

The Influence of Seafaring Experience, Fishermen's Productive Assets and Livelihood Diversification on Fishermen's Welfare in Singkuang Village, Mandailing Natal Regency

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Abstract

This study examines the effects of seafaring experience and productive assets on fishermen's welfare, with livelihood diversification serving as an intervening variable. A quantitative approach was employed using Partial Least Squares Structural Equation Modeling (PLS-SEM). Data were collected through questionnaires administered to 98 fishermen in Singkuang Village, Mandailing Natal Regency. The findings reveal that seafaring experience and productive assets have positive and significant effects on livelihood diversification and fishermen's welfare. Livelihood diversification also has a positive and significant effect on fishermen's welfare ($\beta = 0.293$, $p < 0.001$). Furthermore, productive assets significantly influence livelihood diversification ($\beta = 0.347$, $p < 0.001$) and fishermen's welfare ($\beta = 0.441$, $p < 0.001$), while seafaring experience significantly affects livelihood diversification ($\beta = 0.392$, $p < 0.001$) and fishermen's welfare ($\beta = 0.366$, $p < 0.001$). The structural model demonstrates substantial explanatory power, with an R^2 value of 0.440 for livelihood diversification and 0.794 for fishermen's welfare, indicating that the model explains 79.4% of the variance in fishermen's welfare. These findings suggest that enhancing fishermen's work experience, strengthening productive assets, and promoting livelihood diversification are effective strategies for improving the sustainable welfare of coastal fishing households.

Keywords

fishing experience; productive assets; livelihood diversification; fishermen's welfare

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1. INTRODUCTION

Indonesia is an archipelagic country with vast marine resource potential. The Ministry of Maritime Affairs and Fisheries states that Indonesia's fish resource potential reaches 12.01 million tons per year. This potential demonstrates the marine and fisheries sector's crucial role in supporting the economy of coastal communities. However, this substantial marine resource potential has not fully improved the welfare of fishermen. Data from the Central Statistics Agency shows that fishing households remain among the low-income groups and are vulnerable to poverty. This is evident in fishermen's unstable incomes and high dependence on marine catches.



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The capture fisheries sector is the primary source of livelihood for coastal communities, particularly traditional fishermen. Fishing activities are heavily influenced by weather conditions, fishing seasons, operational costs, and the selling price of the catch. When bad weather or a lean season occurs, some fishermen are unable to go to sea, resulting in decreased family income. This situation contributes to the economic instability of fishermen. Research by (Mulyani, R., Suryana, I., & Hidayah, 2023) explained that traditional fishermen still face various problems such as low-quality human resources, limited technology, and weak household economic capacity.

These problems are also experienced by fishermen in Singkuang Village, Mandailing Natal Regency. Based on the characteristics of fisheries in Mandailing Natal Regency, fishing activities in the west coast, including Singkuang Village, are still dominated by small-scale fisheries using motorized vessels under 5 GT or non-motorized boats. This situation indicates that most fishermen still face limitations in business capital, ownership of productive assets, mastery of fishing technology, and inadequate fishing facilities and infrastructure, resulting in relatively low productivity and income. The Central Statistics Agency of Mandailing Natal Regency recorded that the poverty rate in this region remained at 8.69% in 2024, indicating that improving community welfare, including coastal communities, remains a challenge for regional development.

Based on observations and initial interviews conducted by researchers with several fishermen in Singkuang Village, it was discovered that most fishermen still experience economic difficulties due to uncertain income and heavy dependence on weather conditions and fishing seasons. During bad weather or high waves, fishermen are unable to go to sea, thus losing their primary source of income. Under these conditions, some fishermen admitted to having to borrow money to meet their daily needs. Preliminary survey results also showed that 75% of respondents still use small boats with traditional fishing gear, while only 25% use motorized boats with more adequate fishing equipment. Furthermore, 70% of respondents stated that their household income is highly dependent on daily catches, while 65% of fishermen do not yet have alternative livelihoods outside the fishing sector, and only 35% earn additional income from activities such as trading, farming, or micro-enterprises.

Limited ownership of productive assets is also a major obstacle to improving fishermen's welfare. Some fishermen still use boats owned by others under a profit-sharing system, resulting in relatively low incomes. Limited capital makes it difficult for fishermen to repair boat engines, purchase more modern fishing gear, or provide storage facilities for their catch. As a result, their catch often must be sold immediately at relatively low prices because it cannot be stored for long periods. Furthermore, low livelihood diversification means that most fishing households rely solely on fishing as their primary source of income. When catches decline or fishermen are unable to go to sea due to weather conditions, the family's economic situation is disrupted due to the lack of alternative sources of income. However,

business diversification through activities such as trading, fish farming, fish processing, and other micro-enterprises has the potential to increase household income stability. Research by (Hidayati, N., Wahyuni, S., & Prasetyo, 2023) explains that livelihood diversification is an effective strategy for increasing the economic resilience of fishing households when income from the fisheries sector declines.

