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Fishermen's Capabilities, Operational Effectiveness, and Perceived Floating Lift Net Performance: The Role of Small Pelagic Fish Resource Utilization in the Makassar Strait

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Abstract
Small-scale capture fisheries are important for utilizing small pelagic fish resources and sustaining coastal livelihoods. The relationship between operational effectiveness and perceived fishing performance, particularly the direct and indirect pathways through resource utilization, remains insufficiently examined in light-assisted floating lift net fisheries. This study examines associations among fishermen's capabilities, operational effectiveness, small pelagic fish resource utilization, and *perceived* floating lift net performance in the Makassar Strait, Donggala, Indonesia. A cross-sectional survey of 300 purposively selected fishermen using a five-point Likert-scale questionnaire was analyzed with PLS-SEM (SmartPLS). Fishermen's capabilities were positively associated with operational effectiveness (β = 0.549), resource utilization (β = 0.239), and perceived performance (β = 0.327; all $p < .001$). Operational effectiveness was positively associated with resource utilization (β = 0.400, $p < .001$), but its direct association with performance was not statistically significant (β = 0.109, $p = .051$). Resource utilization was positively associated with performance (β = 0.349, $p < .001$). The indirect pathway through resource utilization (X2 → M → Y: β = 0.140, $p < .001$) and sequential pathway (X1 → X2 → M → Y: β = 0.077, $p < .001$) were significant. The model explained 42.5% of variance in perceived performance. Although Q^2predict values were positive (0.142–0.203), some prediction errors exceeded the linear-model benchmark. These findings support the relevance of resource utilization but do not establish causal mediation or objective fishing outcomes.

Keywords: Fishermen's capabilities; operational effectiveness; small pelagic fish resource utilization; perceived floating lift net performance; *Makassar* Strait; small-scale fisheries.

INTRODUCTION

Capture fisheries are a crucial economic activity for coastal communities, providing a source of income and supporting the fulfillment of food needs based on fisheries resources. This activity relies heavily on the ability of fishermen to utilize the fish resources available in the waters where they operate (Putri et al., 2021). One of the resource groups frequently targeted by fishing activities is small pelagic fish. This group of fish has characteristics related to aquatic environmental conditions, movement patterns, seasons, and responses to certain stimuli during fishing activities. These conditions mean that the success of capture fisheries activities is determined not only by the quantity of fish resources available, but also by the ability of fishermen to manage the fishing process productively and efficiently. Fishing productivity is important because it relates to the ability of fishermen to obtain results that are in accordance with the resources, time, energy, and costs used in operational activities (Widiyastuti et al., 2021).

The Makassar Strait waters off Sabang Village, Balaesang District, Donggala Regency, Central Sulawesi, are an area with active capture fisheries utilizing various types of fishing gear. One such fishing unit used by fishermen is the floating lift net (bagan apung). This fishing gear

utilizes light to attract and concentrate fish near the fishing area before catching them. The use of light makes the floating lift net closely linked to the behavior of light-responsive fish, particularly small pelagic fish (Bubun et al., 2022). Floating lift net operations not only involve the use of fishing gear, but also require the arrangement of various activities ranging from equipment preparation, use of light sources, location determination, determination of operating time, to the setting and hauling process (I. Sari et al., 2021). These conditions indicate that the operational characteristics of floating lift nets require proper management so that the available fish resources can be utilized optimally.

38 The success of floating lift net operations is not solely determined by the presence of fish in a fishing area. Fishing results are also related to the fishermen's ability to operate the floating lift net, understand water conditions, use lighting technology, determine operating times, select fishing locations, and manage fishing activities efficiently (Azakhrah et al., 2022). Differences in operational capabilities between fishermen can lead to differences in fishing operations and ultimately result in varying levels of effectiveness and productivity of their floating lift nets. Fishermen who are able to read water conditions and adapt their fishing activities to changing conditions in the field have greater leeway to manage operations appropriately (Suharyanto et al., 2022). This aspect shows that the performance of floating lift nets needs to be understood as a result of the relationship between human factors, operational factors, and the ability to utilize fish resources.

45 Fishermen's capabilities are a relevant factor in explaining the success of floating lift net operations. These capabilities include knowledge of water characteristics and fishing seasons, experience in fishing activities, the ability to identify fishing grounds, the ability to determine operating times, the ability to operate a floating lift net, the ability to use lighting technology, and the ability to adapt to changing fishing conditions (Arief, 2022). Fishermen's knowledge and experience can form the basis for determining operational actions during fishing activities. The ability to determine the location and timing of operations also relates to fishermen's decisions in utilizing water conditions that are suitable for the presence of target fish. Technical capabilities are necessary for the effective use of floating lift nets and supporting technology (Phuong et al., 2023). In the context of this research, the capability of fishermen is seen as a factor that has the potential to influence operational effectiveness, utilization of small pelagic fish resources, and the performance of floating lift nets.

46 The operational effectiveness of the floating lift net is another aspect that determines the success of fishing activities. Operational effectiveness relates to the ability to carry out fishing activities accurately, efficiently, and sustainably throughout the operation (Fang & Zhang, 2025). These aspects can be seen through the readiness of the floating lift net before the operation, the effectiveness of the use of lights, the accuracy of the operation time, the accuracy of the selection of the fishing location, time efficiency, efficiency of fuel or energy use, the smoothness of the setting and hauling process, and minimal operational disruptions (Mulyasari et al., 2023). Management of these aspects determines how fishermen's resources are utilized during fishing activities. Operational effectiveness also plays a key role in the research model because it can serve as a link between fishermen's capabilities and their ability to utilize small pelagic fish resources and the performance of floating lift nets (Silas et al., 2023).

The utilization of small pelagic fish resources in this study is not only understood based on the number of fish successfully caught. Resource utilization includes the ability to obtain target fish, use fishing grounds effectively, adjust fishing activities to the season, maintain consistent resource utilization, apply selectivity to target fish, optimize catches, reduce unused catches, and pay attention to the sustainability of fish resources (Saksono et al., 2023). This perspective positions resource utilization as part of the fishing management process, not simply as the end result of catch volume. Fishermen's ability to adapt fishing strategies to resource conditions is crucial because fishing activities must generate economic benefits while also ensuring the sustainability of fisheries resources (Muslim et al., 2023).

A number of studies on lift-net fisheries have examined technical determinants of catch outcomes, including variations in catch quantity and size associated with hauling time (Iskandar et al., 2024). Such studies provide valuable operational evidence but offer limited explanation of how fishermen's capabilities translate into resource utilization and overall fishing performance. International research has also examined how information influences fisher behavior and fisheries governance (McClanahan et al., 2025). However, whether operational effectiveness contributes directly to fishing performance or primarily through resource utilization remains insufficiently understood. This distinction is particularly relevant to floating lift net fisheries in the Makassar Strait, where light-assisted operations depend on fishing-ground selection, seasonal resource availability, and changing environmental conditions. These characteristics provide a context for examining whether relationships identified in broader small-scale fisheries research also apply to mobile, light-assisted fishing operations. Understanding the direct and indirect relationships among human capabilities, operational effectiveness, and resource utilization can therefore extend existing explanations of fishing performance beyond isolated technical determinants (Suryanto et al., 2025).

