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# Determinants of Small-Scale Fishermen's Welfare in Waplau and Air Buaya Districts, Buru Regency, Indonesia: A Multiple Linear Regression Approach

**Wilda Fesanrey[1*], Muhammad Kasnir[2], Abdul Rauf[2], Hamsiah[2]**

[1] Doctor Candidate of Fisheries Science Program, University of Muslim Indonesia
[2] Department of Fisheries Science, University of Muslim Indonesia
[*]**Corresponding Author:** wildafesanrey.umi@gmail.com

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## ABSTRACT

Small-scale fishers play a vital role in Indonesia's coastal economy, yet their welfare remains vulnerable and poorly understood in eastern Indonesia. This study analyzes the determinants of small-scale fishermen's welfare in Waplau and Air Buaya Districts of Buru Regency based on 80 purposively selected respondents. Four variables—socio-cultural, economic, environmental, and institutional—were quantified using structured questionnaires and analyzed through multiple linear regression. Results show that environmental ($P < 0.001$) and socio-cultural factors ($P < 0.01$) significantly improve fishers' welfare, whereas economic and institutional variables are not statistically significant in partial tests. The model explains 54.78% of welfare variability (Adjusted $R^2 = 0.5237$). The findings highlight that improving environmental quality, alongside strengthening cultural and social embeddedness in fishing communities, is crucial for welfare enhancement. Policy actions should focus on sustainable marine resource protection and capacity-building to increase social resilience.

## INTRODUCTION

Maluku boasts abundant natural resources, both biological and non-biological, that are vital to the lives of its people. As an archipelagic province with 92.4% ocean area, 1,340 islands, and a coastline of 10,662 km, Maluku holds vast fisheries potential that should significantly contribute to the welfare of its coastal communities. However, the reality faced by most small-scale fishers remains far from prosperous. Buru Regency is one of the marine resource-rich regions where both demersal and pelagic fisheries could play a strategic role in improving community welfare

The welfare of small-scale fishers is strongly linked to poverty levels, particularly considering their dependence on natural resources and fluctuating marine conditions. Poverty in Indonesia is measured by the cost of fulfilling basic food and non-food needs, and inadequate income prevents fishers from meeting these necessities **(Mutia *et al.*, 2023; Pical & Rahman, 2025)**.

Welfare includes social, material, and spiritual aspects of life that enable individuals to meet their needs and achieve a secure and dignified existence **(Mokalu *et al.*, 2021)**. Although small-scale fishers are often perceived as living in a poverty trap, their challenges extend beyond income-related issues. Cultural norms, limited access to capital, and vulnerabilities to environmental change constrain livelihood improvements, especially among fishers with ≤5 GT vessels in Waplau and Air Buaya districts. According to Indonesian Law No. 45/2009, these small-scale fishers rely on simple fishing gear and traditional practices, which exposes them to higher livelihood risks.

While many studies have highlighted poverty and vulnerability among Indonesian small-scale fishers, specific empirical evidence from Maluku—particularly Buru Regency—remains limited. Most research in Eastern Indonesia focuses on resource utilization and catch productivity, rather than a holistic analysis of socio-cultural, economic, environmental, and institutional determinants of welfare **(Bene *et al.*, 2016; Ferrol-Schulte *et al.*, 2021)**.

Moreover, existing literature has not sufficiently explained why welfare outcomes remain poor despite resource abundance—a paradox that indicates underlying structural constraints such as governance shortcomings, limited livelihood assets, and exposure to environmental threats.

Therefore, this research addresses a critical knowledge gap by quantitatively examining multidimensional livelihood factors influencing fishers' welfare in a remote archipelagic context where data scarcity has hindered policy improvements.

## MATERIALS AND METHODS

### Location and time of research

This research was conducted in Buru Regency, Maluku Province, specifically in two coastal districts: Airbuaya and Waplau (Fig. 1). These areas were selected because the majority of their residents rely on small-scale capture fisheries as their primary livelihood, using traditional fishing gear and vessels ≤5 GT. Fieldwork was implemented from August 2024 to March 2025, covering both peak and low fishing seasons to capture livelihood variations in different environmental conditions.

Buru Regency represents a typical archipelagic rural fishery economy in Eastern Indonesia, surrounded by rich marine ecosystems yet facing socio-economic vulnerability. The fishing grounds in Airbuaya and Waplau are characterized by shallow coastal waters with high productivity influenced by seasonal monsoons and tidal patterns. However, these communities remain exposed to climate variability, limited fishery infrastructure and market access, and fluctuating resource abundance, which greatly influence the welfare outcomes of small-scale fishers.