These various conditions indicate that the welfare of fishermen in Singkuang Village is still affected by limited fishing experience, ownership of productive assets, and low livelihood diversification. This phenomenon demonstrates a gap between the potential of fishery resources and the relatively low level of fisherman welfare. Therefore, research on the influence of fishing experience, productive assets, and livelihood diversification on fisherman welfare is crucial to provide empirical evidence and serve as a basis for developing more effective and sustainable policies for empowering coastal communities.

The welfare of fishermen is fundamentally influenced by various factors related to individual capacity and available resources. One such factor is fishing experience, a form of human capital acquired through repeated learning and practice in fishing activities. Experience at sea is not only related to the length of time working as a fisherman, but also includes the ability to understand sea conditions, determine fishing locations, read the weather, use fishing gear, and manage risks during the fishing process. The more experience a fisherman has at sea, the better their ability to increase fishing productivity. Experienced fishers generally possess better knowledge of fishing grounds, weather conditions, and fishing techniques through accumulated practical experience, enabling them to improve fishing productivity and decision-making (Rahman, M. S., Toiba, H., & Huang, 2021). Furthermore, experienced fishers tend to be more adaptive to changes in marine ecosystems and climate by adjusting fishing locations, fishing seasons, and livelihood strategies (Galappaththi, E. K., Ford, J. D., Bennett, E. M., & Berkes, 2021). In accordance with Human Capital Theory, accumulated work experience enhances workers' knowledge, skills, productivity, and efficiency through continuous learning and practice (Becker, 2017). Research by Nasution (2022) (Nasution Rizki, 2022), showed that fishing experience positively impacts productivity, household income stability, risk management skills, and operational decision-making in fishermen. In fact, the (FAO, 2022) emphasized that fishing experience plays a crucial role in increasing business efficiency and fishermen's adaptability to uncertain marine environments.

In addition to fishing experience, productive assets also play a crucial role in improving fishermen's welfare. Productive assets include boats, engines, fishing gear, navigation equipment, operational capital, and fish storage facilities, which are the primary resources in capture fisheries. Ownership of productive assets determines production capacity and business efficiency, thereby directly affecting fishermen's income levels (Rahim, A., & Hastuti, 2019). Research by (Fauzi, A., Rahim, A., & Yusuf, 2022) indicates that the use of motorized boats, modern fishing equipment, and technological support

contributes significantly to increasing the productivity and income of coastal fishing communities. Within the Sustainable Livelihoods Framework, productive assets constitute an important form of livelihood capital that strengthens household economic resilience and supports sustainable welfare (Imsar., 2021). Productive assets also serve as an economic buffer, helping fishing households survive lean seasons and increasing income during the fishing season (Zulkifli., & Hasibuan, 2021). Conversely, limited productive assets can lead to low productivity among traditional fishermen and hinder their ability to compete in modern fishing businesses (Hamzah, A., Siregar, H., & Harahap, 2022). The relationship between fishing experience and productive assets is also complementary in increasing fishermen's productivity and income (Putra, IG, Wibowo, A., & Santoso, 2021; Hamzah, A., Siregar, H., & Harahap, 2022; Galappaththi, E. K., Ford, J. D., Bennett, E. M., & Berkes, 2021).

Facing uncertain catches, fishermen often diversify their livelihoods as a strategy to maintain household economic stability. Livelihood diversification refers to the effort of obtaining multiple sources of income to reduce economic risks arising from dependence on a single livelihood (Ellis, 2000). Diversification has become one of the most widely adopted livelihood strategies among coastal communities to strengthen household resilience against seasonal fluctuations and declining fish catches. Empirical studies in Indonesia have shown that households engaging in fisheries-related and non-fisheries activities tend to achieve more stable incomes and better welfare than those relying solely on capture fisheries (Hidayat, T., Firmansyah, & Putri, 2023). Furthermore, (FAO, 2022) emphasizes that livelihood diversification is an important strategy for improving the resilience and sustainability of small-scale fishing households.

The welfare of fishermen is a primary goal in the economic development of coastal communities. In general, welfare is influenced by various economic factors, such as income level, ownership of productive assets, access to education, health, and the household's ability to meet living needs. According to the Central Statistics Agency, welfare can be measured through indicators of income, housing conditions, education, health, and consumption patterns (Nasution, 2020; Tuti Anggraini, 2020; Chapra, 2021). This study focuses on measuring welfare by examining dimensions of welfare that can be observed and measured empirically through survey instruments.

