

Conference Paper

## Food Insecurity among Female Maize Farmer Household in Guluk - Guluk Subdistrict, Sumenep Regency, Madura Island

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### ABSTRACT

Sumenep Regency, located in East Java Province, is one of the regions facing food insecurity, despite being known as a significant maize producer on Madura Island. This research aims to analyze the level of food insecurity among female maize farmer households (FMFH), including their food consumption patterns and the determinant factors influencing these patterns. The study was conducted in the Guluk-Guluk subdistrict of Sumenep Regency, Madura Island. In total, we interviewed 75 female maize farmers about their food consumption over the previous 24 hours, using a 1-day food recall method. The Household Dietary Diversity Score (HDDS) was employed to assess consumption patterns and determine food insecurity status, while a binary logistic regression analysis was used to identify influencing factors. Our study reveals that 100% of FMFH consumed cereals (rice, maize, and a rice-maize mix), in contrast to milk consumption, which was only 1.3%. The average HDDS was 7.2, and more than half (53.3%) of FMFH had low dietary diversity, placing them in the food insecurity category. We identified three primary factors determining food insecurity: education, age, and farm production diversity (FPD). It is advised to encourage the utilization of home gardens for food plant cultivation and cattle rearing in order to reduce food insecurity and boost nutritional diversity, especially in rural areas.

*Keywords: Binary logistic regression, food consumption patterns, food security, HDDS, Madura Island*

### Introduction

Food insecurity remains a pressing issue globally, with significant implications for health, well-being, and economic development. To facilitate access to food, food security is needed, which can be realized through increasing food production along with population growth (Pradnyadewi et al., 2021). According to the National Food Agency (2022), the ideal food security condition is when the food needs of the country and individuals are well met. Research by Elias and Jambor, (2021) explained that during the COVID-19 pandemic, various countries experienced economic decline due to limited activity and many layoffs. The impact is that people are unable to buy enough food or consume a variety of foods such as vegetables, fruit, and animal protein. The post-COVID-19 pandemic has had an impact on unstable food security conditions. According to the Center for Agricultural Data and Information Systems (2022) the development of moderate or severe food insecurity (FIES - Food Insecurity Experienced Scale) in Indonesia is experiencing fluctuations. Meanwhile, malnutrition in older people can trigger obesity due to consuming high quantities of less nutritious food (Simanjuntak & Erwinsyah, 2020). The need for adequate nutrition is very important for the body. Everyone must get used to consuming a variety of staple foods, side dishes that are rich in protein, and increase consumption of fruit and vegetables that

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are rich in fiber and vitamins. Apart from that, you should limit your consumption of sweet, salty and fatty foods (Maulidini & Aidha, 2020).

In 2018, Sumenep Regency was one of the districts in East Java with the highest poverty rate compared to the three districts on Madura Island (Utami & Suprapti, 2020). However, this area has a potential agricultural land area of 168,558 ha for the development of food crop farming, horticulture, and plantations (BPS Sumenep Regency, 2021). The maize commodity is one of the food crops that is widely cultivated, so this area is known as a maize-producing center (Verdiansyah et al., 2023). The number of residents in Sumenep Regency continues to increase from 2017 to 2021 by around 5% or 56,740 people (BPS Sumenep Regency, 2020). Of the many sub-districts in Sumenep Regency, Guluk-guluk sub-district is one of the maize producers because the majority of the population makes their living as maize farmers. The need for food will increase as the population increases, while the availability of food is decreasing day by day (Sudrajat, 2022). Therefore, it is necessary to take action to improve food security and food consumption patterns in society, including diversifying food consumption.

There are several studies regarding food security in Sumenep Regency. For example, research by Utami and Suprapti (2020) focuses on social capital factors in food security. The results of this research show that social capital factors, such as networks, trust, participation, cooperation, social norms, mutual exchange of kindness between individuals, values (ethics), and proactive actions, have a significant effect on local maize food security. In addition, Anam et al. (2020) also carried out research on food security with a focus on developing lowland rice and maize cultivation. Research on food security in Sumenep Regency is still limited, especially focusing on the level of food diversification, especially in maize farming households. This research was conducted to fill this gap with the following objectives: (1) identify the food consumption patterns of maize farmer households, (2) determine the level of household food security based on food consumption diversification, and (3) analyze the factors that influence the level of diversification in maize farmer households in Guluk-Guluk District, Sumenep Regency.

