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Assessment of Household Food Security of Fishermen Households in Tanjung Bumi Sub-District, Bangkalan

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ABSTRACT

Food security in coastal areas presents is a significant challenge for fishing communities, which are particularly vulnerable to fluctuations in fish catches and persistent poverty. The high dependence on fish harvest often renders the food security of fisher households unstable. This study aims to: (1) identify the food consumption patterns of fishermen (2) evaluate the food security status of fisher households, and (3) analyze the factors influencing their food security. This research employs a quantitative descriptive approach, involving 77 respondents selected through simple random sampling. Using a structured questionnaire, fishermen were interviewed about the types of food they consumed over the past seven days. Data were analyzed using the Food consumption score (FCS) to assess food security status, while binary logistic regression was applied to identify the factors affecting food security. The results indicate that all of the household consumes rice, fish and oil; however, milk consumption is notably lacking. The average of FCS is 35.77 and more than a half of fisher household (56%) experience food insecurity. Key factors significantly influencing food security include education level of the household head, ownership of boat assets, and the availability of home gardens.

Keywords: *Bangkalan, Binary logistic regression, FCS, Food security, Fishery households.*

INTRODUCTION

Food security remain critical issue for many nations, particularly in developing countries (Schleifer & Sun, 2020). It underpins food self-sufficiency and community well-being, highlighting it's importance as a global priority (Manikas et al., 2023). Moreover, Food security is directly aligned with sustainable development goal (SDG) 2, which aims to eradicate hunger and ensure global food security by 2030 (Jubayer et al., 2023; Malec et al., 2024). Coastal areas worldwide face unique challenges in achieving food security, with complicated effort to alleviate poverty. Globally, over than 2.37 billion people experience moderate to severe food insecurity, with a significant proportion residing in vulnerable coastal regions. Furthermore, more than 820 million individuals worldwide continue to live under conditions of chronic hunger (FAO, IFAD, UNICEF, WFP, 2021).

The fisheries sector plays a vital role in food security and poverty (Béné et al., 2016), particularly as it provides a critical source of animal protein and essential nutrition

for millions people worldwide (Lauria et al., 2018). Food security is crucial for countries with large populations, such as Indonesia. As the world's largest archipelago state, Indonesia rank as the second largest producer of marine fish globally (FAO, 2018). According to FAO (2018), over than six million Indonesians are engaged in fisheries and aquaculture, with approximately 95% of country's fisheries production attributed to small-scale fishers. Food insecurity is prevalent in vulnerable areas, including in 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 population of 1.047 million, with 190,940 household still classified as living below poverty (Badan Pusat Statistik, 2023; BPS Kab Bangkalan, 2024b). According to the 2016 FSVA, Bangkalan Regency is categorized as a food insecure area, with a vulnerability level of 2.85% (Triwindiyanti et al., 2018). Additionally, this regency is the second largest producing fish on Madura Island, which a total catch is 26,676 tons in 2022 (DKP Jawa Timur, 2022). Environment factors such as rainfall variability, water temperature and drought are significantly impact on fishing activities (Rakib et al., 2018). These factors have the potential to influence the resilience and poverty of fishing households.

Small-scale fisheries represent a significant source of employment in the marine sector, accounting for 90% of all fishermen globally and serving as a primary source of income for local communities (FAO & WorldFish, 2023). The Tanjung Bumi sub-district is located on the northern coast of Madura Island in Bangkalan, has a population of 55,264 people (BPS Kab Bangkalan, 2023). This region plays a crucial role in the fisheries sector,

with 1,321 individuals engaged as fishermen. However, the northern coastal areas of the Java Sea, including Tanjung Bumi, face persistent food insecurity, larger driven by the prevalent of poverty within the communities (BPS Kab Bangkalan, 2024a). The heavy reliance on unpredictable fishing yields raises concern about adequacy of catches to meet daily household needs (Lussy et al., 2023). Such uncertainties directly affect household food security, highlighting the needs to assess food security status of fisher households, and identify its determinants. This information is essential to inform interventions and policy development, aimed at improving their livelihoods and resilience.

Previous research on food security in Bangkalan, utilizing the Household Dietary Diversity Score (HDDS) and focusing on maize farmers, was conducted by Setiani et al. (2024). Similarly, Wijayanti. (2021), highlighted the significant potential of dryland agriculture to support food security through superior commodities such as corn, soybeans, and peanuts. However, to date, no studies have specifically examined food security in fishermen's households in Bangkalan Regency, particularly using the Food Consumption Score (FCS) analysis. This gap underscores the relevance and conducting research on food security among coastal fishermen one of the villages within Tanjung Bumi sub-district, Bangkalan Regency. Accordingly, this study aims to: (1) identify food the consumption patterns of fishermen, (2) assess the food security levels of fishermen's households, and (3) analyze the factors influencing food security of fishermen households.

