

Factors affecting the small-scale fishermen welfare in Bontang, Indonesia

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Abstract. This study is designed to determine the welfare of small-scale fishermen with reference to traditional trap nets fisheries. In addition, it also identifies the factors that influence their welfare. The fishermen terms of trade (FTT) method and Tobit model were employed to obtain the desired objectives. The cross-sectional technique was applied to collect data from 100 small-scale fishermen. Results showed that the FTT index value was 1.61, indicating that most fishermen were sufficiently prosperous. Furthermore, education, experience, revenue, and cost variables were the significant determinants of small-scale fishermen welfare. The welfare of fishermen can be increased by providing necessary education and training facilitation, and incentive for enhancing fishing efforts.

Key Words: Bontang, fishermen terms of trade, Tobit model, traditional trap nets.

Introduction. Poverty is a significant problem in many countries. About 689 million people live in poverty worldwide, and almost 48% of the world's poverty rate is in rural areas. 62.2% of the world's poor work in agriculture (World Bank 2020; Susilo et al 2021). Capture fisheries and aquaculture are sectors that have contributed to food security and poverty reduction (FAO 2007; Heck et al 2007; Susilo et al 2019). Global fish production in 2018 attained 178.5 million tons. Of this, 54% originated from capture fisheries, providing 20.5 kg of fish per capita for the global population (FAO 2020). In low- and middle-income countries, it is said that almost 90% of families depend on fisheries activities for livelihood and income; however, this could be an exaggeration (Bene et al 2016).

Indonesia was one of the top seven marine capture producers that accounted for 6.71 million tons, or nearly 8 percent of the world's marine capture production in 2018 (FAO 2020). About 2.7 million people worked in 2019 as fishermen in marine and inland waters. Out of which, 3.7% came from East Kalimantan Province, providing 176000 tons of capture fisheries for Indonesia's capture fisheries production (Central Bureau of Statistics 2021). This production also provided economic value at USD 352 million (Central Bureau of Statistics 2021). As mentioned above, capture fisheries play a primary role in poverty alleviation, especially in the coastal area.

Indonesia also has a similar issue related to poverty. Poor people in Indonesia reached 25.14 million in 2019, and nearly 60.26% lived in rural and coastal areas (Statistics Indonesia 2020). Small-scale fishery households are still synonymous with poverty (Pranata 2019; Rinaldi et al 2019). Moreover, Bontang, one of the cities in East Kalimantan, also has an identical situation regarding poverty. Although Bontang contributes with nearly 12% to East Kalimantan capture fisheries production, with 1.912 households living as fishermen, there are still 7910 poor people in this city (Central Bureau of Statistics 2021).

The fishermen terms of trade (FTT) is one of the indicators in Indonesia that measures the welfare of fishermen. This indicator is introduced by The Ministry of Marine Affairs and Fisheries of the Republic of Indonesia to estimate the fishermen purchasing

power in meeting their routine needs. The advantage of FTT over the old indicator is that it simultaneously considers fishermen revenue and expenditure (Bidarkota & Crucini 2000; Anna et al 2019; Susilo et al 2021). Some studies related to FTT indicators to measure fishermen welfare have been conducted in Indonesia, by Guritno et al (2014), Anna et al (2019), Muzakir et al (2021). However, studies that focus on applying the FTT to fishermen welfare in the Bontang are limited. Following these findings, this study investigates the fishermen welfare as a proxy of poverty and determines factors influencing the fishermen welfare in Bontang, Indonesia.

Material and Method

Study area and data collection. The study focuses on small-scale fishermen welfare in Bontang, geographically stretched between 117°23' and 117°38' E and 0°01' and 0°12' N. This study area is included in East Kalimantan province, Indonesia. In 2020, Bontang's capture fisheries production was reported at 21200 tons, providing economic value at 84.3 million USD (Central Bureau of Statistics 2021). One of the dominant fishing gears used by small-scale fishermen are the traditional trap nets, with the local name being "belat". The survey was conducted from July to September 2021 by face-to-face interviews applying a questionnaire. 100 small-scale fishermen using traditional trap nets were selected from two sub-districts, including South Bontang and North Bontang.