## **Material and Methods**

This study is structured using normative legal study methods, which is a study performed by examining the sources of library materials (secondary data) that are used as the basis for the study, in the form of legislation and associated study reports, and the issues raised. The primary source of the constitution used is the 1945 Constitution of the Republic of Indonesia, Constitution No. 1 of 1946 regarding the Criminal

### ***Research location***

This research was conducted in Bragung village, Guluk-Guluk Subdistrict, Sumenep Regency, Madura Island. There were some steps and reasons in the determination of the study site. First, Sumenep is selected based on the food security index (FSI) and maize production. According to the Ministry of Agriculture (2021), the FSI score in Sumenep is 76.17, which lower than the average in East Java Province (79.70). Furthermore, according to the BPS-Indonesia Statistic Government Office (2021), Sumenep is reported as the highest maize production in Madura Island. The second step, the selection of Guluk-Guluk subdistrict and Bragung village based on information and recommendations from the Agricultural Extension Center (BPP).

### ***Types of data and types of research***

This research is quantitative descriptive research used to analyze research data obtained from researchers. This method can carry out measurements on an object at a certain time, and then the results of the analysis will be described (Fitriyani & Febrianti, 2020). This research uses primary data obtained directly from the subjects concerned for analysis (Suryani et al., 2020). Data collection was carried out in September 2023.

### ***Determination of respondent samples***

The purposive sampling method was used to select a sample of respondents. The purposive sampling method was used because the researcher visited the head of the Guluk-guluk Village Women's Farmers Group (KWT), who had information about other farmers who could be respondents in this research. Determining the number of samples uses the Event Per Variable (EPV) method as in the research Hu et al. (2021) have a minimum sample size of 10 times the number of independent variables while research Gola et al. (2022) explains that if you use the EPV method, the number of samples must be equal to or more than 10 ( $=10$ ). This research uses seven variables in the form of education, respondent's age, agricultural land area, household income, FPD, number of household members, and government assistance. The minimum sample size of respondents is 70, and the sample in this study used 75 samples, which means it exceeds these criteria. All respondents are female farmers who determine and understand the food consumed in farming households.

### ***Determining the level of security and diversification of household food consumption***

This research uses HDDS to determine the food security status and level of food consumption diversification of maize farming households. This research adopted the 1x24 food recall method to obtain consumption data for 7 household foods (Cheteni et al., 2020). The use of 1x24 food recall is recommended by the Food and Agriculture Organization (FAO) because errors in data collection are lower. The type of food consumed by the household is given a score of 0 if they do not consume it and a score of 1 if they consume it (Admaja et al., 2022). This research refers to Nevhutalu et al. (2023), which uses 12 types of food groups so that the total HDDS value is in the range of 0 to 12. The HDDS formula used is as follows:

$$\text{HDDS} = (A+B+C+D+E+F+G+H+I+J+K+L) \dots\dots\dots(1)$$

Where A= cereals, B = tubers, C = vegetables, D = fruit E = meat, F = eggs, G = fish and seafood, H = nuts, I = milk and milk products, J = oil or fat, K = sweetener, L = other foods. To find out the average HDDS value in this study, it was calculated using the formula:

$$\text{Average HDDS} = \frac{\text{Total HDDS}}{\text{number of household}} \dots\dots\dots(2)$$

If a household's HDDS score is below the average, it indicates that the household is in a condition of low food security or food insecurity, which will be marked with the number 0. On the other hand, if the maize farmer's HDDS score is above the average, it can be said that these farmers have a high level of food security, which will be marked with the number 1.