Small-scale fishers in these districts operate within strong customary social structures that shape community cohesion and fishing traditions. At the same time, institutional support systems such as fishers' groups, cooperatives, and local governance

mechanisms are still developing, which may weaken their adaptive capacity. Thus, Buru Regency serves as a strategic case study to understand how environmental, socio-cultural, economic, and institutional factors interact in influencing livelihood welfare among small-scale fishers in archipelagic regions like Maluku.

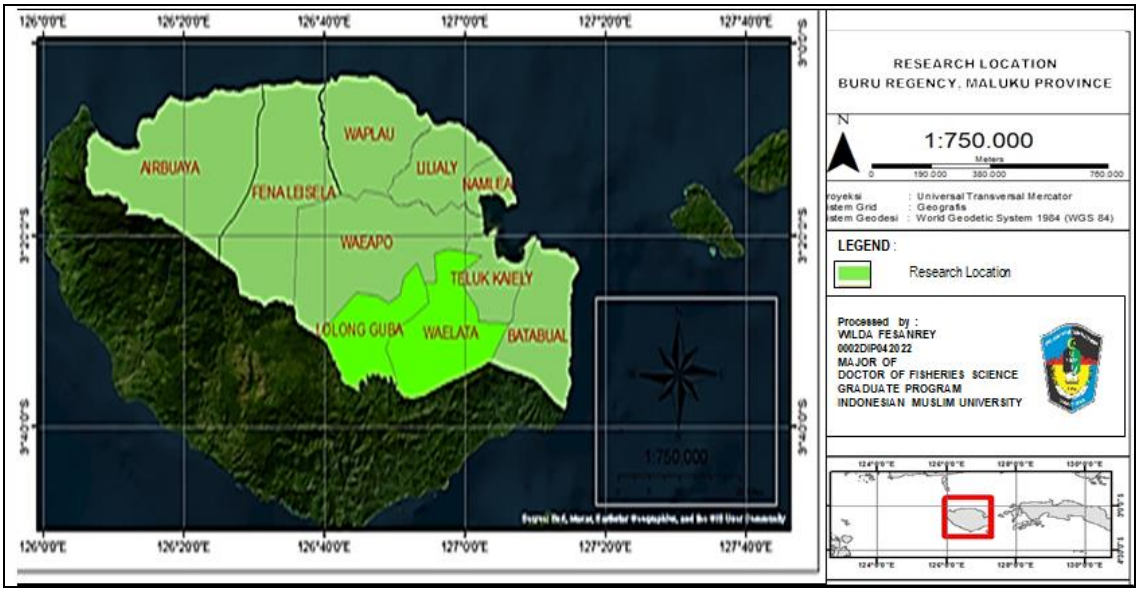


**Fig. 1**. Research location map

**Data types and sources**

The type of research used is quantitative. Quantitative research refers to data collection methods based on numbers or statistics related to multiple linear regression analysis. This research relies on scientific methods to explain the relationship between variables and is usually objective and systematic by combining primary and secondary data. According to **Siregar (2017)**, primary data are data collected directly by the researcher from the primary source or the place where the research object is conducted. Primary data are those collected directly through interviews, the use of questionnaires, field surveys, data collection, and documentation. Meanwhile, secondary data are information obtained from library books, related agencies, literature studies, and legislation.

**Population and sample**

The study population consists of small-scale fishers in Airbuaya and Waplau Districts whose livelihoods depend on fishing activities using vessels ≤5 GT or without vessels. Although the total population was relatively small (100 individuals), not all fishers were directly exposed to welfare-related vulnerabilities targeted by this study.

Therefore, purposive sampling was applied to ensure that respondents met inclusion criteria: (1) Active small-scale fishers, (2) directly involved in household income decisions, and (3) dependent on marine resources as the primary livelihood

source.

Although random sampling could reduce sampling bias, it may include respondents whose characteristics do not represent the study's objectives. Purposive sampling thus ensures validity of respondent selection for welfare assessment in a socio-economic context **(Sugiyono, 2012)**.

The Slovin formula was used to determine minimum sample size to maintain representativeness and avoid overgeneralization from too small a sample. Using a 5% margin of error yielded 80 respondents, which is statistically acceptable given the model's multivariate nature. Potential sampling bias may arise from subjective selection; therefore: (1) Respondents were verified through fisher groups and local institutional listings, and (2) cross-checks were performed with village officials to ensure correctness of livelihood status. These measures help maintain accuracy and minimize selection bias.