Research by (Mulyani, R., Suryana, I., & Hidayah, 2023) shows that most fishermen still fall into the pre-prosperous category, while (Setiawan, I., & Ahmad, 2024) found that education and ownership of productive assets are important factors influencing fishermen's welfare. Furthermore, well-being from an Islamic perspective must be understood holistically through a balance of material and spiritual aspects (Tuti Anggraini, 2020; Isnaini, 2019). This view is further reinforced by (Chapra, 2021), who asserts that well-being encompasses the sustainable fulfillment of economic, social, and spiritual dimensions.

Previous research has shown that work experience, productive assets, and business diversification influence both the income and well-being of fishermen. (Putra, IG, Wibowo, A., & Santoso, 2021) explain that business diversification can increase the economic resilience of fishing households. (Sari, D., Pratama, R., & Nugroho, 2022) show that productive assets influence fishermen's ability to develop additional economic ventures, while (Fauzi, A., Rahim, A., & Yusuf, 2022) found that fishermen's work experience influences the economic adaptability of coastal communities. However, research specifically examining the role of livelihood diversification as an intervening variable in the relationship between fishing experience and productive assets on fishermen's well-being is still relatively limited, particularly in the traditional fishing community in Singkuang Village, Mandailing Natal Regency.

This research is important because welfare is one of the main indicators in assessing a community's quality of life. The level of welfare is influenced by various economic factors, such as income, wage system, and number of dependents in the family. The better an individual or household's ability to meet their living needs, the higher the level of welfare achieved (Sari, R., Ramadhani, S., & Syahbudi, 2022). Based on this background description, this study aims to analyze the influence of fishing experience and productive assets on the welfare of fishermen, with livelihood diversification as an intervening variable in the fishing community in Singkuang Village, Mandailing Natal Regency.

2. METHODS

This study used a quantitative approach with an associative approach to analyze the influence of fishing experience and productive assets on fishers' welfare through livelihood diversification as an intervening variable. Data analysis was conducted using Structural Equation Modeling-Partial Least Squares (SEM-PLS) because it can simultaneously test direct and indirect relationships between variables (Syahbudi, M., Barus, EE, & Barus, 2023).

This research was conducted in Singkuang Village, Mandailing Natal Regency. Prior to the main research, the researcher conducted a preliminary survey through field observations and interviews with several fishermen to identify socio-economic conditions, ownership of productive assets, livelihood diversification, and the problems faced by fishermen. The results of the preliminary survey were used as the basis for formulating the research problem and developing the research instrument. The study population consisted of 160 active fishermen, based on 2024 data from the Singkuang Village Government. The sampling technique used purposive sampling, which selects respondents based on specific criteria aligned with the research objectives. The respondent criteria included fishermen who were still actively fishing, residing in Singkuang Village, and owning or having previously run a side business outside the fisheries sector. This technique was chosen to ensure that the respondents had characteristics relevant to the livelihood diversification variables analyzed in the study.

The sample size was determined based on the guidelines of (Hair, J. F., Black, W. C., Babin, B. J., & Anderson, 2020), which states that the minimum sample size in Structural Equation Modeling–Partial Least Squares (SEM-PLS) analysis is between 5–10 times the number of indicators used. This study used 18 indicators, so the minimum sample size required is 90 respondents. After a selection process based on research criteria, 98 respondents were obtained who met the requirements, thus exceeding the minimum limit recommended by (Hair, J. F., Black, W. C., Babin, B. J., & Anderson, 2020) and deemed sufficient to produce representative model estimates. Primary data were collected using a questionnaire with a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), then analyzed using the Structural Equation Modeling–Partial Least Squares (SEM-PLS) method.

The operational definitions of the variables in this study are based on theoretical studies and previous research. The fishing experience variable represents the accumulated knowledge, skills, and abilities of fishermen acquired during fishing activities. This variable is measured through indicators such as length of fishing experience, ability to determine fishing areas, ability to operate fishing gear, ability to adapt to changes in weather and seasons, and ability to make decisions during fishing activities. The productive assets variable is defined as the economic resources owned by fishermen to support fishing activities and increase business productivity. Indicators used include boat ownership and engine capacity, availability of fishing gear, ownership of navigation equipment, availability of operational capital, and catch storage facilities. The livelihood diversification variable represents efforts by fishing households to develop more than one source of income to reduce dependence on fishing. This variable is measured through the number of income sources, types of side businesses owned, the proportion of income from non-fishing businesses, the sustainability of side businesses, and the contribution of these businesses to household economic stability. The welfare variable of fishermen is the condition of fulfilling the material and spiritual needs of fishing households. Material welfare is measured through income level, housing conditions, access to health services, education level, and the ability to meet household consumption needs.