### ***Binary Logistic Regression Analysis***

The logistic regression method can be used to identify factors that influence food security at the household level (Mekonnen et al., 2021). Meanwhile, according to Shirreff et al. (2021) Binary logistic regression was used to test associations with food insecurity. By using binary logistic regression, we can find out what influences the food security of maize farming households. Household food security status is a binary dependent variable that only has two beliefs, between the value 1 if the household has food security and 0 if it has food insecurity (Woleba et al., 2023). The binary logistic regression equation can be written as follows (Li, 2022) :

$$\text{Logistic Regression (Y)} = \ln (P1-p) = \alpha + \beta_1 \text{Edu} + \beta_2 \text{Age} + \beta_3 \text{LH} + \beta_4 \text{IC} + \beta_5 \text{FPD} + \beta_6 \text{HS} + \beta_7 \text{GAe} \dots\dots\dots(3)$$

Where  $P$  is the probability of food security of farming households, is the intercept model indicator,  $\beta$  is the regression coefficient of the independent variable, and  $e$  is the error term or

error constant. Independent variables used in binary logistic regression include: 1) education (Edu); 2) government assistance (GA); 3) respondent's age (Age); 4) agricultural land area (LA); 5) household income (IC); 6) FPD (Farm Production Diversity); and 7) number of household members (HS). A complete description and characteristics of the categories of dependent and independent variables used in this research can be seen in Table 1.

Table 1. Variable description

<b>Dependent Variable</b>	
Food Security Status of FMFH	Food security status based on HDDS score: HDDS > average = 1 (food security) HDDS < mean = 0 (food insecurity)
<b>Independent Variable</b>	
Education (Edu)	Total years taken during the education period in years.
Government Assistance (GA)	Assistance in the form of cash transfers to each maize farming household. Data in the form of categories: 0 = not received 1 = Received
Age	Respondent's age in years.
Agricultural land area (LA)	Land area is calculated in hectares (Ha).
Household income (IC)	Total household income for one month in millions.
FPD ( <i>Farm Production Diversity</i> )	The number of types of plants planted in rice fields and the number of plants used in home gardens and the number of types of livestock kept.
Number of family members (HGU)	The total number of members in one maize farming household.

The hypotheses used in this research are:

$H_0$ = there is no significant influence between the independent variables on the dependent variable

$H_1$ = there is a significant influence between the independent variable and the dependent variable

## Results and Discussion

### *Respondent characteristics*

The majority of research respondents who are residents of the Guluk-Guluk District make their living as farmers. The commodity most often cultivated by farmers in Guluk-Guluk District is maize. This is because the land conditions are very suitable for maize cultivation. However, if there is influence from the weather that causes the condition, land does not allow them to plant maize; they switch to other commodities such as peanuts and tobacco. In one year, agricultural land in Guluk-Guluk District can be cultivated twice, this is because the agricultural land system still relies on weather (rainfall). Maize cultivation is usually carried out from November to January. Apart from farming, maize farmers in Guluk-Guluk District also fill their free time by using their yard for gardening or raising livestock. This is done to increase their income or meet their daily needs. All respondents are female maize farmers who have joined the Women's Farmers Group (KWT).

The results of surveys and interviews with 75 respondents, according to the variables used, obtained various characteristics. Based on the education variable (Edu), the majority (41.1%) of respondents with an elementary school education, while respondents with a bachelor's degree had the lowest percentage (5.3%). There are also 28% of maize farmers in Guluk-Guluk District who receive government assistance (GA), but the number of maize farmers in Guluk-Guluk District

who do not receive government assistance is greater, namely 72%. The age variable is known if the minimum age is 24 years and the maximum age is 70 years. Then the land area (LH) variable has a minimum land area value of 0.01 hectares and a maximum of 1 hectare. The minimum income (IC) per month for maize farming households in Guluk-Guluk District is IDR. 1,170,000 and a maximum of IDR. 11,000,000. In the FPD of maize farming households in Guluk - Guluk District, the minimum number of types of plants planted in the rice fields and the number of plants used in the home yard, as well as the number of types of livestock kept, is 1, while the maximum is 9. For the number of family members (HS) at home, the household of maize farmers in Guluk-Guluk District is 1 person with a maximum of 9 people. Respondent characteristics data can be seen in Table 2.

