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Economic returns and constraints of traditional fish smoking in North Buton District of Southeast Sulawesi

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Abstract. Fish smoking is a method of preserving fish using smoke from burning coconut shells or wood charcoal. This study aimed to assess the economic returns from traditional fish smoking, examine its contribution to the total household income, and identify the constraints it is facing. The study was undertaken in Malalanda Village, Kulisusu Sub-district, North Buton District. The data collection was carried out in July-September 2019. Data and information were collected from ten smoked fish producers living in the village. Cost and returns analysis and descriptive statistics were used to analyse the data. Study results showed that the monthly household income of smoked fish producers was IDR10,930,201, consisting of IDR8,515,505 from fishing and fish smoking, and IDR2,414,696 from selling foods. The contribution of fishing and fish smoking to the total household income was 78.0 percent. Traditional fish smoking has some constraints related to processing technology, handling practices, and labour work. Traditional fish smoking provides a significant contribution to household income, so there is a need to improve the processing method and working environment to enhance the product quality and safeguard women producers' health.

1. Introduction

Preservation of fishes is a crucial aspect of the coastal community in Indonesia. Due to the abundance of catches compared to market demand, lack of refrigerators, and seasonality of fishing operation due to weather conditions, fish preservation is an essential part of artisanal fisheries [1]. Smoking is a common technique for fish preservation since time immemorial since it is easy to apply using local resources and has many advantages. Fish smoking lengthens shelf-life, strengthens flavour, and enable more uses in various dishes [2]. It minimizes waste during the bumper season and enables storage when the catches are less. It improves the availability of protein to people in all seasons and facilitates packing, transporting, and marketing of fish [2]. Thus, traditional smoking emerged from the urgent necessity to preserve fish, minimize fish loss and waste, and earn income [3]. For these reasons, fish smoking has been widely practiced in coastal areas in Indonesia for domestic needs and commercial purposes.

Fish smoking is a method of preserving/processing fish using smoke from burning coconut shells or wood charcoal [4]. Traditional fish smoking is carried out using kilns which are simple in design and construction. These kilns are basically an open fire where the fish are placed above it on a grill [3]. Traditional fish smoking suffers from a lack of mechanisms to control fire temperature and smoke production, which can lead to decreased production and quality of the smoked fish [1]. It also requires



a large amount of firewood and involves the release of polycyclic aromatic hydrocarbons (PAHs) [2,5], which is hazardous to human health.

Tuna species is the first leading commodity in the fisheries sector in Southeast Sulawesi [6]. Smoking of tuna and skipjack tuna is especially popular due to their availability and vast consumption among the coastal households. Women usually perform tuna and skipjack tuna smoking in coastal villages through wet hot smoking [7]. Wet hot smoking usually requires several hours to finish, and the shelf-life is limited to 1-3 days. Tuna species are regarded as delicious and nutritious fish, so smoked tuna forms an important traditional diet among households in the coastal community. Smoked tuna can be consumed directly without additional heat treatment, or cooked again into various dishes.

Despite the high demand for smoked fish and the potential of fish smoking to increase household income, fish smoking has not received sufficient attention yet. Several studies have been done to find out net returns from fish smoking [8-11]. However, little is known about its contribution to the total household income of smoked fish producers and the constraints it has been facing. Such information on economic returns and constraints is crucial to understand the welfare level of producers' households and the prospect and sustainability of fish smoking operations. This study was conducted to assess the economic returns of traditional fish smoking, examine its contribution to the total household income, and identify the constraints it is facing.

2. Materials and methods

The study was undertaken in Malalanda village, Kulisusu subdistrict, North Buton district. The village was purposively selected because the traditional fish smoking had long been done in the village, and it supplied the smoked fish to consumers in the district capital. Besides, the fresh fish processed to be smoked was obtained from their catches. All ten smoked fish producers existing in the village were taken as respondents. An interview method based on questionnaires was used to collect data and information. Variables collected through the questionnaires included cost and prices of input and output in all sources of income, namely, fishing, fish smoking, and food selling. Calculation of costs and returns from fishing and fish smoking was combined since most fishermen's catches were used as raw materials for fish smoking. Data were analysed using cost and returns analysis [12-14] and descriptive statistics.

3. Results and discussion

3.1. Socioeconomic characteristics of respondents

The age of respondents was 41 years on average. This average age implies that all women producers were in their productive ages. Level of education was from elementary school to senior high school, with the average length of education being nine years, or until completing junior high school. The average household size was four persons. The length of experience of doing fish smoking was 7.1 years on average. This average length of involvement implied that most respondents already had sufficient experience in fish smoking. The length of experience might also reflect respondents' ability to sustain the livelihoods amidst such challenges as raw material procurement, processing, and marketing.