The research data were obtained through a questionnaire as the primary instrument, supported by interviews and documentation. The questionnaire was constructed using a 1–5 Likert scale to measure variables such as fishing experience, productive assets, livelihood diversification, and fisher welfare. Data analysis was conducted through several stages: instrument validity and reliability testing, measurement model testing (outer model), structural model testing (inner model), and hypothesis testing. Convergent validity was assessed based on factor loadings and Average Variance Extracted (AVE) values ≥ 0.50 , while construct reliability was measured using Composite Reliability and Cronbach's Alpha ≥ 0.70 . Hypothesis testing was conducted through a bootstrapping procedure, with criteria of t-statistics > 1.96 and p-value < 0.05 . Furthermore, the mediating effect of livelihood

diversification was analyzed using an indirect effect test in the SEM-PLS model.

3. FINDINGS AND DISCUSSION

A. Outer Model

This section explains the evaluation of the measurement model (outer model) through validity and reliability tests. Validity testing was conducted using convergent validity and discriminant validity, while reliability testing was conducted through internal consistency testing using Cronbach's Alpha and Composite Reliability values. Evaluation of the outer model was conducted with the help of the SmartPLS application using the PLS algorithm. The following are the results of the outer model using the PLS algorithm.

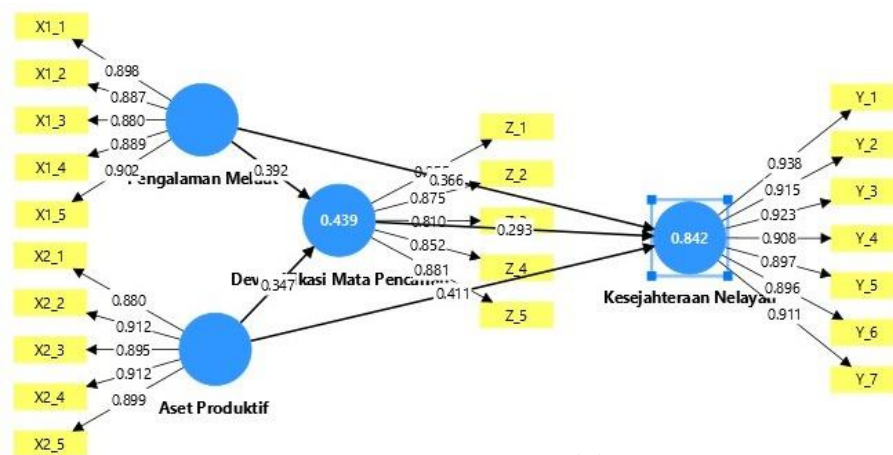


Figure 1. Outer model

1. Test Validity Convergent (Convergent Validity)

The first stage in evaluating the measurement model (outer model) is carried out through convergent validity testing, namely by examining the outer loading value of each indicator against the latent construct being measured. Convergent validity indicates the extent to which an indicator is able to represent the construct being measured. According to Joseph (Mulyani, R., Suryana, I., & Hidayah, 2023), an indicator is considered to have good convergent validity if the outer loading value is above 0.70. However, in exploratory research or the initial stages of instrument development, outer loading values between 0.60 and 0.70 are still acceptable as long as the indicator continues to contribute to the construct being measured. Based on these considerations, this study uses a minimum outer loading limit of 0.60. Indicators with outer loading values below 0.60 are eliminated from the model. The following are the results of the Convergent Validity Test:

Table 1. Beginning Outer Loading (Measurement Model)

Variables	Indicator	Outer Loading	Information
Sea Experience (X1)	X1_1	0.898	Valid
	X1_2	0.887	Valid
	X1_3	0.880	Valid
	X1_4	0.889	Valid
	X1_5	0.902	Valid
Productive Assets (X2)	X2_1	0.880	Valid
	X2_2	0.912	Valid
	X2_3	0.895	Valid
	X2_4	0.912	Valid
	X2_5	0.899	Valid
Livelihood Deprivation (X3)	Z_1	0.748	Valid
	Z_2	0.874	Valid
	Z_3	0.812	Valid
	Z_4	0.851	Valid
	Z_5	0.882	Valid
Fishermen's Welfare (Y)	Y_1	0.938	Valid
	Y_2	0.915	Valid
	Y_3	0.923	Valid
	Y_4	0.908	Valid
	Y_5	0.897	Valid
	Y_6	0.896	Valid
	Y_7	0.911	Valid

Source Data: *Data processed with SmartPLS version 4.0*

Based on the table above, it is known that all indicators have loading factor values above 0.60, so no indicators were eliminated from the model. Therefore, all constructs in this study are declared valid because they have met the criteria for convergent validity. Convergent validity aims to measure the level of correlation between indicators within a construct. A construct is declared to meet convergent validity if its indicators are correlated with each other and have an outer loading value ≥ 0.60 . Furthermore, all indicators must also be statistically significant to ensure model feasibility.