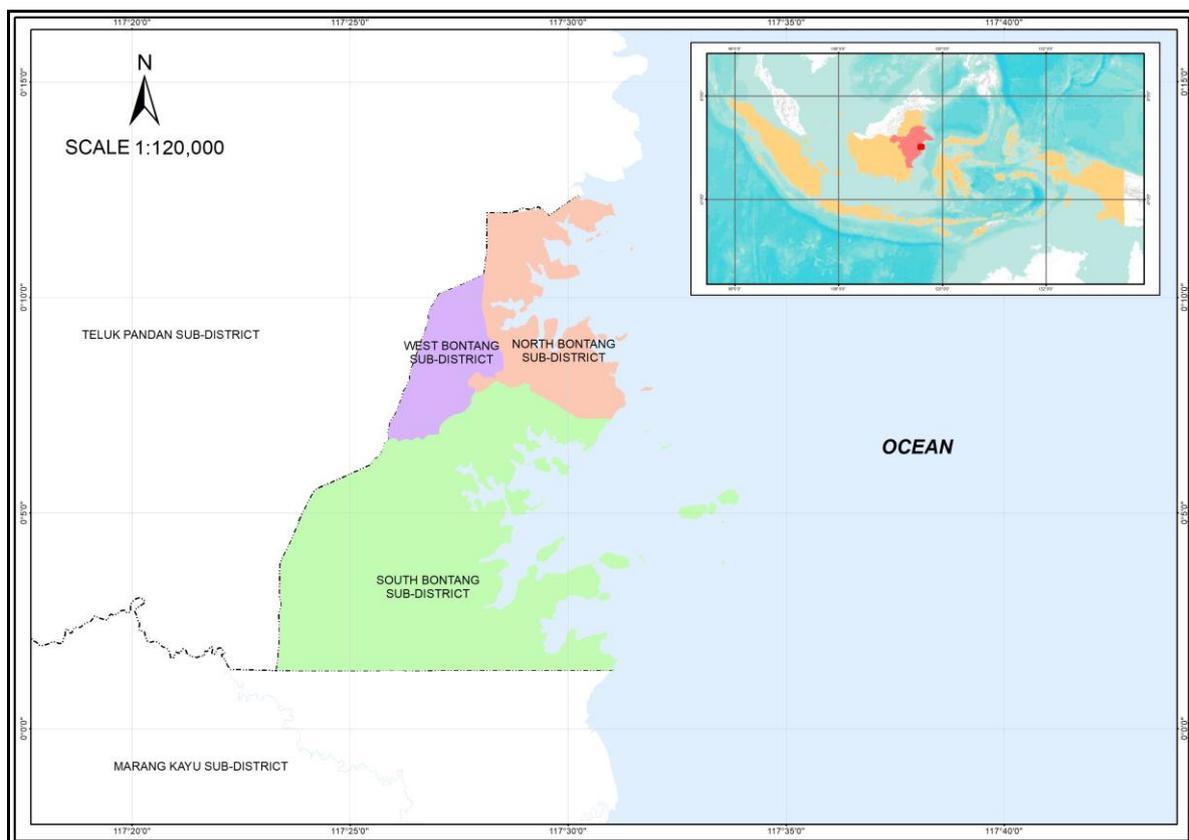


Figure 1. Study sites.

The fishermen terms of trade (FTT). FTT is an indicator measuring small-scale fishermen welfare by considering small-scale fishermen income and expenditure, simultaneously. In addition, FTT describes the small-scale fishermen purchasing power to meet their life necessities (Bidarkota & Crucini 2000). FTT denotes the ratio of the income obtained from catches using traditional trap nets and other sources to the expenditure, consisting of the operational cost of catching and the consumption needs. If

the FTT value is greater than or equal to one, fishermen are prosperous and vice versa. FTT is formulated as follows (Susilo et al 2021):

$$FTT = \frac{\sum_{i=1}^n P_{xi} Q_{xi} + \sum_{i=1}^n R_i}{\sum_{i=1}^n P_{yi} Q_{yi} + \sum_{i=1}^n C_i}$$

Where: FTT - fishermen terms of trade; P_{xi} - commodity price from catches using traditional traps; Q_{xi} - commodity quantity of catches; P_{yi} - input price from traditional traps operation; Q_{yi} - the input quantity of traditional traps operation; R_i - income from other sources; C_i - fishermen household expenditures.

