



Food Security of Fishermen Households in Tanjung Bumi Sub-district, Bangkalan, Madura Island

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ABSTRACT

Food security in coastal locations poses a huge challenge for fishing communities, which are especially exposed to changes in fish catches and persistent poverty. Fisher households' food security is frequently jeopardized due to their reliance on fish collection. The objectives of this study were to (1) identify fishermen's food consumption habits, (2) assess the food security status of fisher households, and (3) examine the factors affecting their food security. This study took a quantitative descriptive method, with 77 respondents chosen at random. Fishermen were interviewed using a standardized questionnaire regarding the types of food they had consumed in the previous seven days. To assess food security status, data was examined using the Food Consumption Score (FCS), and factors influencing food security were identified using binary logistic regression. The findings showed that all households consume rice, fish, and oil; nevertheless, milk consumption is noticeably low. The average FCS was 35.77, and more than half of fisher households (56%) reported food insecurity. Key factors determining food security include the household head's education level, ownership of marine assets, and the presence of home gardens.

Keywords: Bangkalan Sub-district, binary logistic regression, food consumption score, fishery households, food security

INTRODUCTION

Food security remains a serious concern for many countries, particularly emerging ones (Schleifer & Sun 2020). It supports community well-being, emphasizing its importance as a worldwide issue (Manikas *et al.* 2023). Furthermore, food security is directly linked to SDG 2, aiming to eliminate hunger and secure global food security by 2030 (Jubayer *et al.* 2023; Malec *et al.* 2024). Coastal communities around the world face distinct problems in ensuring food security, which complicates attempts to reduce poverty. More than 2.37 billion people worldwide face moderate to severe food insecurity, with a large proportion living in vulnerable coastal regions. Furthermore, more than 820 million people globally continue to face chronic hunger (FAO, IFAD, UNICEF, WFP 2021).

The fisheries sector is key to food security and poverty alleviation (Béné *et al.* 2016), especially because it supplies a critical supply of animal protein and basic nutrition to millions of people globally (Lauria *et al.* 2018). Food security is critical in countries with large populations, such as Indonesia, the world's largest archipelago state and the second greatest

producer of marine fish (FAO 2018). In addition, more than six million Indonesians work in fisheries and aquaculture, with small-scale fishers accounting for over 95% of total production. Food insecurity is widespread in susceptible places, particularly coastal regions. The Food Security and Vulnerability Atlas (FSVA) identified 74 districts or cities as food insecure, equivalent to 14% of the total area in Indonesia (Badan Pangan Nasional 2022).

Bangkalan Regency has a population of 1.047 million, with 190,940 households still living in poverty (Badan Pusat Statistik 2023; BPS Kab Bangkalan 2024b). According to the 2016 FSVA, this regency is classified as food-insecure, with a vulnerability score of 2.85% (Triwindiyanti *et al.* 2018), also the second highest producer of fish on Madura Island, with a total catch of 26,676 tons in 2022 (DKP Jawa Timur 2022). Environmental factors such as rainfall fluctuation, water temperature, and drought have a substantial impact on fishing operations (Rakib *et al.* 2018). These factors could affect the resilience and poverty of fishing households. Small-scale fisheries employed 90% of all fishermen worldwide and are a key source of income for local communities (FAO & WorldFish 2023). Tanjung Bumi Sub-district, located on the northern coast of Madura Island in Bangkalan, has a population of 55,264 (BPS Kabupaten Bangkalan 2023). This region is important in the fishing sector, with 1,321 people working as fishermen. However, the northern coastal areas of the Java Sea, including Tanjung Bumi, confront ongoing food insecurity, which is worsened by

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the prevalence of poverty in the communities (BPS Kabupaten Bangkalan 2024a). The high reliance on variable fishing yields elevated concerns regarding the availability of catches to meet daily family needs (Lussy *et al.* 2023). Such uncertainties have a direct impact on household food security, emphasizing the importance of assessing the food security status of fisher households and identifying the determinants. This information is critical for guiding interventions and policy development targeted at enhancing their livelihoods and resilience.