**Data collection techniques**

The respondent data collection technique used purposive sampling technique where respondents came from small fishermen in Buru Regency in 2 (two) sub-districts, namely Airbuaya Sub-district and Waplau Sub-district, selected based on those who received and were directly involved in the problem. Data collection was carried out through the use of interview methods using questionnaires, observations of research objects related to welfare problems in the field, then recorded and photographed by camera.

The data that will be observed using the above technique are as follows: Factors that influence welfare include economic, socio-cultural, environmental and institutional factors.

To ensure clarity of measurement and enable replicability, each independent and dependent variable was operationalized into measurable indicators using a five-point Likert scale. The operational definitions, indicators, and scoring system are presented in Table (1).

Before the full data collection process was conducted, the questionnaire instrument was pre-tested on a small subset of respondents to ensure clarity, reliability, and content validity of the measurement items. Enumerators involved in field data collection also received training to standardize interview procedures and minimize interviewer bias. All respondents were briefed about the study objectives and provided consent prior to participation. Each completed questionnaire was checked for completeness and consistency before being included in the analysis, ensuring that the dataset was accurate and ready for statistical testing.

**Table 1.** Operational definitions of independent (socio-cultural, economic, environmental, and institutional) and dependent (welfare) variables, including the measurement indicators and scoring scheme based on a five-point Likert scale

| Variable | Conceptual Definition | Indicators (Survey Items) | Measurement Scale | Coding/Score |
|---|---|---|---|---|
| Socio-Cultural (X1) | Social relations, norms, and cultural practices that support livelihood | 1) Participation in community groups; 2) Local knowledge in fishing; 3) Family labor contribution; 4) Social support network | Likert scale 1–5 | Higher score = stronger socio-cultural support |
| Economic (X2) | Economic capacity in sustaining household needs | 1) Monthly income stability; 2) Asset ownership; 3) Access to capital; 4) Alternative livelihoods | Likert scale 1–5 | Higher score = better economic condition |
| Environmental (X3) | Marine environmental quality affecting fishing activities | 1) Resource availability; 2) Water condition; 3) Weather–climate impact; 4) Distance to fishing grounds | Likert scale 1–5 | Higher score = more favorable environment |
| Institutional (X4) | Governance, services, and fisher group capacity | 1) Access to subsidy/support; 2) Fisher organization involvement; 3) Licensing compliance; 4) Policy assistance effectiveness | Likert scale 1–5 | Higher score = stronger institutional support |
| Welfare (Y) | Level of fulfillment of economic, social, and basic household needs | 1) Household expenditure adequacy; 2) Housing condition; 3) Education access; 4) Food security | Likert scale 1–5 | Higher score = better welfare |

**Data analysis**

Socio-cultural, economic, environmental and institutional factors which affect the welfare of fishermen are used for assessing the multiple linear regression analysis.

$$Y' = a + b_1X_1 + b_2X_2 + \ldots\ldots + b_nX_n$$

Where, Y = dependent variable (Welfare); X = independent variable (X1 = Socio-Cultural, X2 = Economic, X3 = Environmental and X4 = Institutional); a = constant; b = regression coefficient.

## RESULTS

### Factors influencing the welfare of Waplau and Air Buaya districts

The results of multiple linear regression analysis show the equation: Y = - 0.049 + 0.159X1 + 0.074X2 + 0.562X3 + 0.021X4 (Table 2). The model summary shows a multiple correlation coefficient (R = 0.7402), indicating a strong relationship between the independent variables and fishermen's welfare. The coefficient of determination ($R^2$ = 0.5478) suggests that 54.78% of the variability in welfare can be explained by socio-cultural, economic, environmental, and institutional factors, while the remaining 47.63% is influenced by other determinants outside the model. Furthermore, the adjusted $R^2$ value of 0.5237 reflects that, when accounting for the number of predictors in the model, 52.37% of the variation in fishermen's welfare is reliably predicted by the measured variables. The results of the F-test (Sig. F = $2.55 \times 10^{-12} < 0.05$) confirm that these independent variables collectively have a statistically significant influence on the welfare of small-scale fishermen.