RESEARCH METHODS

Data Collection

The study was conducted in Banyu Sangkah Village, Tanjung Bumi Subdistrict, Bangkalan Regency, Madura Island. The study site was selected through a multi-stage process. First, Bangkalan Regency was chosen based on data from the Department of Marine Affairs and Fisheries, which identified Bangkalan as the second-largest producer of fish on Madura Island, with a production volume of 26,676 tons in 2022 (DKP Jawa Timur, 2022). Next, Tanjung Bumi Subdistrict was randomly selected from 10 coastal subdistricts on Madura Island (DPKP Jawa Timur, 2016). Finally, Banyu Sangkah Village was purposively selected due to its proximity to a fish auction site and the predominance of fishermen among its resident.

Data collection was carried out from August to October 2024. The sample size was determined following logistic regression analysis guidelines from previous studies (Hu et al., 2021; Setiani et al., 2024), which recommended of 10 times the number of independent variables. With seventh independent variables in this study (see table 2). the minimum required sample size was 70. However, 77 samples were collected, exceeding this threshold. Primary data were gathered through questionnaires and in-depth interviews, which included detailed questions about food consumption over the last seven days. The responses were categorized into nine food groups based on the FCS framework (Gonella et al., 2022).

Data Analysis

This study employs three analytical methods: descriptive analysis, FCS analysis and binary logistic regression analysis. Descriptive analysis provides an overview of the the

consumption levels of nine food categories among fisher households, offering insights into their dietary patterns. To assess food security status, the FCS formula is applied as follows:

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

In this formula, y_i represents food groups assigned specific weights, as outlined in Table 1, while f_i indicates the frequency of consumption of each food group over the past seven days. The calculated of FCS values are then categorized to reflect household food security status. Households are classified as poor or food insecure if FCS ≤ 35, and as acceptable or Food Secure if FCS > 35 (Adeoye et al., 2022; Danso-Abbeam et al., 2022).

Table 1. Food types FCS

Food types/items	Food group	Weight
Rice (Comed Rice, Porridge), bread, and other cereals. Cassava, potatoes, and sweet potatoes, other root vegetables.	Staple Food	2
Peas, peanuts, cashews and other nuts	Nuts	3
Vegetables and leaves	Vegetables	1
Fruit	Fruit	1
Beef, mutton, poultry meat, eggs and 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)

Further analysis was performed to identify the factors influencing the food security of fisher households using the binary logistic regression method, with data analyzed in STATA software. The model, adapted and modified from Masha et al. (2023), is represented as follows:

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

Where:

Y	=	food security status; 1 if food secure; 0 if otherwise
P	=	the desired probability,
α	=	the intercept term,
β1-β7	=	the regression coefficients.
AGE	=	age of the fisherman (years old)
EDU	=	education level represents the total year of education by fisherman; 0 if no school/illiteracy; 6 if finished elementary school; 9 if finished junior school; 12 if finished senior high school; 16 if graduates 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 influence on the independent variables on food security of fishermen

H_1: There is a significant influence on the independent variables on food security in fishermen.

RESULTS AND DISCUSSION

Respondent characteristics

Table 2 presents the descriptive statistics of the fishermen surveyed in the study area. The majority of respondents (64%) are classified as adults, with an average age of 43 years. According to (Lamane et al., 2020), adult fishermen are in their optimal physical condition, enabling them to actively participate in fishing activities and meet their families' needs.

Table 2 Descriptive statistics

Independent Variable	Mean	Std Dev
AGE	43.467	9.946
EDU	5.896	3.458
FHI	10,463	12,818
FHM	3.662	1.131
BA	0.350	0.480
CRD	0.623	0.487
HGA	0.051	0.223

Source: Primary Data Processed, 2024

In terms of education, more than half of the respondents (52%) had only completed elementary school. The average level of education was 5.90 years, with a standard deviation of 3.46 years, indicating a generally low level of educational attainment among fishermen. This finding aligns with Mongabay (2023) which reported that 80% of small-scale fishermen have low educational levels (below junior high school), adversely affecting the regeneration of the fishing community.

The average household income is 10,463 million IDR per month with a large standard deviation suggesting substantial income variability across fishing households. This variability due to the type of fishermen, where some work as crew members and others are boat owners. Crew members only receive income from a share of the catch, while boat owners earn income from leasing their boats. Consistent with the findings of Hidayati and Widayatun (2021), the income of fishermen in coastal Sumatra is predominantly derived from capture fisheries, which exhibit fluctuations over the years.