3.2. Economic returns from fishing and fish smoking

Table 1 shows household income from fishing and fish smoking. The total variable cost amounted to IDR3,726,500 per month or 97.6 percent of the total cost, and total fixed cost accounted for IDR90,496 per month or 2.4 percent of the total cost. The first and second smallest variable costs were for market retribution (IDR60,000) and plastic rope (IDR64,000), and the first and second highest variable costs were for gasoline used for fishing (IDR1,215,000) and fuelwood used in fish smoking (IDR1,205,000). Gasoline was used as fuel in fishing operation, whereas fuelwood was the most common material in traditional fish smoking. Fixed costs consisted of depreciation of tools and equipment used in fishing and fish smoking, namely, machete, knife, big bowl, basket, roasting iron,

box, boat, and boat engine. The simple street stalls used for selling smoked fish and associated foods were built and provided by the government, so they were not included in the cost.

Table 1. Household income from fishing and fish smoking (IDR/month)

Items	Value (IDR)	%
A. Variable cost		
- Single-use plastic bag	165,000	4.3
- Wood stick	300,000	7.9
- Fuelwood	1,205,000	31.6
- Plastic rope	64,500	1.7
- Ice	267,000	6.9
- Market retribution	60,000	1.6
- Transportation (ojek)	300,000	7.9
- Fuel	1,215,000	31.8
- Hand reel	77,000	2.0
- Fishing gear	75,000	2.0
- Total variable cost	3,726,500	97.6
B. Fixed cost		
- Depreciation	90,496	2.4
- Total fixed cost	90,496	2.4
C. Total cost	3,816,996	100.00
D. Returns		
- Revenue	12,332,500	
- Net returns (Revenue-Total Cost)	8,515,505	

The average revenue that each household generated from fishing and fish smoking was IDR12,332,500. This revenue was obtained from selling tuna and skipjack tuna in the form of fresh fish and smoked fish. Their prices fluctuated depending on some factors, such as the weather condition and fish supply. As Table 2 shows, the average prices of fresh tuna and skipjack tuna were IDR16,660 and IDR20,000 per kg, respectively. The average prices of smoked tuna and skipjack tuna were IDR30,000 and IDR25,000 per kg, respectively. The average production of fresh tuna and skipjack tuna by each respondent's household was 15 kg and 123 kg, respectively. Likewise, the average production of smoked tuna and skipjack tuna was 136.5 kg and 207 kg, respectively. Overall, the fresh fish production amounted to 138 kg and contributed to 22.0 percent of the total revenue. Production of smoked fish accounted for 3,435 kg and contributed to 78 percent of the total revenue.

If assumed that two or three persons in each household were involved in fishing and fish smoking, their monthly net returns were still higher than the minimum monthly wage prevailing in Southeast Sulawesi (IDR2,351,000 per person in 2019). The net returns were also higher than those reported in various studies [8-11]. Several reasons were responsible for these high net returns. Firstly, the calculation included net returns from two activities, namely, fishing and fish smoking. Secondly, producers used their fresh catches as raw material for fish smoking, which were not included in the cost calculation. Thirdly, family labours used in the fishing operation and fish smoking were not included in the cost calculation. Finally, simple street stalls used to sell smoked fish were provided by the local government. Among these factors, the use of family labour is particularly worth noting as both fishing and fish smoking are laborious and take considerable time.

Further analysis of the production and revenue details according to types of products and fish revealed some meaningful information (table 2). Firstly, 71.3 percent of the fish being caught was sold in the form of smoked fish. This result indicated the importance of fish smoking as a method of

preservation and a means of livelihood. This result agrees with the findings of other studies [9,15,16] that the fish smoking home industry is feasible and profitable. Secondly, 53.9 percent of the catches were skipjack tuna, and the remaining 46.1 percent was tuna. Thirdly, the price of fresh skipjack tuna was higher than that of fresh tuna, but the smoked tuna price was higher than that of smoked skipjack tuna. Finally, people preferred eating fresh skipjack tuna to fresh tuna and consumed more smoked tuna than fresh tuna.