**Table 2.** Results of multiple linear regression analysis of Waplau District and Air Buaya District in 2025

| **Predictor** | **Coefficient** | **SE Coef.** | **t** | ***P*-value** |
|---|---|---|---|---|
| Constant | -0.0487 | 0.3467 | -0.140 | 0.8887 |
| $X_1$ (Social Culture) | 0.1588 | 0.0553 | 2.869 | 0.0053 ** |
| $X_2$ (Economy) | 0.0743 | 0.0593 | 1.253 | 0.2142 |
| $X_3$ (Environment) | 0.5622 | 0.0940 | 5.979 | $7.08\times10^{-8}$ *** |
| $X_4$ (Institutional) | 0.0214 | 0.0895 | 0.239 | 0.8119 |

| Model Summary | Value | ANOVA | Value |
|---|---|---|---|
| Multiple R | 0.7402 | F-statistic | 22.7181 |
| R Square | 0.5478 | Significance F | $2.55\times10^{-12}$ *** |
| Adjusted R Square | 0.5237 | Regression df | 4 |
| Standard Error | 0.1163 | Residual df | 75 |
| Observations | 80 | Total df | 79 |

**Note:** **P*< 0.05 indicates statistical significance; ***P*< 0.01 indicates high significance; ***P*< *0.001* indicates very high significance.

## DISCUSSION

Based on the results of the analysis, we can see the magnitude of the influence of the independent variables on the dependent variables which can be seen in the regression analysis, namely based on the order, Y (welfare indicator) is greatly influenced by X1 (Socio-Cultural), X2 (Economic), X3 (Environmental), X4 (Institutional).

***Socio-cultural factors (X1)**:*

A coefficient of 0.159 with a *P*-value of 0.005338 (*P*< 0.05) indicates that socio-cultural factors have a positive and significant effect on fishermen's welfare. Each one-unit increase in socio-cultural indicators will increase welfare by 0.159, assuming other variables remain constant. This finding emphasizes the importance of customary values,

traditional fishing knowledge, and social support networks in shaping livelihood security among small-scale fishers. Strong collective action, communal resource sharing, and kin-based labor arrangements help reduce livelihood risks and contribute to more stable welfare conditions **(Sangadji *et al.*, 2025)**.

This result aligns with the Sustainable Livelihoods Framework, where social capital plays a crucial role as a buffer when financial capital is weak. Studies in other small-island contexts, such as in Southeast Sulawesi and the Philippines, similarly demonstrate that cultural cohesion and informal safety nets enable fishers to withstand income fluctuations and environmental pressures. These cultural institutions serve as a form of resilience that protects households from falling into deeper poverty when catches decline or market prices fluctuate.

However, the continued reliance on cultural systems without adequate economic, environmental, and institutional support may also limit upward livelihood mobility. As highlighted by **Tuwu (2025)**, the vulnerability of small-scale fishers to climate change and disruptions in fishing grounds shows that socio-cultural strengths alone are insufficient. Therefore, cultural advantages must be complemented with stronger governance support, improved access to capital, and equitable market structures to ensure sustainable welfare improvements.

***Economic factors (X2):***

A coefficient of 0.074 with a *P*-value of 0.214174 ($P > 0.05$) indicates that, partially, economic factors have no significant effect on the welfare of small-scale fishermen in this model, despite having a positive coefficient. This suggests that increases in income or asset ownership alone do not necessarily lead to meaningful improvements in welfare. The insignificance may indicate the presence of indirect or mediating influences not captured in the partial regression model, such as consumption patterns or structural financial constraints.

Although the economic factor is statistically insignificant at the individual level, it still contributes simultaneously to welfare when combined with other variables. This finding reflects the reality that small-scale fishers' income is often highly unstable due to fluctuating market prices, seasonal weather changes, and shifting government regulations. In Eastern Indonesia, including Maluku and Papua, fishers frequently remain in poverty despite the abundance of marine resources, demonstrating what scholars describe as a resource-rich but income-poor paradox. For example, during the COVID-19 pandemic, significant declines in catch volume and market demand sharply reduced fishers' earnings, worsening their already fragile welfare **(Lopulalan & Rahman, 2024)**.

This condition aligns with the poverty trap concept, in which limited access to capital and productive assets restricts fishers' ability to increase their income or invest in more efficient fishing technologies. Many fishers are also dependent on middlemen for loans and market access, leading to debt-based relationships that absorb financial gains and hinder economic mobility. Therefore, while the economic factor appears statistically

weak, it remains structurally important and should be addressed alongside socio-cultural and environmental improvements to achieve measurable welfare enhancement.

