peatlands in South Kalimantan, Indonesia, have become important in protecting the environment and supporting the economy. The occurrence of fires threatens the condition of these forests and peatlands, affecting both the environment and human life. Sustainable development for forests and peatlands can help the relevant parties address these challenges (Ramadhan et al. 2022). The results of this development might increase food security for farmers. People in the surrounding forest and peatland areas benefit from these resources, even though land ownership rights remain challenging (Bose 2015). Supporting land ownership rights can provide farmers with more stable conditions for their land tenure.

4. Conclusions

Forest and peatland fires in Indonesia remain a recurring disaster in several regions, including South Kalimantan. The dominant agricultural sector in these disaster-prone areas suffers significant impacts, leading to a notable effect on the farmers' food security. The majority of farmers, approximately 62%, experience mild food insecurity, while 12% face moderate food insecurity. These conditions demonstrate that with the various challenges in the agricultural sector and the threat of forest and peatland fires, farmers become vulnerable regarding their food resilience. Four factors influence farmers' resilience, namely land status, family size, land size, and fire rate. Despite the diverse challenges and the threat of forest and peatland fires, farmers continue to cultivate and live in the area as agriculture remains their main source of livelihood. Therefore, reducing the impact of forest and peatland fires on farmers' food security can be achieved through education and disaster mitigation efforts involving collaboration among relevant stakeholders. Making the priority policy of the forest and peatland fires issue can help farmers and other affected parties adapt well.

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