This study develops an integrated model linking fisher capabilities, lift net operational effectiveness, small pelagic fish resource utilization, and floating lift net performance. Drawing on Human Capital Theory, fishermen's knowledge, skills, and experience are expected to support operational effectiveness, resource utilization, and performance. Ecological knowledge explains how fishermen adapt operational decisions to resource conditions, while socio-ecological systems reasoning suggests that operational effectiveness may contribute to performance directly or through resource utilization. The model positions fisher capabilities as a factor related to operational effectiveness and resource utilization, while operational effectiveness is also examined in relation to resource utilization (Sarwati et al., 2025). These three constructs are then linked to the performance of the floating lift net. The relationships tested include fishermen's capabilities to operational effectiveness, fishermen's capabilities to resource utilization, operational effectiveness to resource utilization, fishermen's capabilities to floating lift net performance, operational effectiveness to floating lift net performance, and resource utilization to floating lift net performance (Hatmar & Nelwan, 2026). These six positive direct associations are hypothesized as H1 (X1→X2), H2 (X1→M), H3 (X2→M), H4 (X1→Y), H5 (X2→Y), and H6 (M→Y). Four indirect relationships are further hypothesized: H7 (X1→M→Y), H8 (X2→M→Y), H9 (X1→X2→Y), and H10 (X1→X2→M→Y), reflecting the proposed resource-utilization, operational, and sequential pathways linking fishermen's capabilities to performance. This model provides an empirical framework for examining the performance of floating lift nets not only in terms of catch yields, but also in terms of the fishermen's capabilities and operational processes that support resource utilization.

This study aims to analyze the relationship between fishermen's capabilities, lift net operational effectiveness, utilization of small pelagic fish resources, and floating lift net performance in the Makassar Strait waters off Sabang Village, Balaesang District, Donggala Regency, Central Sulawesi, Indonesia. Specifically, the study tests six direct and four indirect relationships in the model and develops an empirical model regarding factors related to floating lift net performance. The study uses a quantitative approach through a survey of fishermen directly involved in fishing activities using lift nets. Data were analyzed using Structural Equation Modeling-Partial Least Squares (SEM-PLS) with the help of SmartPLS to test the relationships between constructs simultaneously. The results of the study are expected to expand the study of floating lift net performance by integrating human factors, operational effectiveness, and utilization of small pelagic fish resources in one empirical model.

METHODS

This study uses a quantitative approach with explanatory research to analyze the relationship between variables that shape the performance of floating lift nets in utilizing small pelagic fish resources. The research model consists of four constructs, namely Fishermen's

Capabilities (X1), Floating Lift Net Operational Effectiveness (X2), Utilization of Small Pelagic Fish Resources (M), and Floating Lift Net Performance (Y). The model tests six direct relationships, namely X1→X2, X1→M, X2→M, X1→Y, X2→Y, and M→Y. Four specific indirect relationships were also examined: X1→M→Y (H7), X2→M→Y (H8), X1→X2→Y (H9), and X1→X2→M→Y (H10), corresponding to the hypothesized indirect and sequential pathways. The data used are primary data collected through a survey using a structured questionnaire and analyzed with Structural Equation Modeling-Partial Least Squares (SEM-PLS) using SmartPLS. Given the cross-sectional design, the estimated relationships are interpreted as associations rather than established causal effects.

The study was conducted on floating lift net fishing activities in the Makassar Strait waters off Sabang Village, Balaesang District, Donggala Regency, Central Sulawesi Province, Indonesia. The study population included fishermen directly involved in floating lift net operational activities, including lift net owners or operators, captains or operators, and crew members. Individual fishermen constituted the unit of analysis. Sampling was conducted using purposive sampling with the criteria of respondents being at least 18 years old, actively involved in fishing activities using floating lift nets, having at least one year of experience using floating lift nets, being directly involved in operational activities, and understanding the fishing process and results. Based on these criteria, the number of research samples was set at 300 respondents. The structural model contains a maximum of three predictors for an endogenous construct; nevertheless, sample adequacy must be distinguished from statistical power to detect very small effects. Potential clustering of respondents within the same fishing unit may also affect the independence of observations and should be considered when interpreting the estimates. Respondent characteristics collected included gender, age, education, role in *lift net* activities, fishing experience, and frequency of operations.

Data were collected through a structured questionnaire completed in person with assistance when necessary. The instrument used a five-point Likert scale, namely 1 = strongly disagree, 2 = disagree, 3 = neutral or undecided, 4 = agree, and 5 = strongly agree. Fishermen's capability (X1) was measured through eight indicators including knowledge of water characteristics, fishing season, location selection and operating time, ability to operate a floating lift net, use of lighting technology, fishing experience, and ability to adapt to changing fishing conditions. The constructs were modeled reflectively, treating their indicators as observed manifestations of the underlying concepts rather than independently weighted components.

The Operational Effectiveness of the Floating Lift Net (X2) is measured through eight indicators which include equipment readiness, lighting effectiveness, operational timeliness, location selection, time efficiency, fuel or energy efficiency, smooth setting and hauling, and the ability to minimize operational disruptions. The Utilization of Small Pelagic Fish Resources (M) also consists of eight indicators, namely the ability to obtain target fish, utilization of fishing areas, adjustment to the season, consistency of utilization, selectivity of catch results, optimization of catch results, reduction of unutilized catch results, and attention to resource sustainability.

The performance of the floating lift net (Y) was measured using eight indicators, including target catch achievement, productivity, yield consistency, cost efficiency, time efficiency, operational success, effectiveness of floating lift net use in catching small pelagic fish, and operational sustainability. Thus, each research construct was represented by eight indicators assessed using a Likert scale. Performance was measured through fishermen's perceptions rather than independently verified catch, fishing effort, fuel consumption, or cost records. Conceptually, operational effectiveness concerns the execution of fishing processes, whereas performance reflects perceived operational outcomes. However, overlapping efficiency-related indicators may blur construct boundaries, even when discriminant validity criteria are satisfied.

Furthermore, collecting predictor and outcome measures from the same respondents introduces potential common-method bias that may inflate estimated associations.

Data analysis was conducted through descriptive analysis and SEM-PLS. PLS-SEM was employed to estimate the interconnected direct and indirect relationships and assess the model's explanatory and predictive performance. Descriptive analysis was used to describe the characteristics of respondents, while the evaluation of the measurement model was conducted through outer loading, Cronbach's Alpha, rho_A, Composite Reliability, AVE, convergent validity, and HTMT for discriminant validity. The assessment applied outer loading and reliability thresholds of 0.70, AVE above 0.50, and HTMT below 0.90. The evaluation of the structural model included VIF, path coefficient, R^2, f^2, and Q^2. PLSpredict was additionally used to compare indicator-level prediction errors against a linear-model benchmark using RMSE and MAE. Hypothesis testing was conducted by bootstrapping on SmartPLS through path coefficient values, t-statistics, p-values, and confidence intervals. Statistical significance was evaluated at $\alpha = 0.05$, with effect sizes considered separately from significance. Six direct hypotheses (H1–H6) and four specific indirect hypotheses (H7–H10) were evaluated. The indirect relationships were assessed using bootstrapped specific indirect effects to distinguish direct associations from indirect and sequential pathways.