Table 2. Responden Characteristic

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Variable			Amount (N)	Percentage (%)
Education (Edu)	No school		9	12
	SD		31	41,4
	SMP		15	20
	SMA		16	21,3
	S1		4	5,3
Government assistance (GA)	Yes		21	28
	No		54	72
	Minimum	Maximum	Average	Std ( $\sigma$ )
Age	24	70	45,6	10,81
Land area (LA)	0,01	1	0,3	0,25
Income (IC)	1,17	11	4,9	2,54
FDP	1	9	4,92	1,67
Number of family members (HGU)	1	9	5	1,68

Based on data on respondent characteristics, it can be said that the respondents of this study were female maize farmers with a final elementary school education (41.4%) with an average age of 45.6 years. The average area of land owned by respondents is 0.3 hectares, and the average monthly income is IDR. 4,900,000. FPD of maize farmer households in Guluk - Guluk District. The majority of family members are 6 - 8 people, and most of them do not receive government assistance.

### **Food Consumption Patterns**

The food consumption needs of maize farmers in Guluk-guluk District and household members who are respondents will be grouped according to 12 types of food ingredients ranging from cereals, tubers, vegetables, fruit, meat, eggs, fish, nuts, milk, oil, sweeteners, and others (spices, condiments, drinks). A score of 1 indicates the food was consumed, and a score of 0 indicates the food was not consumed. The percentage of types of food consumed by maize farming households in Gulu-guluk District can be seen in Figure 1.

The food menu prepared by maize farmer housewives is divided into three meals every day: morning, afternoon, and evening. All maize farming households in Guluk-guluk Village (100%) consume cereal in the form of white rice, sometimes also mixed with maize rice. This cereal is the main food that must be available every day. On average, in the Madura region, many maize farming households consume maize as the main food ingredient. The maize consumed by households comes from agricultural products grown in their own rice fields. The high percentage of cereal consumption is also in line with the findings of Rahajeng and Khotimah (2020) the percentage of

cereal consumption is 100% in the form of rice. Tubers (22.7%) are consumed because they are only used as snacks for farmers. The use of oil in households is in the high category (100%) because it is used for cooking or frying side dishes that are used as daily food. Not only consuming carbohydrates, but it must be balanced with protein, which contains nutrients for the body, such as processed nuts (40%), usually in the form of tofu or tempeh, meat (22.7%), eggs (37.2%), and fish (100%). Fish is a favorite food for maize farmer households in the Guluk-guluk sub-district because it is easy to find, the price is affordable, and it tastes delicious. The types of fish consumed are skipjack and tuna.