Furthermore, convergent validity can also be evaluated through the Average Variance Extracted (AVE) value. A construct is considered to have good convergent validity if the AVE value is > 0.50 . This indicates that the construct is able to explain more than 50% of the variance in its indicators.

Table 2. AVE (Average variance (eZtracted))

Variables	AVE	Information
Sea Experience	0.794	Meets Convergent Validity
Productive Assets	0.809	Meets Convergent Validity
Welfare Fisherman	0.833	Meets Convergent Validity
Livelihood Diversification	0.731	Meets Convergent Validity

Source: *Data processed by SmartPls 4.0 application*

Based on the table above, the Average Variance Extracted (AVE) value for each construct is above 0.50, thus meeting the convergent validity criteria. Supported by the outer loading values that also meet the minimum threshold, it can be concluded that all constructs in this study are convergently valid. Thus, the research model is suitable for proceeding to the discriminant validity testing stage.

2. Composite Reliability

Composite Reliability value is used to measure the level of internal consistency of a construct. In exploratory research, an acceptable Composite Reliability value is in the range of 0.60–0.70, while a construct is said to have good reliability if its value is ≥ 0.70 . The results of the Composite Reliability values in this study are presented in the following table:

Table 3. Cronbach's Alpha and Composite Reliability

Variables	Cronbach's Alpha	Composite Reliability	Information
Sea Experience	0.935	0.951	Reliable
Fishermen's Productive Assets	0.941	0.955	Reliable
Livelihood Diversification	0.908	0.931	Reliable
Fishermen's Welfare	0.967	0.972	Reliable

Source Data: Data processed application SmartPls 4.0

Based on Table 5 above, it can be concluded that the constructs are reliable, with both *composite reliability* and *Cronbach's alpha* having values above 0.70. Thus, all variables in this research model have *internal consistency reliability*.

B. Testing Model Structural (Inner Model)

Structural Model Testing (*Inner Model*) was conducted to see the relationship between constructs, significance values and R-square and the research model. This model was evaluated using R-square for the dependent construct, T-test and significance. from coefficient parameter track Structural. The following are the results of the inner model:

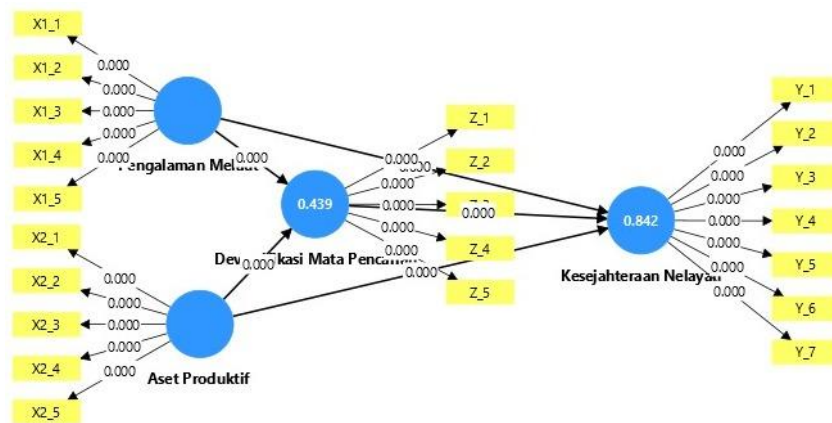


Figure 2. Inner model

In process evaluation research model with PLS, starting by looking at the R-square for each variable latent dependent. The following table shows the results of R-square estimation using SmartPLS.

Table 4. Mark R-Square

Variables	R Square	Information
Diversification of Fishermen's Livelihoods	0.440	Strong
Fishermen's Welfare	0.794	Very strong

Source Data : Data processed application SmartPls 4.0

From table 6 The above shows the R-Square value for the variable Diversification of fishermen's livelihoods obtained a value of 0.440. This result indicates that 44.0% of the Fishermen's Livelihood Diversification variable can be influenced by the variables of fishing experience and productive assets, while 56.0% is influenced by other variables outside those studied. Meanwhile, the R-Square value for the fishermen's welfare variable was 0.794. These results indicate that 79.4% of the fishermen's welfare variable can be influenced by fishing experience, productive assets and Diversification of fishermen's livelihoods , while 20.6% is influenced by other variables outside those studied.