RESULTS AND DISCUSSION

Respondent Characteristics

Table 1. Respondent Characteristics

Characteristics	Category	Frequency (n)	Percentage (%)
Gender	Man	296	98.67
	Woman	4	1.33
Age	18–30 years	48	16.00
	31–40 years	116	38.67
	41–50 years	99	33.00
	51–60 years	34	11.33
	≥61 years	3	1.00
Education	Elementary School/Equivalent	52	17.33
	Junior High School/Equivalent	101	33.67
	High School/Equivalent	117	39.00
	Diploma/Bachelor's Degree	30	10.00
Roles in the floating lift net	Owner/Operator	92	30.67
	Captain/Operator	103	34.33
	crew/fishermen	105	35.00
Sea experience	1–10 years	57	19.00
	11–20 years	112	37.33
	21–30 years	93	31.00
	31–40 years	38	12.67
Operating frequency	1–2 times/week	49	16.33
	3–4 times/week	112	37.33
	5–6 times/week	88	29.33
	Every day/according to the season	51	17.00
Total respondents		300	100.00

Respondent characteristics show that floating lift net operational activities in this study were dominated by men, namely 296 people or 98.67%, while women numbered 4 people or 1.33%. In terms of age, the majority of respondents were in the 31–40 year group, as many as 116 people (38.67%), followed by the 41–50 year group as many as 99 people (33.00%). Respondents aged 18–30 years numbered 48 people (16.00%), while the 51–60 year group numbered 34 people (11.33%) and respondents aged ≥61 years as many as 3 people (1.00%). This composition shows that most respondents are in the productive age group and have been involved in floating lift net fishing activities.

The educational level of respondents was dominated by high school/equivalent as many as 117 people (39.00%), then junior high school/equivalent as many as 101 people (33.67%) and elementary school/equivalent as many as 52 people (17.33%). Respondents with Diploma/S1 education numbered 30 people (10.00%). Based on their roles in floating lift net activities, the composition of respondents was relatively even, namely 105 people (35.00%) acted as crew/fishermen, 103 people (34.33%) as captains/operators, and 92 people (30.67%) as owners/operators. This composition provides a representation of several positions directly involved in the operation of floating lift nets.

Respondents' fishing experience also indicates a fairly long level of involvement in fishing activities. A total of 112 respondents (37.33%) had 11–20 years of fishing experience, followed by 93 respondents (31.00%) with 21–30 years of experience. Respondents with 1–10 years of experience numbered 57 people (19.00%), while 38 people (12.67%) had 31–40 years of experience. In terms of operational frequency, activities were most often carried out 3–4 times per week by 112 respondents (37.33%), followed by 5–6 times per week by 88 respondents (29.33%). A total of 51 respondents (17.00%) carried out operations every day or adjusted to the season, while 49 respondents (16.33%) carried out operations 1–2 times per week. This composition shows that the majority of respondents have experience at sea and quite intensive operational involvement, so it is relevant to provide an assessment of fishermen's capabilities, operational effectiveness, utilization of small pelagic fish resources, and floating lift net performance.

Measurement Model Assessment

Table 2. Outer Loading

Construct	Indicator	Outer Loading	Information
Fisherman's Capability (X1)	X1.1	0.761	Valid
	X1.2	0.743	Valid
	X1.3	0.740	Valid
	X1.4	0.711	Valid
	X1.5	0.718	Valid
	X1.6	0.746	Valid
	X1.7	0.751	Valid
	X1.8	0.766	Valid
Floating Lift Net Operational Effectiveness (X2)	X2.1	0.762	Valid
	X2.2	0.796	Valid
	X2.3	0.739	Valid
	X2.4	0.760	Valid
	X2.5	0.716	Valid
	X2.6	0.745	Valid
	X2.7	0.771	Valid
	X2.8	0.738	Valid
Utilization of Small Pelagic Fish Resources (M)	M1	0.804	Valid
	M2	0.771	Valid
	M3	0.779	Valid
	M4	0.740	Valid
	M5	0.762	Valid
	M6	0.799	Valid
	M7	0.763	Valid
	M8	0.750	Valid
Floating Lift Net Performance (Y)	Y1	0.806	Valid
	Y2	0.769	Valid
	Y3	0.795	Valid
	Y4	0.777	Valid
	Y5	0.766	Valid
	Y6	0.768	Valid
	Y7	0.786	Valid

Y8	0.735	Valid

Evaluation of the measurement model shows that all research indicators have outer loading values above 0.70. In the Fisherman's Capability construct (X1), the outer loading value is in the range of 0.711–0.766. The highest value is found in X1.8 at 0.766, while the lowest value is found in X1.4 at 0.711. This condition indicates that all indicators are able to reflect the Fisherman's Capability construct well.

The Floating Lift Net Operational Effectiveness construct (X2) has an outer loading value between 0.716–0.796. The indicator with the highest value is X2.2 at 0.796, while the lowest value is X2.5 at 0.716. All indicators remain above the 0.70 limit, so no indicators need to be eliminated from this construct.

In the Small Pelagic Fish Resource Utilization construct (M), the outer loading values ranged from 0.740 to 0.804. M1 had the highest value of 0.804, followed by M6 at 0.799, and M4 at the lowest value of 0.740. All indicators met the established criteria and demonstrated adequate ability to represent the small pelagic fish resource utilization construct.

The Floating Lift Net Performance construct (Y) shows an outer loading value between 0.735–0.806. The highest value is found in Y1 at 0.806, while the lowest value is found in Y8 at 0.735. With all values above 0.70, the indicators in the Floating Lift Net Performance construct are considered to meet the convergent validity criteria at the indicator level. Overall, 32 indicators used in the research model meet the outer loading criteria so that all indicators are retained for the next stage of the measurement model evaluation.

Table 3. Reliability Test and Convergent Validity of Constructs

Construct	Cronbach's Alpha	Composite Reliability (rho_A)	Composite Reliability (rho_C)	AVE	Information
Fisherman's Capability (X1)	0.883	0.885	0.907	0.551	Reliable and valid
Floating Lift Net Operational Effectiveness (X2)	0.891	0.893	0.913	0.568	Reliable and valid
Utilization of Small Pelagic Fish Resources (M)	0.903	0.905	0.922	0.595	Reliable and valid
Floating Lift Net Performance (Y)	0.905	0.908	0.924	0.602	Reliable and valid

The quality of the instruments indicates that all research constructs have a good level of reliability. Fishermen's Capability (X1) obtained a Cronbach's Alpha of 0.883, rho_A of 0.885, and Composite Reliability of 0.907. Floating Lift Net Operational Effectiveness (X2) had a Cronbach's Alpha of 0.891, rho_A of 0.893, and Composite Reliability of 0.913. Meanwhile, Small Pelagic Fish Resource Utilization (M) produced a Cronbach's Alpha of 0.903, rho_A of 0.905, and Composite Reliability of 0.922. Floating Lift Net Performance (Y) had a Cronbach's Alpha of 0.905, rho_A of 0.908, and Composite Reliability of 0.924. All of these values are above the 0.70 limit, so that the indicators for each construct show adequate internal consistency.