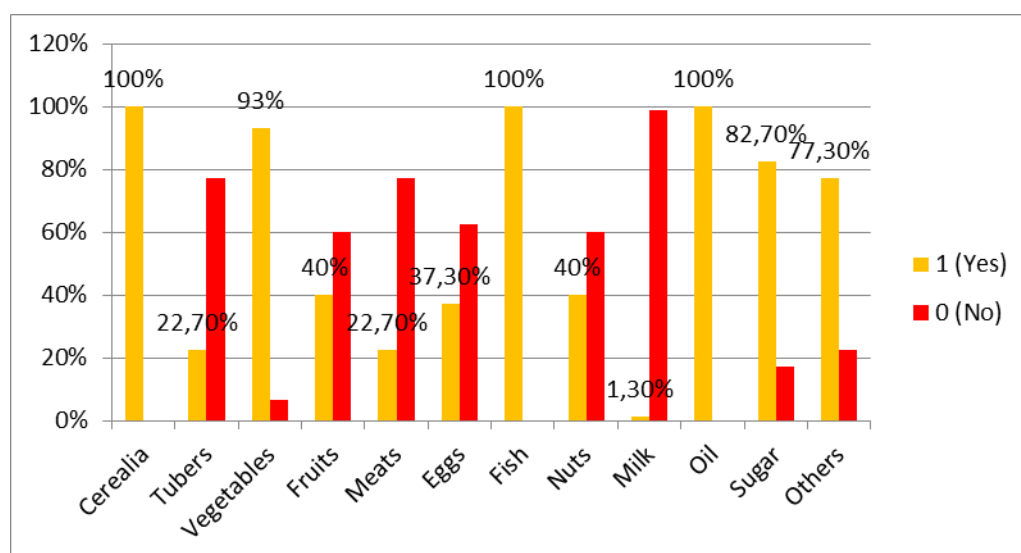


Figure 1. Consumption Pattern

Apart from consuming side dishes that contain protein, they also fulfill their fiber needs by consuming vegetables (93%) and fruit (40%) to meet the body's vitamin needs. The fruit and vegetables consumed come from the use of the home garden, so that in terms of costs, it becomes more economical, and the money can be allocated to other needs. The types of vegetables that are usually grown include moringa, eggplant, cassava (the leaves are used as a vegetable), while the types of fruit that are planted are usually bananas, mangoes, rambutan, and papaya. Milk consumption by maize farming households in Guluk-guluk District is very low, namely 1.3%. This is inversely proportional to research conducted by Cordero-Ahiman et al. (2021) the results of the research show that the percentage of milk consumption is quite high, namely more than 80%.

### **Food security status**

The food security status of maize farming households in Guluk-Guluk District is determined based on calculation results using the HDDS formula. The average HDDS value obtained was 7.2. If the total HDDS value of maize farming households is greater than the average value, it means that the farming household is in food security status which is marked with a score of 1, and if the total HDDS value of maize farming households is smaller than the average value, it means that the household These farmers are in food insecurity status which is marked with a score of 0. The results of HDDS calculations for maize farmer households in Guluk-Guluk District can be seen in Table 3.

Table 3. Food security status of maize farming households

Household Status	Score	Amount	Percentage (%)
Food security (HDDS > 7,2)	1	35	46,7
Food insecurity (HDDS < 7,2)	0	40	53,3
<b>Total</b>		<b>75</b>	<b>100</b>

Table 3 shows that more maize farming households are in food-insecure status (53.3%) compared to maize farming households with food-secure status (46.7%). This is because they have the mindset "what matters is being full" in consuming food every day without paying attention to nutritional needs. So, the food consumed is not diverse. The types of food that are widely consumed by maize farming households in Guluk-Guluk District are cereals (white rice, maize rice), vegetables, fish, oil, sweeteners, and other foods (serundeng, crackers, soy sauce). All respondents from maize farming households consume fish (100%) every day. The average HDDS value of this research is higher than the research conducted by Cheteni et al. (2020) whose average HDDS value is only 3, as well as the results of research conducted Mkhize and Sibanda, (2022) also shows that the average HDDS value is lower than the average value of this study, namely 5.09.

### **Factors that influence food security**

The HDDS calculation results that can determine whether a maize farming household is in food-secure or food-insecure status are also influenced by several factors. These factors can be identified by carrying out this binary logistic regression analysis. There is a model feasibility test, assessing the entire model, coefficient of determination, and partial test (significance). The results of the binary logistic regression analysis of this research can be seen in Table 4.

Table 4. Regression binary logistic result

Variabel	Coefficients Sign	Coefficients Regression	p-value	Odds Ratio
Education (Edu)	+	0,326	0,013**	1,385
Age	+	0,078	0,080***	1,081
Land Area (LA)	+	1,120	0,372	3,064
Income (IC)	+	0,151	0,257	1,162
FPD	+	0,776	0,002*	2,172
Number of family members (HGU)	-	-0,155	0,497	0,857
Government Assistance (GA)	+	0,816	0,265	2,262
Constant	-	-10,221	0,001	0,000
-2 Log likelihood			67,715 <sup>a</sup>	
Omnibus Test of Model Coefficients		0,000		
Nagelkerke R Square		0,510		
Hosmer and Lemeshow Test		0,632		
Ket: *significant effect on $\alpha = 1\%$				
** significant effect on $\alpha = 5\%$				
***significant effect on $\alpha = 10\%$				

The model feasibility test is based on the Hosmer and Lemeshow Test value, the value of which must be > 0.005. This research has a Hosmer and Lemeshow test value of 0.632, meaning that the research model can be said to be suitable for use, so that H0 is accepted. The overall model test refers to the Omnibus Test of Model Coefficient values, which is 0.000. Because 0.000 < 0.005, then H0 is rejected and H1 is accepted. This means that overall, there are independent variables that

simultaneously or simultaneously influence the dependent variable (food security). Next, to determine the ability of the independent variables to influence food security, a coefficient of determination test was carried out, which refers to the Nagelkerke R Square value, which is 0.510. This means that the independent variable used in this research can explain the dependent variable (food security), accounting for 51%, and the remaining 49% is explained by other variables that are not in this research. The partial test based on the p-value shows that 3 independent variables have significant values, namely education, age, and FPD.