Table 5. Mark F-Square

Relationship between variables	f-Square	Information
Experience at Sea → Diversification of Fishermen's Livelihoods	0.173	Moderate
Fishermen's Productive Assets → Diversification of Fishermen's Livelihoods	0.135	Moderate
Experience at Sea → Fishermen's Welfare	0.456	Tall
Fishermen's Productive Assets → Fishermen's Welfare	0.591	Tall

Diversification of Fishermen's Livelihoods → Fishermen's Welfare	0.307	Moderate
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Source Data : Processed application SmartPLS 4.0

According to Sarstedt et al., the f-square value is divided into three categories, namely 0.02 is categorized as low, 0.15 is categorized as moderate, and 0.35 is categorized as high. Based on the f-square value in the table above, it can be seen that the influence of fishing experience on the diversification of fishermen's livelihoods can be categorized as moderate (0.173), then the influence of fishermen's productive assets on the diversification of fishermen's livelihoods is categorized as close to moderate (0.135). Furthermore, the influence of fishing experience on fishermen's welfare is categorized as high (0.456), and the influence of fishermen's productive assets on fishermen's welfare is also categorized as high (0.591). The influence of fishermen's livelihood diversification on fishermen's welfare can be categorized as moderate (0.307).

1. Testing Hypothesis

The basis used in hypothesis testing is the value contained in *the path coefficients output* . The following table shows the estimated output for structural model testing .

Table 6. Hypothesis Test Results

Hypothesis	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values	Information
Fishermen's Productive Assets → Diversification of Fishermen's Livelihoods	0.347	0.347	0.098	3,525	0.000	Accepted
Fishermen's Productive Assets → Fishermen's Welfare	0.441	0.412	0.064	6,415	0.000	Accepted
Diversification of Fishermen's Livelihoods → Fishermen's Welfare	0.293	0.294	0.067	4,374	0.000	Accepted
Experience at Sea → Fishermen's Welfare	0.392	0.394	0.101	3,899	0.000	Accepted
Experience at Sea → Fishermen's Welfare	0.366	0.364	0.065	5,653	0.000	Accepted

Source Data : Data processed application SmartPls 4.0

In PLS, statistical testing of each hypothesized relationship is performed using simulation. In this case, calculations are performed using bootstrapping techniques on samples. Bootstrapping testing aims to minimize the problem of abnormality in research data. The results of the hypothesis testing from the PLS analysis are as follows:

1. Testing Hypothesis H1 (Productive Assets have a positive effect on Livelihood Diversification)

Hypothesis one, which states that productive assets have a positive effect on livelihood diversification, is proven. The test results show a path coefficient of 0.347 and a t-statistic of 3.525, where the t-statistic is greater than 1.96. The p-value is $0.000 < \alpha = 5\% (0.05)$. This means that productive assets have a positive and significant effect on livelihood diversification. Thus, hypothesis one is accepted.

2. Testing Hypothesis H2 (Productive Assets have a positive effect on Fishermen's Welfare)

Hypothesis two, which states that productive assets have a positive effect on fishermen's welfare, was proven. The test results showed a path coefficient of 0.411 and a t-statistic of 6.415, both of which are greater than 1.96. The p-value was $0.000 < \alpha = 5\% (0.05)$. This indicates that productive assets have a positive and significant effect on fishermen's welfare. Therefore, hypothesis two is accepted.

3. Testing Hypothesis H3 (Livelihood Diversification has a positive effect on Fishermen's Welfare)

Hypothesis three, which states that livelihood diversification has a positive effect on fishermen's welfare, is proven. The test results show a path coefficient of 0.293 and a t-statistic of 4.374, where the t-statistic value is greater than 1.96. The p-value is $0.000 < \alpha = 5\% (0.05)$. This means that livelihood diversification has a positive and significant effect on fishermen's welfare. Thus, hypothesis three is accepted.

4. Testing Hypothesis H4 (Seafaring Experience has a positive effect on Livelihood Diversification)

Hypothesis four, which states that fishing experience has a positive effect on livelihood diversification, is proven. Based on the test results, the path coefficient value is 0.392 and the t-statistic is 3.899, where the t-statistic value is greater than 1.96. The p-value is $0.000 < \alpha = 5\% (0.05)$. This means that fishing experience has a positive and significant effect on livelihood diversification. Thus, hypothesis four is accepted.