The majority of fisher households (81%) consist of 1 to 4 family members, with an average household size of 3.662 individuals. This figure is lower than the average household size of fisheries households in Indramayu, North Java, which ranges from 3 to 5 members (Firdaus & Triyanti, 2017). Regarding boat ownership, 39% of respondents own a boat, often referred to as *juragan*. According to Agvitasari (2022) fishermen can experience vertical social mobility, transitioning from crew members to *juragan*, which signifies a change in their socioeconomic status.

More than a half (62.3%) of respondents were have access on credit. *Juragan* typically access credit for capital needs related to their vessels, such as purchasing a new boat or other capital-related expenses. In contrast, crew members generally access credit

for consumption purposes, often borrowing from the boat owners to meet their family's needs. In terms of home garden ownership, only 5% of respondents reported owning a home garden. Coastal areas are typically densely populated, which likely contributes to the low prevalence of home garden ownership. Among fishery households with home gardens, some utilize the plants, particularly fruit-bearing ones, as a source of daily food.

The majority of fishermen in the study area depend on their catch as their primary source of livelihood. Fishing activities in this village are heavily influenced by weather and climate conditions, leading to frequent uncertainties in their catches. The fishermen embody a spirit reflected in the phrase, "Afraid of hunger, brave enough to face death," which encapsulates their willingness to take extreme risks, even at the cost of their lives, to avoid subjecting their families to hunger. During periods of strong waves, fishing activities are temporarily suspended. However, once the weather calms, even slightly, they return to the sea to meet their daily needs.

Food Consumption Patterns

Understanding food consumption patterns is essential for analyzing people's dietary habits and preferences in meeting their nutritional needs. At the study site, fishermen typically go to sea in the afternoon and return home in the morning or evening. Regarding food consumption, similar to fishermen in Kutai Kartanegara (Marliza, 2023) and East Nusa Tenggara (Therik, 2008), they bring prepared meals as part of their cultural practices.

Figure 1 illustrates the types of food consumed by fisher households. Cereals, fish, and oil were the most consumed food items, each at 100%. consumed cereals in various forms, such as white rice or a mixture of rice and corn, a common dietary practice among

the Madurese ethnic (Setiani et al., 2022b). The high consumption of cereals is influenced by cultural factors, as rice is the staple food of the Indonesian people and is considered incomplete without rice.

The consumption levels of fish and oil reach 100%, reflecting both the availability of these resources and a cultural preference for fried foods. Fish is consistently accessible as a food source due to the frequent fishing activities of fishermen. Beyond selling their catch, each crew member receives a share of the fish after each trip. This share is primarily consumed by the household, although it is occasionally sold. One respondent mentioned that while they sometimes feel bored with eating fish, it remains the most readily available and cost-free option, leading to its continued consumption. Fish is typically prepared by frying, as respondents reported a preference for the taste of fried fish over boiled fish. This preference also accounts for the high consumption 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).
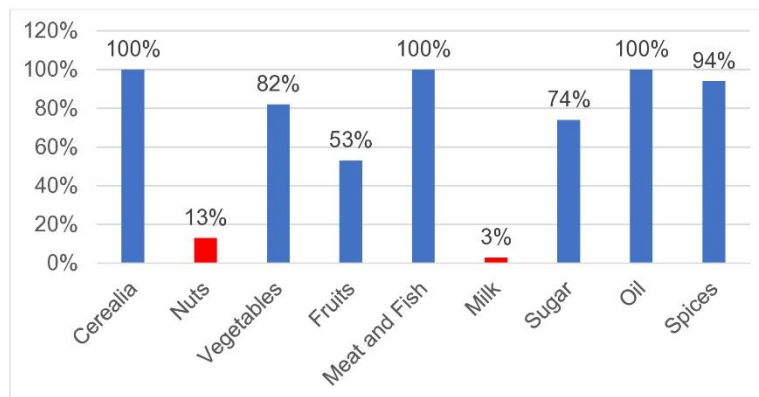

Figure 1. Food Consumption Patterns of Fisher Households

Source: Primary Data Processed, 2024

The consumption levels of spices, vegetables, and sugar are relatively high, at 94%, 82%, and 74%, respectively. Spices are a staple in various dishes and are often paired with vegetables and fish. Sugar is primarily consumed in beverages such as tea or coffee, which are commonly brought along during fishing trips. Vegetable consumption among fishing households in this study is lower compared to farming households (Aweke et al., 2020). This disparity is likely due to differences in availability; farming households typically have greater access to a wider variety of vegetables, often sourced from their own production. Among fishing households, water spinach is the most commonly consumed vegetable, whereas moringa is more prevalent among farming households. A similar pattern explains the low consumption of legumes, which account for only 13% of the diet., most fishers are in the "food insufficient" and "food insecure" groups, indicating limited access to diverse food sources other than fish (Ismah et al., 2020; Mustafa et al., 2020).