The education variable has a p-value of 0.013, which is significant at the  $\alpha = 5\%$  level and has a positive correlation with food security, which means that H1 is accepted (education influences the food security status of maize farming households in Guluk-Guluk District). The odds ratio value for the education variable is 1.385, which explains that maize farmers with 1 year more education have a 1.385 times chance of being food secure. Maize farmers in Guluk - Guluk District with higher education, such as high school and bachelor's degrees, tend to have food-secure household status because they already have a basic understanding of the nutritional needs that must be met every day, such as fiber, protein, and vitamins. Apart from that, they become wiser in allocating their finances to meet their daily food needs. This is proven by diverse consumption patterns, namely 8 to 9 types of food a day. This is in line with the results of research conducted by Abenwi et al. (2020), Akukwe & Iheoma (2020), Ellenora & Kadir (2023), and Savari et al. (2020), namely, the educational variable has a significant effect on food security because education is a determining factor in human quality and can be a guarantee for realizing good household food security.

The age variable has a p-value of 0.080, which is significant at the  $\alpha = 10\%$  level and has a positive correlation with food security, which means that H1 is accepted (age influences the food security status of maize farming households in Guluk-Guluk District). The odds ratio value for the age variable is 1.081, which explains that maize farmers who are 1 year older have 1.081 times the chance of being food secure. Mature maize farmers tend to have knowledge that comes from experience regarding providing nutritious food. Adult maize farming households in Guluk-Guluk District usually already know that nutritious food does not have to come from expensive food ingredients. For example, protein can not only be obtained from meat, they usually replace the protein source with eggs, tempeh, tofu, and fish, which are affordable. Likewise, with the research results of Elshoryi et al. (2020); Pujilestari and Haryanto (2020), namely, age has a significant value in determining household food security status. Different from research results Ariyadi, (2021), his findings explain that age does not affect the resilience of farming households because farming household expenditure does not take into account the farmer's age, which means whether they are adults, pre-elderly or elderly, the amount of expenditure to meet their daily food needs is the same.

Furthermore, the FPD variable has a p-value of 0.002, which is significant at the  $\alpha = 1\%$  level and has a positive correlation with food security, which means that H1 is accepted (FPD influences the food security status of maize farming households in Guluk-Guluk District). The odds ratio value for the FPD variable is 2.172, which explains that maize farmers with a higher FPD value of 1 type have a 2.172 times chance of being in food secure status. Maize farmers in Guluk - Guluk District use their yards to grow vegetables such as eggplant, cassava, moringa, and fruit such as bananas, mangoes, rambutan, and papaya. Apart from that, they also use it to raise livestock such as cows, ducks, and chickens. The results from the use of the home yard are then diversified into food for daily meals. Maize farmer households that implement FPD can support their consumption patterns to become more diverse, so that they reach food security status. This is in accordance with the research results of Awoke et al. (2022), Fikire & Zegeye (2022), and Susanti et al. (2022), which explains that the use of home gardens can increase household food consumption and support household food diversification.

## Conclusion

Based on the results of the analysis in this research, it can be concluded that the household consumption patterns of maize farmers in Guluk-Guluk District are not diverse. The food consumed daily is limited to staple foods such as rice, vegetables, fish, tempeh, tofu, and oil. Based on the average HDDS value of 7.2, it is known that the number of households with food insecurity status (53.3%) is greater than households with food security status (46.7%). Three factors influence the level of consumption diversification, namely education, age, and FPD. These three factors have a positive correlation with food security.

The recommendation that the author can give is that the use of home gardens that have been carried out should be maximized, because the use of home gardens has quite a big opportunity to diversify household food. The results of this research can be an illustration for the government that diversifying food consumption is important for realizing the ideal quality of Human Resources (HR). So, the government has an important role in this matter, efforts that can be made include increasing understanding and assisting in the form of cash or food directly to the community. Suggestions for further research are to carry out further research regarding what has not been done or is not perfect in this research, such as other factors that influence the diversification of food consumption patterns and how to increase people's understanding of the importance of consuming nutritious food every day.

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