Factors affecting small-scale fishermen welfare. The Tobit model is employed to determine the factors influencing small-scale fishermen welfare. The formula can be described as follows (Tobin 1958):

$$FTT_i^{Tobit} = X_i' \beta + e_i, \quad e_i \sim N(0, \sigma^2)$$

Where: FTT_i^{Tobit} - an unobserved continuous endogenous variable; X_i' - a vector of exogenous variables; β - a coefficient vector; e_i - an independently distributed error term expected to be normal with a zero mean and constant variance σ^2 ; i - individual in the sample. The observed FTT_i^{Tobit} variable can be formulated as follows:

$$FTT_i^{Tobit} = \begin{cases} X_i' \beta + e_i & \text{if } FTT_i^{Tobit} > 0, \\ 0 & \text{if } FTT_i^{Tobit} \leq 0. \end{cases}$$

The likelihood function used for Tobit model is the following:

$$L = \prod_{y_i=0} \left[1 - \Phi \left(\frac{x_i' \beta}{\sigma} \right) \right] \cdot \prod_{y_i>0} \frac{1}{\sigma} \phi \left(\frac{y_i - x_i' \beta}{\sigma} \right)$$

Where: Φ and ϕ - the distribution and density functions, respectively, of the standard normal variable; β - Tobit maximum vector likelihood estimates; σ - the standard error of the error term.

Descriptive statistics of the sampled data were performed, namely for the FTT index, age, education, family size, experience, fishing effort, revenue and cost.

Results and Discussion

Descriptive statistics. Table 1 shows the descriptive statistics of the sampled small-scale fishermen. The welfare of small-scale fishermen was mostly adequately prosperous, fact indicated by the mean actual FTT index of 1.63. It shows that the small-scale fishermen can fulfill their life necessities. The mean actual age of 39.48 years indicated that most small-scale fishermen were within the economic active labor force group. On average, small-scale fishermen actual mean education level was 6.98 years or primary school, indicating that their work does not require any educational qualification. Furthermore, the average family size of the respondents was three people per family, while the mean fishing experience was 17.01 years. Those imply that most of them are mature and have experience carrying out their work. Regarding the economic factors, small-scale fishermen revenue per trip ranged between 17.5 and 99.64 USD, with the mean of 31.11 USD. Meanwhile, the mean small-scale fishermen cost per trip was 6.94 USD, ranging between 4.5 and 8.57 USD.

Table 1

Descriptive statistic of the sampled small-scale fishermen

<i>Variables</i>	<i>Description</i>	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
	Dependent				
FTT index	Small-scale fishermen welfare indicator	1.63	0.6	1	3.76
	Independent				
	Fishermen demographics				
Age	The actual age of small-scale fishermen in years	42.84	10.54	22	80
Education	Formal education level of small-scale fishermen in years	6.98	2.66	0	16
Family size	Family size of small-scale fishermen	3.3	1.49	0	7
Experience	Number of years in small-scale fishermen experience	17.01	6.66	1	30
	Economic factors				
Fishing effort	The time used fishing using traditional trap nets	24.95	2.51	15	30
Revenue	The money obtained from fishing activities	31.11	16.3	17.5	99.64
Cost	The expenditures required to obtain fish in fishing activities	6.94	1.05	4.5	8.57

Fishermen terms of trade index. As can be observed from the results shown in Table 2, the actual mean small-scale fishermen revenue was valued at 8370 USD year⁻¹, including revenue of fishing activities using traditional trap nets (8322 USD) and revenue of non-fishing activities (48 USD). Moreover, the actual mean small-scale fishermen cost was valued at 5192 USD year⁻¹, including costs of fishing activities using traditional trap nets (3224 USD) and household expenses (1969 USD). Therefore, fishermen welfare using the FTT index was valued at 1.61, greater than 1, suggesting that most fishermen were sufficiently prosperous.

Table 2

Fishermen terms of trade estimation

<i>Description</i>	<i>Average (USD year⁻¹)</i>
Revenue of fishing activities using traditional trap nets	8322
Revenue of non-fishing activities	48
Costs of fishing activities using traditional trap nets	3224
Household expenses	1969
Fishermen terms of trade	1.61

Factors affecting the small-scale fishermen welfare. Table 3 displays the empirical estimate of the Tobit model. The FTT index is an endogenous variable defined as a proxy of small-scale fishermen welfare. Of 7 exogenous variables considered in the Tobit model, four variables influence the FTT index: education, experience, revenue, and cost variables. In contrast, three variables do not significantly affect the FTT index: age, family size, and fishing effort variables. The specification of the Tobit model provides a good fit of the model as indicated by the value of the Likelihood Ratio-Chi-Square test (134.11), statistically significant at 1% level.