***Environmental factors (X3)***

A coefficient of 0.562 with a *P*-value of 7.08E-08 ($P < 0.05$) indicates that environmental factors have a positive and highly significant influence on fishermen's welfare. This variable exhibits the strongest standardized coefficient in the model, meaning that each one-unit increase in environmental conditions would increase fishermen's welfare by 0.562, assuming other variables remain constant. These results underscore that the quality of marine ecosystems and availability of fishery resources remain the primary determinants of livelihood security in small-scale fishing communities **(Béné *et al.*, 2016)**.

Environmental conditions directly shape fishing productivity, effort levels, and access to fishing grounds. When marine ecosystems degrade—due to overfishing, destructive fishing practices, sedimentation, or coral reef decline—the reduced fish abundance immediately lowers fishers' income and food access (**Cinner *et al.*, 2012)**. Moreover, climate-related stressors, such as temperature rise, seasonal shifts, and extreme weather events, intensify livelihood vulnerability by decreasing catch predictability and increasing operational risk **(Allison & Ellis, 2001; Pical & Rahman, 2025)**.

These findings are consistent with research in other small-island contexts, such as Vietnam, East Africa, and the Pacific, which have demonstrated that natural capital is the most influential livelihood asset for small-scale fishers, particularly where financial and institutional access remains weak **(Ferrol-Schulte *et al.*, 2021)**. Under the Sustainable Livelihoods Framework (SLF), environmental assets form the foundation upon which other livelihood strategies depend, making local fishers extremely sensitive to ecological change **(Scoones, 2015)**.

Therefore, the dominance of environmental factors in this study highlights that efforts to improve welfare in Buru Regency must prioritize ecosystem integrity and resource sustainability, including community-based monitoring, responsible fishing practices, and policies that enhance climate resilience **(Foale *et al.*, 2021)**. Without ecological security, socio-economic interventions are unlikely to deliver sustainable welfare improvements for small-scale fishers in the region.

***Institutional factors (X4):***

A coefficient of 0.021 with a *P*-value of 0.811949 ($P > 0.05$) indicates that, partially, institutional factors do not significantly influence the welfare of small-scale fishermen in this model, despite having a positive coefficient. Its influence is the smallest among the four variables, suggesting that existing institutional support mechanisms have not yet been translated into measurable improvements in welfare outcomes. This is reflective of weak institutional capacity and limited access to fisheries governance

structures at the community level.

Although statistically insignificant on a partial basis, institutional variables still contribute simultaneously to welfare through regulatory frameworks, fisheries management programs, and fisher group organizations. Government initiatives and international interventions—such as inclusive co-management and community capacity building—are designed to strengthen small-scale fisheries governance. However, in many remote fishing villages in Indonesia, including Maluku, institutional systems remain bureaucratically distant, top-down, and insufficiently integrated with local socio-cultural structures **(Satria, 2015; Pomeroy *et al*., 2020)**.

These results are consistent with studies in Southeast Asia and the Pacific showing that the mere presence of institutions is not enough—their effectiveness depends on accessibility, legitimacy, and alignment with local norms. When fishers lack representation, market negotiation power, or institutional voice, welfare conditions remain stagnant despite policy interventions **(Cohen *et al*., 2019; Foale *et al*., 2021)**. In the context of the Sustainable Livelihoods Framework, this finding reflects that institutional capital is the weakest livelihood asset shaping well-being in Buru Regency, compared to strong environmental dependence and socio-cultural resilience.

Therefore, to enhance welfare outcomes, institutional development must shift toward locally rooted co-management systems involving customary authorities, strengthening of fisher cooperatives, and operational support that directly addresses production, market access, and climate vulnerability. Without structural improvements in institutional accessibility and governance equity, small-scale fishers risk remaining marginalized in the coastal development agenda.

## CONCLUSION

This study demonstrates that the welfare of small-scale fishermen in Buru Regency is mainly influenced by socio-cultural strengths and environmental conditions, while economic and institutional factors have not yet provided a significant impact. These results show that healthy marine ecosystems and strong community solidarity remain essential for sustaining livelihoods in remote coastal areas. Therefore, efforts to improve fishermen's welfare should focus on protecting fishery resources, strengthening local co-management practices, and expanding access to capital and fair markets. Aligning institutional support with community needs will help create more resilient and sustainable welfare outcomes for small-scale fishers in Maluku.

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