Convergent validity was also met for all constructs. The AVE value for Fishermen's Capability was 0.551, Floating Lift Net Operational Effectiveness was 0.568, Utilization of Small Pelagic Fish Resources was 0.595, and Floating Lift Net Performance was 0.602. All AVE values were above 0.50, indicating that each construct was able to explain more than half of the variance of its indicators. This result is consistent with the outer loading values for all indicators, which were previously above 0.70. Thus, all 32 indicators were retained, and the measurement model met the requirements for reliability and convergent validity to proceed to the evaluation of discriminant validity and the structural model.

Table 4. Discriminant Validity Test (HTMT)

Construct	M	X1	X2	Y
Utilization of Small Pelagic Fish Resources (M)	-	-	-	-
Fisherman's Capability (X1)	0.510	-	-	-
Floating Lift Net Operational Effectiveness (X2)	0.584	0.615	-	-

Floating Lift Net Performance (Y)	0.610	0.606	0.519	-

The discriminant validity of all research constructs is fulfilled with HTMT values in the range of 0.510–0.615. The relationship between Small Pelagic Fish Resource Utilization (M) and Fishermen's Capability (X1) has an HTMT value of 0.510, while the relationship between M and the Floating Lift Net Operational Effectiveness (X2) is 0.584 and M with the Floating Lift Net Performance (Y) is 0.610. Furthermore, the HTMT value between Fishermen's Capability (X1) and the Floating Lift Net Operational Effectiveness (X2) is 0.615, X1 with the Floating Lift Net Performance (Y) is 0.606, and X2 with Y is 0.519.

All HTMT values were well below the 0.90 threshold. These results indicate that each construct has distinct empirical characteristics, and its indicators better represent the construct being measured than the others. Nevertheless, statistical discriminant validity does not entirely eliminate potential content overlap between efficiency-related indicators of operational effectiveness and performance. Thus, the measurement model meets the criteria for discriminant validity and can proceed to the structural model evaluation stage to test the relationships between constructs in the research model.

Structural Model Assessment

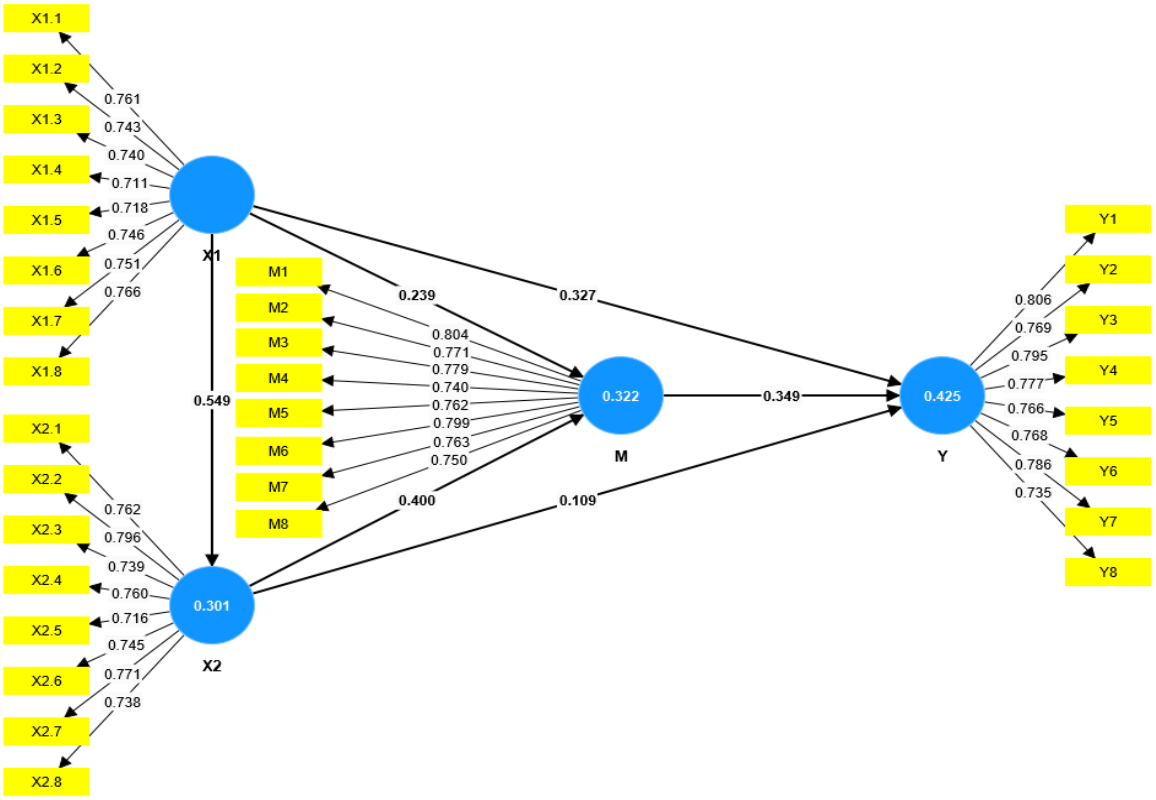


Figure 1. Structural Model of Floating Lift Net Performance

The structural model shows that Fisherman's Capability (X1) has a path coefficient of 0.549 on the Floating Lift Net Operational Effectiveness (X2). This value indicates a positive relationship between fishermen's capability and operational effectiveness, so that increasing fishermen's capability is related to increasing effectiveness in carrying out floating lift net operational activities. Construct X2 has an R^2 value of 0.301, which means that Fisherman's Capability is able to explain 30.1% of the variation in the Floating Lift Net Operational Effectiveness in the research model.

Fisherman's Capability (X1) also has a path coefficient of 0.239 towards the Utilization of Small Pelagic Fish Resources (M), while the Floating Lift Net Operational Effectiveness (X2) has a path coefficient of 0.400 towards M. Both relationships show a positive direction, with the coefficient of X2→M being greater than X1→M. The R^2 value in the M construct of 0.322 indicates that Fisherman's Capability and Floating Lift Net Operational Effectiveness together are able to explain 32.2% of the variation in the Utilization of Small Pelagic Fish Resources.

In the direct relationship to Floating Lift Net Performance (Y), Fisherman Capability (X1) has a path coefficient of 0.327, Floating Lift Net Operational Effectiveness (X2) of 0.109, and Utilization of Small Pelagic Fish Resources (M) of 0.349. All coefficients show a positive direction. The path coefficient M→Y is the largest among the three direct paths to Floating Lift Net Performance, followed by X1→Y and X2→Y. The R^2 value of construct Y of 0.425 indicates that Fisherman Capability, Floating Lift Net Operational Effectiveness, and Utilization of Small Pelagic Fish Resources together explain 42.5% of the variation in Floating Lift Net Performance, while the remaining 57.5% is related to other factors outside the research model.