Only education and experience variables in fishermen demographics were statistically significant at 1% and had a positive coefficient for the FTT index. The revenue variable had a significantly positive influence on the FTT index (1%) in terms of economic factors. Meanwhile, the cost variable was statistically significant at 1% and negative.

Table 3

Tobit model estimates of the FTT index

<i>Variables</i>	<i>Coefficient</i>	<i>Std. error</i>
Fishermen demographics		
Age (years)	-0.0022	0.0038
Education (years)	0.0522**	0.0126
Family size (number)	-0.0234	0.0229
Experience (years)	0.0172**	0.0062
Economic factors		
Fishing effort (trip month ⁻¹)	0.0182	0.0139
Revenue (USD trip ⁻¹ year ⁻¹)	0.0244**	0.0023
Cost (USD trip ⁻¹ year ⁻¹)	-0.2298**	0.0325
Constant	1.5315**	0.4435
Model diagnosis		
Log-likelihood	-23.9427	
LR Chi Square	134.11**	
Pseudo R ²	0.7369	
Observations	100	

Note: ** - indicates significance differences at $p < 0.01$.

As shown in Table 3, the estimated education coefficients have a positive statistical significant impact on the FTT index. It implies that small-scale fishermen with higher education levels tend to be more prosperous than those with lower education. Higher education level assists small-scale fishermen in obtaining knowledge of fishing techniques, causing their operational costs to be lower and obtaining better production. Generally, small-scale fishermen welfare is affected by an increased income. This finding is in line with Islam et al (2006), and Sukuno et al (2021), who recorded that fishermen income was influenced by education.

As expected, and corresponding to the literature (Sukuno et al 2021), experience has a positive and significant impact on fishermen income. It indicated that more years involved in fishing activities bring more success to the fishermen. It relates to improving the fishing skills, to manage fishing operations regarding reducing input costs and increasing fish production. Contrary to this finding, Anna et al (2019) reported that experience did not significantly influence the FTT index. This study argued that experience was not a guarantee that could influence an individual's success in his profession.

Additionally, revenue and cost variables were significantly linked with the small-scale fishermen welfare in terms of economic factors. The revenue variable was statistically significant at 1% and had a positive coefficient. It implies that small-scale fishermen with higher revenue had a better chance of improving welfare. This finding contradicts the study carried out by Anna et al (2019), in which the revenue variable had a significantly negative relationship with the FTT index, indicating that small-scale fishermen with higher revenue had a lower chance of increasing welfare.

Furthermore, the model exhibited a significant negative relationship between the cost variable and the FTT index. It demonstrates that small-scale fishermen who use a lower cost for fishing operations have a better chance of increasing welfare and vice versa. The finding is consistent with Lein & Setiawina (2018) and Sukono et al (2021), who reported that cost occurring in fishing activities has a relationship with fishermen welfare level.

Conclusions. This study contributes with knowledge regarding small-scale fishermen welfare by applying fishermen terms of trade and factors affecting these by employing the Tobit model. The findings of this study are essential for the local government in identifying the welfare level of small-scale fishermen, particularly those who use traditional trap nets, by recognizing factors that influence the welfare. Most of the findings are logically consistent with previous studies. Education, experience, and

revenue can improve the small-scale fishermen welfare. Conversely, the cost variable is an obstacle to welfare.

Results show that the FTT index value indicated that most small-scale fishermen are adequately prosperous. However, their welfare still depends on their education and work experience, particularly reducing fishing costs and increasing their income. The critical policy implications of these findings are that small-scale fishermen require substantial education and training facilitation relating to fishing techniques and skills by decision-makers, including government, private sectors, NGOs, and universities. Since the cost variable has a negative and significant effect on small-scale fishermen welfare, incentives for enhancing fishing efforts should be delivered by decision-makers to the small-scale fishermen to support improved fish productivity, indirectly raising small-scale fishermen welfare.

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Conflict of Interest. The authors declare no conflict of interest.

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