5. Testing Hypothesis H5 (Sea Experience has a positive effect on Fishermen's Welfare)

Hypothesis five, which states that fishing experience has a positive effect on fishermen's welfare, was proven. The test results showed a path coefficient of 0.366 and a t-statistic of 5.653, where the t-statistic value is greater than 1.96. The p-value is $0.000 < \alpha = 5\% (0.05)$. This means that fishing experience has a positive and significant effect on fishermen's welfare. Thus, hypothesis five is accepted.

Discussion

Based on the results of data analysis using the Partial Least Squares (PLS) method, all hypotheses in this study were accepted. These results indicate that fishing experience, fishermen's productive assets,

and livelihood diversification have a positive and significant influence on fishermen's welfare. These findings confirm that fishermen's welfare is the result of a combination of human capital, physical capital, and household economic strategies.

Based on the results of the Partial Least Squares (PLS) analysis, all hypotheses proposed in this study were supported. The findings indicate that fishing experience, productive assets, and livelihood diversification have positive and significant effects on the welfare of fishermen in Singkuang Village, Mandailing Natal Regency. These results confirm that fishermen's welfare is not determined by a single factor but rather by the interaction of human capital, physical capital, and household economic strategies. This finding is consistent with the Islamic macroeconomic perspective, which argues that social welfare is achieved not only through increased income but also through the optimal utilization of productive resources that promote sustainable economic activities. From this perspective, the effective use of economic resources enhances productivity, expands income-generating opportunities, and ultimately leads to the achievement of welfare (*falah*), encompassing both material and spiritual dimensions (Daulay, AN, Syahbudi, M., & Lubis, 2019).

Productive assets were found to be one of the most important determinants of fishermen's welfare. Ownership of productive assets, including fishing boats, engines, fishing gear, business capital, transportation, and other supporting facilities, enables fishermen to increase fishing productivity and expand their economic opportunities. In the context of Singkuang Village, where fisheries are predominantly small-scale, productive assets determine fishermen's ability to access more productive fishing grounds, improve catch volumes, and reduce operational costs. Beyond increasing fish catches, productive assets also provide opportunities for fishermen to develop alternative income-generating activities outside capture fisheries, thereby reducing dependence on seasonal fishing income. This is particularly important because fishing activities are highly vulnerable to weather fluctuations and seasonal changes, resulting in unstable household income. Consequently, productive assets contribute not only to higher income but also to greater household economic resilience by enhancing fishermen's capacity to cope with livelihood risks. These findings support the Sustainable Livelihood Framework proposed by (Scoones, 2018), which emphasizes that livelihood assets play a crucial role in enabling households to develop sustainable livelihood strategies and strengthen their resilience. The present findings are also consistent with (Hamzah, A., Siregar, H., & Harahap, 2022), who reported that livelihood assets significantly influence the economic stability of coastal fishing households. (Rahayu, NP, & Diatmika, 2021) demonstrated that productive asset management improves economic activities in coastal communities while strengthening fishermen's ability to diversify their livelihoods.

The ownership of productive assets ultimately contributes to improvements in fishermen's welfare. Fishermen with adequate production facilities generally achieve higher productivity and enjoy greater

income opportunities, enabling them to meet household needs more effectively. Increased income improves their ability to finance education, healthcare, daily consumption, and other social needs. Moreover, productive assets provide greater financial security by allowing households to maintain income even when fish catches decline. This finding is consistent with (Todaro, M. P., & Smith, 2021), who argue that welfare is closely associated with an individual's ability to satisfy basic needs and improve quality of life through access to economic resources. Likewise, (Mudzakir, AK, 2020) found that household economic conditions and access to productive resources significantly influence the welfare of small-scale fishermen. (Sulkiah., 2021) also concluded that strengthening productive economic assets contributes substantially to improving the welfare of coastal fishing households.

In addition to productive assets, livelihood diversification was found to have a positive and significant effect on fishermen's welfare. Livelihood diversification serves as an adaptive household strategy to reduce dependence on fishing, an occupation characterized by considerable income uncertainty. Fishing households engaged in supplementary activities such as fish trading, aquaculture, fish processing, or other non-fishing enterprises enjoy more stable income streams, allowing them to meet household expenses even when fishing activities are disrupted by adverse weather or low fishing seasons. These findings suggest that livelihood diversification is an effective adaptation strategy for strengthening household economic resilience. This result supports (Carney, 2018), who emphasized that livelihood diversification is essential for reducing economic vulnerability, maintaining household income stability, and enhancing adaptive capacity to environmental and economic changes. The findings are further supported by (Che Mata, Z., Mohd, N., & Hassan, 2020), who demonstrated that additional income sources improve household resilience and reduce poverty among coastal communities. (Hidayati, N., Wahyuni, S., & Prasetyo, 2023) concluded that livelihood diversification contributes significantly to increasing household income and improving fishermen's welfare.