Overall, the structural model shows that the four constructs have a positive relationship according to the direction of the relationship designed in the research model. Fisherman Capability is related to the Floating Lift Net Operational Effectiveness and Utilization of Small Pelagic Fish Resources, while the three predictor constructs have a direct relationship with the Floating Lift Net Performance. However, the path coefficient values in the figure cannot be used to determine statistical support for the hypothesis. Decisions regarding H1 to H10 need to be based on the results of bootstrapping, especially the t-statistic, p-value, and confidence interval.

Table 5. Multicollinearity Test (Inner VIF)

Relationship between constructs	VIF	Information
X1 → X2	1.000	No problematic collinearity
X1 → M	1.431	No problematic collinearity
X2 → M	1.431	No problematic collinearity
X1 → Y	1.516	No problematic collinearity
X2 → Y	1.667	No problematic collinearity
M → Y	1.475	No problematic collinearity

Multicollinearity examination shows that all predictor relationships in the model have low VIF values, namely between 1.000 and 1.667. The relationship between Fisherman Capability (X1) and the Floating Lift Net Operational Effectiveness (X2) has a VIF value of 1.000. In the construct of Small Pelagic Fish Resource Utilization (M), the VIF values for X1→M and X2→M are 1.431, respectively. Meanwhile, in the construct of Floating Lift Net Performance (Y), the VIF values for X1→Y are 1.516, X2→Y are 1.667, and M→Y are 1.475.

All VIF values were below 5.00, indicating no problematic multicollinearity among the predictor constructs in the structural model. This condition indicates that Fisherman Capability, Floating Lift Net Operational Effectiveness, and Utilization of Small Pelagic Fish Resources can be used together in testing structural relationships without showing significant collinearity problems. Thus, the structural model meets the collinearity criteria and can proceed to evaluate the model's explanatory power through the R^2 value and the f^2 effect size.

Table 6. R-Square (R^2)

Endogenous Construct	R-Square (R^2)	R-Square Adjusted	Information
Floating Lift Net Operational Effectiveness (X2)	0.301	0.299	30.1% is explained by X1
Utilization of Small Pelagic Fish Resources (M)	0.322	0.318	32.2% is explained by X1 and X2
Floating Lift Net Performance (Y)	0.425	0.419	42.5% is explained by X1, X2, and M

The model's explanatory power shows that the Floating Lift Net Operational Effectiveness (X2) has an R^2 value of 0.301 and an adjusted R^2 of 0.299. These results indicate that Fishermen's Capability (X1) is able to explain 30.1% of the variation in the Floating Lift Net Operational Effectiveness, while the remaining 69.9% is explained by other factors outside the research model. The very small difference between the R^2 and adjusted R^2 values indicates that the model's explanatory ability is relatively stable after considering the number of predictors used.

The utilization of small pelagic fish resources (M) has an R^2 value of 0.322 with an adjusted R^2 of 0.318. This means that Fisherman Capability (X1) and Floating Lift Net Operational Effectiveness (X2) together are able to explain 32.2% of the variation in the utilization of small pelagic fish resources. Meanwhile, 67.8% of the variation in this construct is related to other factors not included in the research model.

The performance of the floating lift net (Y) has an R^2 value of 0.425 and an adjusted R^2 of 0.419. This indicates that Fisherman Capability (X1), Floating Lift Net Operational Effectiveness (X2), and Utilization of Small Pelagic Fish Resources (M) together are able to explain 42.5% of the variation in the performance of the floating lift net. The remaining 57.5% is explained by other factors outside the model. The R^2 value indicates that the model has a higher explanatory power for the construct of floating lift net performance compared to the other two endogenous constructs. Thus, the structural model provides moderate explanatory power for the variation in the performance of the floating lift net in the context of this study.

Table 7. Effect Size (f^2)

Predictor Construct	Endogenous Construct	f^2	Information
Fisherman's Capability (X1)	Utilization of Small Pelagic Fish Resources (M)	0.059	Small effect
Floating Lift Net Operational Effectiveness (X2)	Utilization of Small Pelagic Fish Resources (M)	0.165	Moderate effect
Fisherman's Capability (X1)	Floating Lift Net Operational Effectiveness (X2)	0.431	Large effect
Fisherman's Capability (X1)	Floating Lift Net Performance (Y)	0.122	Small effect
Floating Lift Net Operational Effectiveness (X2)	Floating Lift Net Performance (Y)	0.012	Very small effect
Utilization of Small Pelagic Fish Resources (M)	Floating Lift Net Performance (Y)	0.143	Small effect

The magnitude of the effect of each construct indicates the variation in contribution in explaining the endogenous construct. Fisherman's Capability (X1) has an f^2 value of 0.431 on the Floating Lift Net Operational Effectiveness (X2), which indicates a relatively large contribution. This result indicates that the presence of Fisherman's Capability has a substantive contribution to the variation in the Floating Lift Net Operational Effectiveness in the model.

In the construct of Small Pelagic Fish Resource Utilization (M), the Floating Lift Net Operational Effectiveness (X2) has an f^2 value of 0.165, while the Fisherman's Capability (X1) has an f^2 value of 0.059. These values indicate that the contribution of X2 to M is at a moderate level, while the contribution of X1 to M is at a small level. Thus, the variation in the utilization of small pelagic fish resources in the model has a relatively greater contribution from the Floating Lift Net Operational Effectiveness compared to the Fisherman's Capability.

On the Floating Lift Net Performance (Y), the Utilization of Small Pelagic Fish Resources (M) has an f^2 value of 0.143 and Fishermen's Capability (X1) of 0.122. Both values indicate a small effect. Meanwhile, the Floating Lift Net Operational Effectiveness (X2) has an f^2 value of 0.012 on Y, which indicates a very small effect. These results indicate that the relative contribution of each predictor to the Floating Lift Net Performance is different, with M and X1 providing a greater contribution than X2 in the research model.

Overall, the f^2 value shows that the X1→X2 relationship has the largest relative contribution in the model, while the X2→Y relationship has the smallest relative contribution. This finding complements the R^2 results by providing information regarding changes in the explanatory power of endogenous constructs when each predictor construct is considered in the model.

Table 8. Predictive Relevance (Q^2)

Construct	SSO	SSE	Q^2	Information

Floating Lift Net Operational Effectiveness (X2)	2,400.000	2,002.641	0.166	Positive predictive relevance
Utilization of Small Pelagic Fish Resources (M)	2,400.000	1,958.882	0.184	Positive predictive relevance
Floating Lift Net Performance (Y)	2,400.000	1,803.568	0.249	Positive predictive relevance
Fisherman's Capability (X1)	—	—	—	Not evaluated as an endogenous construct

The model's cross-validated redundancy assessment indicates that the endogenous constructs have positive Q^2 values. Floating Lift Net Operational Effectiveness (X2) obtained a Q^2 value of 0.166, Small Pelagic Fish Resource Utilization (M) of 0.184, and Floating Lift Net Performance (Y) of 0.249. These positive values indicate predictive relevance under the cross-validated redundancy procedure, rather than independently establishing strong out-of-sample predictive performance.