Table 2. Average revenue according to types of product and fish

Types of product and fish	Amount Sold (Kg)	Price (IDR/kg)	Revenue (IDR)
1. Smoked fish	343.5		9,622,500
a. Skipjack tuna	136.5	25,000	3,412,500
b. Tuna	207.0	30,000	6,210,000
2. Fresh fish	138.0		2,710,000
a. Skipjack tuna	123.0	20,000	2,460,000
b. Tuna	15.0	16,665	250,000
Average	481.5		12,332,500

3.3. Income from other activities

Fishing and fish smoking were the main income-earning activities of the respondent households. Men exclusively did the former, while women only applied the later. Both livelihoods took considerable time to do. For example, women usually took the fresh catches to the market, brought home the unsold ones to be smoked, and sold the smoked fish again at the kiosk. Therefore, respondent households were no longer involved in agriculture and other types of livelihoods. However, they also sold other food usually consumed with the smoked fish, namely, *kasoami*, *buras*, aqua, key lime, tomato, shallot, and chili. *Soami* or *kasoami* is a local food made from cassava [17,18] and is consumed as a staple in several districts in the islands of Buton and Wakatobi [18,19]. In contrast, *buras* is a local delicacy made from rice cooked with coconut milk put inside a pouch of banana leaf. Selling these foods provided additional returns to the respondents (table 3).

Table 3. Average monthly net returns from selling other foods

Items	Cost (IDR)	Revenue (IDR)	Net returns (IDR)
<i>Soami</i>	1,343,832	2,250,000	906,168
<i>Buras</i>	1,065,972	1,620,000	554,028
Aqua	347,500	667,200	319,700
Key lime, tomato, shallot, and chili	460,200	1,095,000	634,800
Total	3,217,504	5,632,200	2,414,696

The amount of net returns from selling other foods was slightly higher than the amount of provincial minimum monthly wage of IDR2,351,000. This result implied that the net returns were high and could substantially contribute to the household income and food security. Moreover, selling foods supported the sale of smoked fish as they diversified the sold items and increased the chance for customers to come. In addition, *kasoami* and *buras* could be prepared in the kiosk while waiting for the customer, so basically, no additional time was spent by the producers. Increasing the kinds of food and items being sold could further improve the net returns from the business.

3.4. Total household income

The total household income per month of the smoked fish producers is presented in Table 4. Fishing and fish smoking provided 78 percent of the total income while selling other foods contributed 22 percent to the total income. The monthly income accounted for IDR10,930,201.

In addition to the provincial monthly minimum wage described above, the poverty line is often used to measure households' welfare. In this regard, given the average family size of four persons, the total household income of the respondents was much higher than the 2018 poverty line of IDR306,000 per capita per month in North Buton district. This result implied that the producers' households could fulfil their food and non-food basic needs. Food needs refer to the minimum daily requirement of calories, while non-food basic needs include a minimum requirement for household necessities such as education, health, clothing, and other basic individual needs.

Table 4. Total monthly income of smoked producers' households

No	Activities	Net returns (IDR)	%
1	Fishing and fish smoking	8,515,505	78.0
2	Selling other foods	2,414,696	22.0
Total household income		10,930,201	100.0

3.5. Constraints

While fish smoking has enormous potential for fish preservation and earning a living, several constraints should be addressed. These constraints are related to processing technology, handling practices, and labour work. Traditional processing technology for fish smoking is simple in design, in which the fish are put on a mesh above an open fire. This technique does not enable control over smoke production and fire temperature. It involves the use of fuelwood more than necessary, which can lead to forest depletion.

Concerning handling practices, there is a need for proper sanitation and hygiene practices during fresh fish processing into smoked fish, and during its display at the kiosk or in the market. There is a need to have sufficient food protection facilities to avoid chemical and microbiological contamination and to have clean and safe materials for wrapping. Proper sanitation and hygienic practices are essential for traditional fish smoking to respond more to food safety challenges.

The traditional method of fish smoking is laborious and the working environment is smoky, which exposed women producers to the health problem. In this respect, women producers need to have sufficient protection for their nose and mouth to cope with health risks as they inhale smoke fumes every day during the smoking process. Therefore, fish smoking kilns should be improved to make the process faster and easier and to reduce smoke emissions to a minimum. Improved fish smoking kilns and hygienic handling practices will reduce the potential release of polycyclic aromatic hydrocarbons (PAHs), which is known to be carcinogenic and harmful to human health. The local government and stakeholders can provide assistance, training, and empowerment activities to enable producers to adopt safe and hygienic fish processing and smoking practices.

4. Conclusions

Smoked fish producers' households obtained their income from fishing and fish smoking, and from selling food. Household monthly income of smoked fish producers was IDR10,930,000, consisting of IDR8,515,505 from fishing and fish smoking, and IDR2,414,696 from selling foods. The contribution of fishing and fish smoking to the total household income was 78.0 percent, and the remaining 22.0 percent was from selling food. Fish smoking is a food preservation method that contributes significantly to household income and food security and produces smoked fish as a popular diet in the region. Traditional fish smoking has some constraints related to processing technology, handling practices, and labour work. The local government and stakeholders should take efforts to help improve processing technology, working environment, and handling practices through assistance, training, and other awareness creation activities.

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