Fishing experience was also found to have positive effects on both livelihood diversification and fishermen's welfare. Fishing experience represents an important form of human capital that enhances fishermen's knowledge of marine conditions, seasonal patterns, fishing locations, appropriate fishing techniques, and potential economic opportunities. Nevertheless, the findings indicate that fishing experience alone is insufficient to achieve optimal welfare. In the waters of Mandailing Natal Regency, fishing activities are increasingly affected by unpredictable weather conditions, high waves, strong winds, and seasonal variability. Consequently, even highly experienced fishermen remain vulnerable to income loss whenever they are unable to fish. Therefore, the benefits of fishing experience become more substantial when fishermen are capable of transforming their knowledge and skills into diversified livelihood strategies.

The mediation analysis further reveals that livelihood diversification acts as an intervening variable that strengthens the relationship between fishing experience and fishermen's welfare. This finding suggests that fishing experience does not directly generate higher welfare but instead enhances fishermen's capacity to establish alternative income-generating activities. Experienced fishermen are better able to utilize their knowledge and skills to develop fish trading businesses, fish processing enterprises, aquaculture, and other productive economic activities when fishing operations are interrupted. These diversified livelihood activities function as an adaptive mechanism that reduces dependence on capture fisheries while maintaining household income stability. Therefore, fishing experience contributes more effectively to welfare when it is transformed into sustainable livelihood diversification strategies. This finding supports (Becker, 2017) human capital theory, which argues that work experience enhances individuals' decision-making abilities, productivity, and capacity to adapt to economic challenges. The results are also consistent with (Masriah, 2020), who reported that fishermen's experience and economic knowledge improve households' ability to develop productive enterprises and enhance family welfare. Furthermore, (Mulyadi, S., Rahman, A., 2021) found that fishermen's work experience positively affects household income and welfare, (Fauzi, A., Rahim, A., & Yusuf, 2022) demonstrated that work experience in coastal communities contributes significantly to economic productivity and household welfare.

4. CONCLUSION

Based on the results of data analysis using the Partial Least Square (PLS) method, it can be concluded that fishing experience and fishermen's productive assets have a positive and significant influence on the diversification of fishermen's livelihoods and fishermen's welfare. The more experience a fisherman has, the greater his ability to develop alternative businesses and increase work productivity, which ultimately has an impact on improving welfare. Similarly, ownership of productive assets such as boats, fishing gear, and business capital can encourage fishermen to diversify their businesses and increase production capacity. In addition, diversification of fishermen's livelihoods has been proven to have a positive and significant influence on welfare, because it can reduce dependence on uncertain marine catches. Overall, fishing experience and productive assets not only have a direct influence on fishermen's welfare but also have an indirect influence through livelihood diversification as an intervening variable, so that these three factors are important keys to improving fishermen's welfare in a sustainable manner.

Based on the research findings, the Mandailing Natal Regency Maritime Affairs and Fisheries Office is recommended to prioritize programs to strengthen fishermen's productive assets through assistance with more efficient boats, engines, and fishing gear, as well as the gradual provision of cold

storage facilities to increase productivity and the market value of fisheries products. Furthermore, the local government needs to conduct capacity-building training for fishermen, particularly on the use of fishing technology, fisheries business management, and household financial management.

Furthermore, the Singkuang Village Government, in collaboration with the Singkuang Village Fishermen's Cooperative, is recommended to develop a livelihood diversification program that focuses on local potential, particularly during the lean season or inclement weather when fishermen cannot go to sea. This program could include training in processing fisheries products into value-added products, household-scale fisheries cultivation, digital marketing of fisheries products, and the development of coastal community-based micro-enterprises. This training should also involve fishermen's wives and family members so that households have a more sustainable alternative source of income.

Furthermore, strengthening the institutional framework of fishermen's cooperatives is necessary by providing access to capital, collective purchasing of production inputs, and joint marketing of fishery products to improve business efficiency and fishermen's bargaining power. These efforts are expected to strengthen the economic resilience of fishing households, reduce vulnerability to fluctuations in catches, and sustainably improve the welfare of coastal communities.

Further research can be expanded by adding other variables that could potentially influence fishermen's welfare, such as access to financing, institutional support, adaptation to climate change, financial literacy, and the use of digital technology. Research in other coastal areas is also needed to obtain more comprehensive results and increase the generalizability of the research findings.

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