Food Security Status

The analysis revealed that the average Food Consumption Score (FCS) was 35.77, with 44% of households scoring >35, placing them in the food secure category, while the remaining 56% were classified as food insecure. This result is lower than findings from previous research by Nyangasa et al. (2019) on Unguja Island, located on the east coast of Africa, where approximately 65% of households exhibited poor food consumption (food insecure), 32% experienced severe food insecurity, and only 40% of households achieved food security, which was largely attributed to higher education levels. Furthermore, the percentage of food security in this study is also lower than findings from Indonesia reported by Delly et al. (2019) in Sukajaya Lempasing Village, Teluk Pandan

Sub-district, Pesawaran District, Lampung, where the majority of fisher households were categorized as food insecure, with the percentage reaching 68.63%.

Table 3. Food Security Status

Food Security Level	FCS	Total	Percentage%
Food secure	>35	34	44
Food insecurity	<35	43	56
Total		77	100

Source: Primary Data Processed, 2024

The high prevalence of food insecurity among fisher households is predominantly attributed to their limited dietary diversity. Daily consumption is primarily centered on staple foods such as rice, vegetables, and fish, while other food groups, including fruits, poultry, beef, and milk, are generally reserved for holidays or special occasions. Many households perceive their basic daily diet as adequate, which further reinforces these restricted dietary patterns. This lack of diversity in food consumption significantly contributes to the large proportion of households classified as food insecure.

Factors Affecting Food Security

Binary regression analysis was employed to identify the independent variables that influence the dependent variable, food security level (Masha et al., 2023). The results of the binary regression are presented in Table 5, which demonstrate the effect of the odds ratio values of the independent variables on food security levels. The Likelihood Ratio Chi-Square value is 21.22, with a significance level (p-value) of 0.003, which is less than 0.05. This indicates that, at the 5% significance level, there is sufficient evidence to suggest that at least one independent variable significantly influences the dependent

variable. Furthermore, the Pseudo R-Square value (Coefficient of Determination) of 0.2007 indicates that the independent variables in this model explain 20.07% of the variation in food security levels.

Table 4. Binary Logistic Regression Analysis Results

Variables	Coefficients Sign	Coefficients Regression	p-value	Odds Ratio
AGE	+	0.003	0.919	1.003
EDU	+	0.217	0.047**	1.243
FHI	+	0.008	0.730	1.008
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
Constan	-	-2.356	0.247	0.094
Log likelihood	-42.23	LR Chi-Square		21.22
Prob > Chi-Square	0.003	Pseudo R2		0.2007

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

Source: Primary Data Processed, 2024

The study identified three independent variables that significantly influence food security: household education, vessel assets, and home garden ownership. Household education has a p-value of 0.047, is significant at the 5% level (α = 0.05), indicating a positive correlation with food security. This supports the hypothesis (H_1), and demonstrates that higher education levels improve the food security status of fisher

households. The odds ratio of 1.243 suggests that fishermen with higher education levels are 1.243 times more likely to achieve food security than those with lower education levels. At the study site, the average education level of fisher households is equivalent to elementary school graduation. Higher education levels can improve fishers' knowledge of effective fishing techniques and financial management, contributing to better household food security and long-term sustainability. These findings emphasize the critical role of the household head's education in determining the family's food security status. Household heads with higher education tend to possess broader knowledge, which supports improved food security and financial stability (Gebre et al., 2023; Khan et al., 2021).

The boat asset variable significantly influences the food security of fisher households, with a p-value of 0.004 at the α = 1% significance level. This finding supports the hypothesis that boat ownership affects the food security status of fisher households. The odds ratio of 7.6082 indicates that fishermen who own boats are 7.6 times more likely to achieve food security compared to those without boats. As described in the respondent characteristics, most fishermen in the study area do not own boats, making boat ownership a critical factor in determining food security levels. This result aligns with the findings of Kariyam & Hanani. (2020), who emphasized that the ownership of productive assets, including boats that support primary livelihoods, plays a significant role in enhancing household food security. Boat ownership is associated with higher income levels, which improve access to adequate food for their families.

The home garden asset variable has a p-value of 0.041, indicating significance at the α = 5% level and a positive correlation with food security. This finding supports the

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