The Q^2 value for Floating Lift Net Performance (Y) is the highest, at 0.249. This indicates greater cross-validated predictive relevance compared to Small Pelagic Fish Resource Utilization and Floating Lift Net Operational Effectiveness. Furthermore, the Q^2 value for Small Pelagic Fish Resource Utilization of 0.184 and Floating Lift Net Operational Effectiveness of 0.166 also indicates positive predictive relevance for both constructs.

Fisherman Capability (X1) was not evaluated for Q^2 because it is an exogenous construct that is not predicted by other constructs in the model. Therefore, no predictive-relevance conclusion is drawn for X1. Overall, the Q^2 results indicate that the model has predictive relevance for all endogenous constructs, namely the Floating Lift Net Operational Effectiveness, Utilization of Small Pelagic Fish Resources, and Floating Lift Net Performance.

Table 9. PLSpredict

Indicator	Q^2predict	PLS-SEM RMSE	PLS-SEM MAE	LM RMSE	LM MAE
M1	0.138	0.702	0.579	0.714	0.589
M2	0.105	0.698	0.564	0.711	0.573
M3	0.116	0.675	0.547	0.682	0.553
M4	0.096	0.690	0.567	0.702	0.576
M5	0.087	0.725	0.598	0.737	0.611
M6	0.132	0.715	0.576	0.725	0.587
M7	0.108	0.734	0.597	0.748	0.609
M8	0.170	0.686	0.560	0.700	0.572
X2.1	0.187	0.649	0.527	0.660	0.534
X2.2	0.177	0.684	0.541	0.700	0.556
X2.3	0.179	0.642	0.517	0.654	0.526
X2.4	0.160	0.685	0.559	0.699	0.571
X2.5	0.105	0.649	0.526	0.660	0.540
X2.6	0.173	0.658	0.529	0.672	0.539
X2.7	0.160	0.676	0.536	0.685	0.544
X2.8	0.170	0.644	0.529	0.651	0.526
Y1	0.201	0.566	0.475	0.574	0.482
Y2	0.149	0.619	0.523	0.620	0.518
Y3	0.167	0.578	0.492	0.586	0.497
Y4	0.194	0.566	0.471	0.569	0.469
Y5	0.179	0.584	0.490	0.590	0.491
Y6	0.144	0.582	0.489	0.591	0.498
Y7	0.203	0.549	0.453	0.554	0.447
Y8	0.142	0.604	0.502	0.613	0.510

The PLSpredict results show that all endogenous indicators in the constructs of Small Pelagic Fish Resource Utilization (M), Floating Lift Net Operational Effectiveness (X2), and Floating Lift Net Performance (Y) have positive Q^2predict values, with a range of 0.087 to 0.203. These results indicate positive out-of-sample predictive relevance, although prediction accuracy must also be evaluated against the linear-model benchmark.

Comparison of RMSE values also shows that PLS-SEM produces lower RMSE values than the benchmark Linear Model (LM) for all 24 endogenous indicators. However, MAE comparisons favor the linear model for X2.8, Y2, Y4, and Y7, while PLS-SEM performs better for the remaining 20 indicators. Therefore, the model demonstrates favorable RMSE-based predictive performance, but the mixed MAE results warrant a more cautious assessment of overall prediction accuracy.

Overall, these results indicate that the model has predictive relevance, which is consistent with the previous Q^2 Construct Cross-Validated Redundancy results. The previous Q^2 values were 0.166 for X2, 0.184 for M, and 0.249 for Y, so the PLSpredict evaluation provides additional evidence that the model has the ability to predict endogenous construct indicators. Nevertheless, these findings support predictive relevance and favorable performance against the linear benchmark on most error comparisons, rather than uniformly strong predictive accuracy.

Hypothesis Testing

Table 10. Direct Effects

Hypothesis	Track	Path Coefficient (β)	T-statistic	P-value	Decision
H1	X1 → X2	0.549	13.887	< .001	Supported
H2	X1 → M	0.239	3.997	< .001	Supported
H3	X2 → M	0.400	7.273	< .001	Supported
H4	X1 → Y	0.327	6.920	< .001	Supported
H5	X2 → Y	0.109	1.948	.051	Not supported
H6	M → Y	0.349	6.028	< .001	Supported

The results of the hypothesis testing indicate that five of the six direct relationships in the research model are empirically supported, while one relationship is not significant at the 5% level. Fisherman capability has a positive and significant association with floating lift net operational effectiveness, with a path coefficient of 0.549, a t-statistic of 13.887, and $p < .001$. These results support H1, which indicates that higher fishermen's capability is associated with greater operational effectiveness. The corresponding f^2 value of 0.431 indicates a large substantive contribution.

Fishermen's capability also has a positive and significant association with the utilization of small pelagic fish resources, with a path coefficient of 0.239, a t-statistic of 3.997, and $p < .001$. Thus, H2 is supported. These findings indicate that knowledge, experience, the ability to determine the location and time of operations, and the ability of fishermen to adapt are related to the ability to utilize small pelagic fish resources more effectively. The f^2 value of 0.059 indicates a small effect.

The Floating Lift Net Operational Effectiveness has a positive and significant association with the Utilization of Small Pelagic Fish Resources, with a path coefficient of 0.400, a t-statistic of 7.273, and $p < .001$. These results support H3. This means that equipment readiness, lighting effectiveness, timeliness and location of operations, time and energy efficiency, and the smoothness of the setting and hauling processes are related to the utilization of small pelagic fish resources. The f^2 value of 0.165 indicates a moderate effect.

Furthermore, Fishermen's Capability has a positive and significant association with Floating Lift Net Performance, with a path coefficient of 0.327, a t-statistic of 6.920, and $p < .001$. Therefore, H4 is supported. These results indicate that fishermen's capability has a direct relationship with perceived floating lift net performance, including productivity, operational efficiency, catch achievement, and the success of fishing activities. Its f^2 value of 0.122 indicates a small effect.

Unlike other relationships, Floating Lift Net Operational Effectiveness has a positive coefficient of 0.109 on Floating Lift Net Performance, but the relationship does not reach statistical significance at the 5% level, with a t-statistic of 1.948 and a p-value of 0.051. Thus, H5 is not supported. This result is statistically inconclusive at the specified significance threshold and should not be interpreted as evidence that the relationship is absent. The f^2 value of 0.012 also indicates a very small contribution to explained variance. This finding needs to be read in

conjunction with the results of specific indirect effects, because the path X2 → M → Y shows a statistically significant indirect association.

The utilization of small pelagic fish resources has a positive and significant association with floating lift net performance, with a path coefficient of 0.349, a t-statistic of 6.028, and p < .001. These results support H6. This finding indicates that greater perceived resource utilization is associated with higher perceived floating lift net performance, as reflected in the achievement of catch results, productivity, efficiency, operational success, and sustainability. The corresponding f^2 value of 0.143 indicates a small effect.