Setiani *et al.* (2024) conducted previous research on food security in Bangkalan, used the Household Dietary Diversity Score (HDDS) and focused on maize producers. Similarly, Wijayanti (2021) emphasized the importance of dryland agriculture in promoting food security through excellent commodities like maize, soybeans, and peanuts. However, no research has looked explicitly at food security in fishermen's homes in Bangkalan Regency, notably using the Food Consumption Score (FCS) methodology. This gap highlights the importance of undertaking research on food security among coastal fishermen in one of the villages in Tanjung Bumi Sub-district. As a result, the objectives of this study were to: (1) identify fishermen's food consumption patterns, (2) measure the food security levels of fishermen's households, and (3) examine the factors impacting fishermen's household food security. This study was expected to provide empirical evidence and policy recommendations to the Bangkalan local government and fisheries agencies for designing targeted food security interventions for vulnerable fisheries households, as well as serve as a baseline study for future coastal food security research in the same contexts.

METHODS

Data Collecting

The study was carried out in Banyu Sangkah Village, Tanjung Bumi Sub-district, Bangkalan Regency, Madura Island. The site was chosen using a multi-stage process. First, Bangkalan Regency was picked based on statistics from the Department of Marine Affairs and Fisheries, which identified

Bangkalan as Madura Island's second-largest fish producer, with a production output of 26,676 tons in 2022 (Wijayanti 2021). Tanjung Bumi Sub-district was chosen at random from ten coastal subdistricts on Madura Island (DPKP Jawa Timur 2016). Finally, Banyu Sangkah Village was deliberately chosen because of its closeness to a fish auction site and the high proportion of fishermen among its population.

Data was collected from August to October 2024. The sample size was selected using logistic regression analysis guidelines from earlier studies (Hu *et al.* 2021; Setiani *et al.* 2024), which suggested ten times the number of independent variables. With seven independent variables, the minimal sample size was 70. However, 77 samples were obtained, exceeding the criterion. Primary data was collected using questionnaires and in-depth interviews, including specific questions regarding food consumption in the previous seven days. The responses were classified into nine dietary groups using the FCS framework (Gonella *et al.* 2022).

Data Analysis

This study used three analytical methods: descriptive analysis, FCS analysis, and binary logistic regression analysis. Descriptive analysis presents an overview of nine food groups' consumption levels in fisher households, providing insights into their dietary habits. To estimate food security status, the FCS formula (1) was used as follows:

$$FCS = \sum (y_i \times f_i) \dots (1)$$

In this formula, y_i represents the food groups assigned specific weights, as shown in Table 1, and f_i reflects the frequency of consumption of each food group over the previous seven days. The estimated FCS values were then classified to represent the household's food security status. Households were defined as poor or food insecure if $FCS < 35$, and satisfactory or food secure if $FCS > 35$ (Adeoye *et al.*, 2022; Danso-Abbeam *et al.* 2022).

The binary logistic regression approach was used to discover the determinants influencing fisher households' food security, and the data was analyzed

Table 1 Food consumption score (FCS)

Food types/items	Food group	Weight
Rice (combed rice, porridge), bread, and other cereals	Staple food	2
Cassava, potatoes, sweet potatoes, other root vegetables		
Peas, peanuts, cashews and other nuts	Nuts	3
Vegetables and leaves	Vegetables	1
Fruit	Fruit	1
Beef, mutton, poultry meat, eggs, fish	Meat and fish	4
Milk and dairy products	Milk	4
Sugar and its processed products	Sugar	0.5
Oil, fat, and butter	Oil	0.5
Spices	Spices	0

Source: Sembiring *et al.* (2015).

in STATA. The model, derived and modified from Masha *et al.* (2023), was provided as follows:

$$(Y) = \ln \left(\frac{P}{1-P} \right) = \alpha + \beta_1 \text{AGE} + \beta_2 \text{EDU} + \beta_3 \text{FHI} + \beta_4 \text{FHM} + \beta_5 \text{BA} + \beta_6 \text{CRD} + \beta_7 \text{HGA} + e_i \dots (2)$$

where:

- Y = Food security status; 1, if food secure; 0, if otherwise
P = The desired probability
 α = The intercept term
 β_1 – β_7 = The regression coefficients
Age = Age of the fisherman (years old)
Edu = Education level represents the total years of education by fisherman; 0 if noschool/illiteracy; 6 if finished elementary school; 9 if finished junior school; 12 if finished senior high school; 16 if graduated from university
FHI = Fishery household income (Indonesian Rupiah/IDR per month)
FHM = Number of fishery household members (people)
BA = Boat ownerships as an asset; 1 if have boat; 0 otherwise
CRD = Access to credit; 1 if have credit access; 0 otherwise
HGA = Home gardens asset
 e_i = The error term

The hypothesis used in this study is as follows:

H_0 : There is no significant effect of the independent variables on the food security of fishermen

H_1 : There is a significant effect of the independent variables on food security in fishermen

RESULTS AND DISCUSSION

Respondent Characteristics

Table 2 shows descriptive information for the fishermen surveyed in the study region. Most responders (64%) are adults, with a mean age of 43 years. According to Lamane *et al.* (2020), adult fishermen are in optimal physical condition, allowing them to actively participate in fishing operations while also meeting the demands of their families. In terms of education, more than half of the respondents (52%) had only finished elementary school. The average level

of education was 5.90 years, with a standard deviation of 3.46 years, indicating that fishermen have a low level of educational attainment overall. This study is consistent with Mongabay (2023), that 80% of small-scale fishermen had poor educational levels (below junior high school), which has a negative impact on the fishing community's regeneration.

The average household income is 10,463 million IDR per month, with a considerable standard deviation indicating significant income variation among fishing households. This variation is related to the sort of fishermen, with some serving as crew members and others as boat owners. Crew members only receive a portion of the catch, whereas boat owners earn money by leasing their vessels. According to Hidayati and Widayatun's (2021), fishermen in coastal Sumatra earn the majority of their revenue from capture fisheries, which fluctuate over time.

Most fisher homes (81%) have one to four family members, with an average household size of 3.662 people. This figure is lower than the average fishery household size in Indramayu, North Java, which ranges between three and five members (Firdaus & Triyanti 2017). As many as 39% of respondents possess a boat, also known as a *juragan*. According to Agvitasari (2022), fisherman can undergo vertical social mobility by moving from crew members to *juragan*, indicating a shift in their socioeconomic standing. More than half of the respondents (62.3%) have access to credit. *Juragan* often uses loans to meet capital needs for their vessels, such as buying a new boat or other capital-related expenses. Crew men, on the other hand, typically use credit for consumption, frequently borrowing from boat owners to meet the demands of their families. Only 5% of respondents said they owned a home garden. Coastal locations are often densely inhabited, which may contribute to the low rate of home garden ownership. Some fisheries homes with home gardens employ the plants, particularly fruit-bearing ones, to supplement their daily diet.

Many fishermen rely on their catch for their primary source of income. Weather and temperature conditions have a significant impact on fishing activity in this town, resulting in regular uncertainties in catch amounts. The fishermen exemplify an attitude embodied in the slogan "Afraid of hunger, brave enough to face death," which summarizes their willingness to take extraordinary risks, even at the cost of their lives, to keep their families from going hungry. Fishing is suspended during instances of strong waves seas. However, as

Table 2 Descriptive statistics

Independent variable	Mean	Std. dev.
Age	43.467	9.946
Education	5.896	3.458
Fishery household income (FHI)	10.463	12.818
Number of fishers household member (FHM)	3.662	1.131
Boat ownership as an asset (BA)	0.350	0.480
Access to credit (CRD)	0.623	0.487
Home garden asset (HGA)	0.051	0.223

the weather calms down, even slightly, they return to the sea to complete their daily needs.

Food Consumption Patterns

Understanding food consumption patterns is critical for understanding people's dietary habits and preferences in satisfying their nutritional requirements. At the study site, fishermen normally go out to sea in the afternoon and return home in the morning or evening. In terms of food consumption, they carry prepared meals as part of their cultural customs, just like fishermen in Kutai Kertanegara (Marliza 2023) and East Nusa Tenggara (Therik 2008). Figure 1 depicts the different types of food consumed by fishing households. Cereals, fish, and oil were the most popular foods, each with a 100% consumption rate. The Madurese ethnic group commonly consumes cereals in various forms, such as white rice or a rice and corn blend (Setiani *et al.* 2022b). Cultural influences cereal consumption, as rice is the Indonesian people's staple food, and life is considered incomplete without it.

The intake of fish and oil reaches 100%, indicating both their availability and a cultural fondness for fried dishes. Fish is always available as a food source since fisherman fish frequently. Aside from selling their catch, each crew member earns a portion of the fish after each trip. This share is mostly consumed by the household, but it is occasionally sold. One respondent stated that, while they occasionally become bored with eating fish, it remains the most readily available and cost-free option, resulting in continuous consumption. Respondents preferred the flavor of fried fish to boiled fish; hence fish is frequently cooked this way. This desire also explains the excessive usage of oil (Setiani *et al.* 2024). This finding contrasts with households of farmers and urban residents, where eggs are the

primary source of animal protein consumption (Ariani *et al.* 2018).