Overall, the test results indicate that H1, H2, H3, H4, and H6 are supported, while H5 is not supported. This pattern shows that Fisherman Capability has a direct relationship with Operational Effectiveness, Resource Utilization, and Floating Lift Net Performance. Meanwhile, the relationship between Operational Effectiveness and Floating Lift Net Performance is not statistically significant at α = .05. Therefore, the results of specific indirect effects are important to explain whether the association between Operational Effectiveness and Floating Lift Net Performance is consistent with an indirect pathway through Small Pelagic Fish Resource Utilization.

Table 11. Specific Indirect Effects

Specific Indirect Effect	Original Sample (O)	Sample Mean (M)	STDEV	T Statistics	P Values	Decision
H7: X1 → M → Y	0.083	0.084	0.025	3.277	.001	Significant
H10: X1 → X2 → M → Y	0.077	0.078	0.017	4.445	< .001	Significant
H8: X2 → M → Y	0.140	0.141	0.030	4.673	< .001	Significant
H9: X1 → X2 → Y	0.060	0.061	0.032	1.881	.060	Not significant

The results of specific indirect effects show that X1 → M → Y has an indirect effect coefficient of 0.083 with a t-statistic of 3.277 and a p-value of 0.001. These results indicate that Fishermen's Capability has a significant indirect association with Floating Lift Net Performance through the Utilization of Small Pelagic Fish Resources. Thus, higher fishermen's capabilities are associated with better resource utilization, which is subsequently associated with higher perceived performance. These findings support H7.

The path X1 → X2 → M → Y produces a coefficient of 0.077, a t-statistic of 4.445, and p < .001. These results indicate a significant serial indirect association. This means that Fisherman Capability is related to the Floating Lift Net Operational Effectiveness, then the operational effectiveness is related to the Utilization of Small Pelagic Fish Resources, and finally related to the Floating Lift Net Performance. This pattern supports H10 and is consistent with the hypothesized sequential pathway, although the cross-sectional design does not establish temporal causality.

Furthermore, the path X2 → M → Y has a coefficient of 0.140 with a t-statistic of 4.673 and p < .001. These results indicate that the Floating Lift Net Operational Effectiveness has a significant indirect association with Floating Lift Net Performance through the Utilization of Small Pelagic Fish Resources. The indirect effect coefficient of 0.140 indicates that the resource-utilization pathway is an important component of the association between operational effectiveness and perceived performance. H8 is therefore supported, while the corresponding direct path H5 remains statistically inconclusive. This pattern is consistent with indirect-only mediation in the specified statistical model, without establishing a causal mediation mechanism.

Meanwhile, the path X1 → X2 → Y produces a coefficient of 0.060 with a t-statistic of 1.881 and a p-value of 0.060. Since the p-value is greater than 0.05, the indirect effect is not significant. Thus, in this research model there is not enough evidence that Fishermen's Capability is indirectly associated with Floating Lift Net Performance through Operational Effectiveness alone, without going through the Utilization of Small Pelagic Fish Resources. Consequently, H9 is not supported.

Table 12. Total Effects

Connection	Original Sample (O)	Sample Mean (M)	STDEV	T Statistics	P Values	Decision
M → Y	0.349	0.351	0.058	6.028	< .001	Significant
X1 → M	0.459	0.461	0.044	10.390	< .001	Significant
X1 → X2	0.549	0.553	0.040	13.887	< .001	Significant
X1 → Y	0.547	0.549	0.039	14.036	< .001	Significant
X2 → M	0.400	0.401	0.055	7.273	< .001	Significant
X2 → Y	0.249	0.251	0.048	5.164	< .001	Significant

17 The total effects results show that all relationships in the model have a significant total association at the 5% level. The total effect estimate of Fishermen's Capability on Floating Lift Net Performance is 0.547 with a t-statistic of 14.036 and p < .001. This value is greater than the direct effect of X1 → Y of 0.327 because it includes the contribution of several indirect paths in the model.

Floating Lift Net Operational Effectiveness has a total effect on Floating Lift Net Performance of 0.249, with a t-statistic of 5.164 and p < .001. This result differs from the direct 61 effect of X2 → Y, which is 0.109 and is not significant at the 5% level. This difference indicates that the association between operational effectiveness and perceived performance is primarily reflected in the indirect pathway through Small Pelagic Fish Resource Utilization.

The utilization of Small Pelagic Fish Resources has a direct and total effect on the Floating Lift Net Performance of 0.349, with a t-statistic of 6.028 and p < .001. Since Y has no other path after M in the model, the total effect value of M → Y is the same as the direct effect of M → Y.

Discussion

The results of the study indicate that the performance of floating lift nets is not only related to the ability of fishing gear to produce fish, but is also associated with fishermen's capabilities, operational effectiveness, and the ability to utilize small pelagic fish resources. The relationship patterns in the model also show that human factors are an important foundation for operational processes, while resource utilization is one of the proposed pathways linking the fishing process 36 to lift net performance (Stacey et al., 2021). This finding aligns with the perspective of Human Capital Theory, which positions individual knowledge, skills, experience, and abilities as resources that can increase productivity. In the context of small-scale fisheries, this perspective is relevant because fishing decisions depend largely on fishermen's ability to read water conditions and adapt their actions to resource dynamics (Malik & Kristiana, 2021). Research on knowledge acquisition in small-scale fisheries further emphasizes the importance of fishermen's understanding of fishing systems and resource conditions (Klein et al., 2021). However, the present findings extend this perspective by suggesting that human capabilities may be associated with performance through both direct and 62 resource-utilization pathways.

The positive relationship between Fisherman Capabilities and Floating Lift Net Operational Effectiveness indicates that human capabilities are integral to the success of floating lift net operations. Knowledge of water characteristics, fishing seasons, fishing locations, operating times, and equipment operating skills enable fishermen to make more informed operational decisions. Experience also serves as practical knowledge that helps fishermen recognize changes in water conditions and determine appropriate actions. The fisher ecological knowledge perspective explains that fishermen possess experiential knowledge regarding resource conditions, environmental changes, fish behavior, and the timing of fish group emergence (Gianelli et al., 2021). This knowledge can inform decision-making in fishing activities. Nevertheless, evidence from broader small-scale fisheries contexts may not directly represent the technological and environmental conditions of light-assisted floating lift net operations. Therefore, in this study, fisherman capability can be understood not simply as the technical skill of operating a floating lift net, but as the ability to translate local experience and knowledge into operational decisions appropriate to water conditions. This finding broadens the understanding

of floating lift net performance, as the effectiveness of the tool is not solely dependent on its technological characteristics but also on the human ability to operate it.