Spices, vegetables, and sugar are consumed at comparatively high rates (94%, 82%, and 74%, respectively). Spices are a common ingredient in many cuisines, and they are frequently coupled with vegetables and fish. Sugar is mostly used in beverages like tea and coffee, which are frequently brought along on fishing trips. In this study, fishing households consume fewer vegetables than agricultural households (Aweke *et al.* 2020). This disparity is most likely related to differences in availability; agricultural households often have more access to a wider variety of vegetables, many of which are grown on their own farms. Water spinach is the most popular vegetable among fishing households, while moringa is more common in farming communities. A similar tendency explains the low consumption of nuts and milk, which makes up only 13% and 3% of the diet. Many fishers fall into the "food insufficient" and "food insecure" categories, indicating limited access to diversified food sources other than fish (Ismah *et al.* 2020; Mustafa *et al.* 2020).

Food Security Status

The analysis found that the average Food Consumption Score (FCS) was 35.77, with 44% of households scoring >35, indicating food security, and the remaining 56% classed as food insecure (Table 3). This result is lower than that of previous finding (Nyangasa *et al.* 2019) on Unguja Island, located on Africa's east coast, where approximately 65% of households exhibited poor food consumption (food insecurity), 32% experienced severe food insecurity, and only 40% achieved food security, which was largely attributed to higher educational levels. Furthermore, the percentage of food security in this study is lower than findings from Indonesia reported by

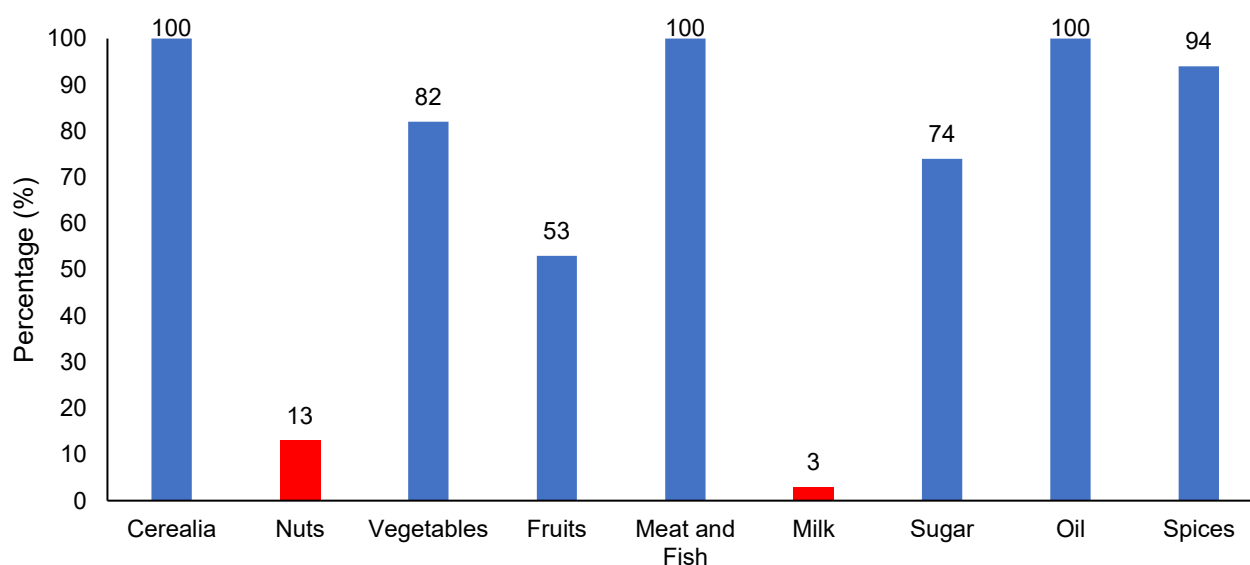


Figure 1 Food consumption patterns of fisher households.

Delly *et al.* (2019) in Sukajaya Lempasing Village, Teluk Pandan Sub-district, Pesawaran District, Lampung, where most fisher households were classified as food insecure, with a percentage reaching 68.63%.

The high rate of food insecurity in fisher households is primarily due to their limited dietary diversification. Rice, vegetables, and fish are the most consumed foods daily, whereas fruits, poultry, meat, and milk are typically held for special occasions or holidays. Many households believe their basic daily diet is acceptable, which promotes these restrictive dietary practices. This lack of diversity in food consumption has a substantial impact on the large share of food insecure households.

Factors Affecting Food Security

Binary regression analysis was used to determine which independent variables influence the dependent variable, food security level (Masha *et al.* 2023). Table 4 displays the binary regression findings, showing the effect of the independent variables' odds ratio values on food security levels. The Likelihood Ratio Chi-Square value is 21.22, and the significance level (p -value) is 0.003, which is less than 0.05. This means that, at the 5% significance level, there is sufficient evidence to imply that at least one independent variable has a substantial effect on the dependent variable. Furthermore, the pseudo- R -Square value (Coefficient of Determination) of 0.2007 suggests that the independent variables in this model account for 20.07% of the variation in food security levels.

The study discovered three independent variables that had a significant impact on food security: household education, vessel assets, and home garden ownership. Household education has a significant positive link with food security (p -value = 0.047, α = 0.05). This validates hypothesis (H_1) and shows that higher education levels improve food security for fisher households. The odds ratio of 1.243 indicates that

fishermen with higher education levels are 1.243 times more likely to attain food security than those with lower education level. At the study site, fisher households have an average education level equivalent to elementary school graduation. Higher education level can help fishers learn more about successful fishing practices and financial management, resulting in improved household food security and long-term sustainability. These results highlight the importance of the household head's education in determining the family's food security status. Household heads with higher education have a greater knowledge base, promoting food security and financial stability (Gebre *et al.* 2023; Khan *et al.* 2021).

The boat asset variable has a substantial impact on the food security of fisher households (p -value = 0.004 at α = 1% significance level). This finding supports the concept that boat ownership affects the food security status of fisher households. The odds ratio of 7.6082 suggests that fishermen with boats are 7.6 times more likely to attain food security than those without. As stated in the respondent characteristics, most fishermen in the study area do not own boats, making boat ownership an important element in determining food security levels. This result is consistent with those of Kariyam & Hanani (2020), that owning productive assets, such as boats that support primary livelihoods, plays an important role in improving household food security. Boat ownership is associated with higher income levels, which improves access to adequate food for their families.

The home garden asset variable has a p -value of 0.041, showing significance at the α = 5% level and a positive relationship with food security. This finding confirms the premise (accepting H_1 and rejecting H_0) that yard ownership affects food security for fisher households. The odds ratio of 16.021 indicates that fisherman who have home gardens are 16.021 times more likely to attain food security than those who don't.

Table 3 Food security status

Food security level	Food consumption score (FCS)	Total	Percentage (%)
Food secure	>35	34	44
Food insecure	<35	43	56
Total		77	100

Table 4 Binary logistic regression analysis results

Variable	Coefficient sign	Coefficient regression	p -Value	Odd ratio
Age	+	0.003	0.919	1.003
Education	+	0.217	0.047**	1.243
Fishery household income (FHI)	+	0.008	0.730	1.008
Number of fishers household member (FHM)	-	-0.249	0.331	0.779
BA	+	2.029	0.004*	7.6082
CRD	+	0.955	0.170	2.599
HGA	+	2.773	0.041**	16.021
Constant (Intercept)	-	-2.356	0.247	
Log likelihood	-42.23	LR Chi-Square		21.22
Prob > Chi-square	0.003	Pseudo R ²		0.2007

Notes: *significant at α = 1%, **significant at α = 5%.

Although just a few fishermen in the study region have home gardens, they provide for their families' food needs. One fisherman described picking and eating fruits like bananas and papayas from their yard. These fruits are common in Madura's traditional home gardens and are usually consumed by the family or sold at local markets (Setiani *et al.* 2022a). According to Salman *et al.* (2023), home gardens provide households with access to a range of foods, so greatly contributing to food security. Similarly, Lal (2020) stated that household gardens have an important part in improving health and well-being, which are required for food security.

CONCLUSIONS

Fishing households in Banyu Sangkah Village, Tanjung Bumi Subdistrict, Bangkalan Regency, rely on fish catches for their primary source of income. This reliance creates insecure food security because fish catches are heavily impacted by weather factors. Their meals are mainly based on rice and fish, with little milk, nuts, and fruits. According to the FCS, 56% of fishing households are food insecure, indicating the need for initiatives to improve their food security. The study finds education level, boat ownership, and home garden ownership as important factors impacting food security. Higher education encourages better financial management and fishing methods, but having a boat or a home garden expands revenue prospects and provides access to alternative food sources.

This research conclusion makes three policy recommendations to the Bangkalan regency government and fisheries authorities. First, because boat ownership immediately increases income stability, we propose subsidies or a low-interest loan scheme. Second, expand the home garden program for fishery households. The final option is a non-formal financial management education program aimed at household heads with low education levels, as this group frequently lacks access to standard financial education resources. The fact that this study only included fishing households in one location may have an impact on generalizability. Future research should be conducted in different places to confirm these findings.

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