The relationship between fisherman's capabilities and the utilization of small pelagic fish resources shows that the ability to utilize resources is associated not only with the presence of fish, but also with the ability of fishermen to recognize and respond to the distribution of these resources. Knowledge of the season, fishing grounds, operating hours, fish behavior, and environmental conditions allows fishermen to adjust fishing activities to the potential presence of target fish (Arthur et al., 2022). This aligns with the concept of Traditional Ecological Knowledge, which views the experiences of coastal communities as a source of ecological information formed through repeated observations of the environment. Such knowledge may provide locally specific information regarding environmental conditions and fishing-ground selection, although its effectiveness can vary across fishing technologies and ecological settings. Integrating local knowledge with oceanographic information can improve the quality of decision-making in dynamic fishing ground management (Putra et al., 2021). Thus, the skills of fishermen in this study have both ecological and operational functions. Fishermen not only determine how fish are caught, but also how available resources are identified, directed, and utilized more appropriately to the conditions of the waters.

The relationship between the operational effectiveness of floating lift nets and the utilization of small pelagic fish resources suggests that technology and operational management are associated with the ability to utilize available resources. In floating lift nets, light serves as a tool to attract and concentrate small pelagic fish in catchable areas. Therefore, the choice of lighting technology, operating hours, location selection, energy efficiency, and the smoothness of the setting and hauling processes may influence how effectively available resources are utilized, although ecological conditions and fishing pressure also affect resource availability (Hilborn et al., 2022). Studies of small-scale fisheries also highlight that resource utilization depends on broader management and environmental conditions beyond fishing-gear efficiency. These findings support the view that operational effectiveness is not simply a matter of operating the equipment according to procedure, but relates to the ability to adjust various operational components to match fish behavior and distribution (Kurniawan & Aini, 2022). In the context of floating lift net fisheries in the Makassar Strait waters of Balaesang, this effectiveness is important because the fishing units can adjust their operating locations in response to fishing-ground conditions. Seasonal oceanographic variability may further influence the distribution and availability of small pelagic fish, limiting the extent to which operational effectiveness alone can explain fishing outcomes (Apriansyah et al., 2022).

The relationship between Fishermen's Capabilities and Floating Lift Net Performance indicates that fishing unit performance has a strong human dimension. Fishermen with better knowledge and experience have a stronger basis for determining actions when water conditions change, selecting operating locations, managing fishing times, and operating equipment appropriately. From a Human Capital Theory perspective, skills and experience constitute productive capital because they can increase an individual's ability to generate output from available resources (W. K. Sari et al., 2022). However, the contribution of individual capabilities may vary according to fishing-unit characteristics, available technology, and environmental conditions. Therefore, perceived floating lift net performance should not be judged solely on catch volume. Performance also reflects the ability of fishers to achieve consistent results, manage time and costs, and maintain successful operations under changing environmental conditions (Apriansyah et al., 2023). The relatively small effect size for the X1→Y pathway (f^2 = 0.122) indicates that human capabilities are relevant but do not independently provide a comprehensive explanation of performance.

The relationship between the Operational Effectiveness of the Floating Lift Net and Floating Lift Net Performance provides more complex findings. The direct effect is not significant at the 5% level, although the direction of the relationship is positive. This result does not establish the absence of a relationship, but indicates insufficient statistical evidence for the direct pathway at

the specified significance threshold. The specific indirect effects provide a stronger explanation because the path Operational Effectiveness → Resource Utilization → Floating Lift Net Performance shows a statistically significant indirect association (β = 0.140, p < .001). Thus, operational effectiveness appears to be more meaningful when it is associated with more effective resource utilization. This explanation aligns with the characteristics of the floating lift net as fishing gear that uses light to concentrate fish before the net lifting process. However, alternative explanations include seasonal changes, variation in fish availability, fishing-unit technology, and unmeasured ecological conditions. Conceptual overlap between operational effectiveness and performance indicators may also affect coefficient estimates. Because the data are cross-sectional, reverse relationships and alternative causal ordering cannot be excluded. Previous studies have emphasized the importance of locally appropriate management arrangements and resource-dependent livelihoods in small-scale fisheries (Booth et al., 2023). Research on Indonesian small-scale fishers also highlights how different combinations of capabilities and available resources shape adaptation to sustainability requirements (Wiranthi et al., 2024a). Therefore, the results of this study provide an important nuance: operational efficiency should not be understood as an end in itself, but as a potentially important component of resource utilization that is associated with perceived performance.

The relationship between small pelagic fish resource utilization and floating lift net performance is one of the key findings in the model. When target fish resources are utilized effectively, the fishing process has a greater chance of producing good productivity and consistency. In the context of this research, resource utilization not only means obtaining large quantities of fish, but also includes accurate fishing grounds, seasonal adjustments, yield consistency, optimal catch utilization, reduction of unused catch, and attention to sustainability. This perspective also recognizes the importance of collective capabilities and group-based sustainability initiatives in small-scale fisheries (Wiranthi et al., 2024b). However, perceived attention to sustainability should be distinguished from independently verified ecological outcomes, such as stock condition, bycatch composition, fishing mortality, and ecosystem health. Research on small-scale fisheries management also demonstrates the relevance of spatial information and stakeholder participation for understanding resource-use dynamics (Rachman et al., 2025). Thus, the performance of the floating lift nets in this study is better understood as an association between perceived resource utilization and operational outcomes, rather than simply increasing catch volume. This finding is also relevant to the characteristics of small pelagic fisheries, which are heavily influenced by fish distribution dynamics and environmental conditions.

Theoretically, this research contributes by shifting the discussion of floating lift net performance from approaches that primarily focus on gear characteristics, catch composition, light intensity, or technical productivity to models that integrate human factors, operational factors, and resource utilization. Recent research on fisheries sustainability has emphasized the importance of balancing economic and ecological considerations in fisheries management (Hidayat et al., 2025). Meanwhile, research on small-scale fishers' perceptions of risk highlights the importance of behavioral and contextual dimensions of fishing activities (Febrica et al., 2025). This study complements this perspective by demonstrating that lift net performance is also related to fishermen's capabilities and how these capabilities are associated with operational effectiveness and resource utilization. The principal theoretical contribution lies in distinguishing direct performance associations from resource-utilization pathways. In particular, the statistically inconclusive direct association between operational effectiveness and performance, alongside a significant indirect association through resource utilization, refines the assumption that technically effective fishing operations necessarily correspond to better performance. This pattern suggests that resource utilization may represent an important intermediate component linking human and operational capabilities to perceived fishing outcomes. However, the findings remain conditional on the ecological, technological, and institutional characteristics of small-scale floating lift net fisheries. Conceptually, the results

support the view that small-scale fisheries are socio-ecological systems, as fishing outcomes are shaped through interactions between humans, technology, resources, and the environment.

The practical implications of this research point to the need for more targeted capacity building for fishermen. Training should not be solely focused on equipment operation but should also encompass the ability to read water conditions, recognize seasonal patterns, determine fishing grounds, manage operating times, use lighting technology effectively, and adapt to changing environmental conditions. Local knowledge of fishermen should also be maintained and combined with scientific information on oceanographic conditions and resources. This approach aligns with developments in fisheries management, which increasingly recognize the importance of fishermen's ecological knowledge in understanding resource dynamics. At the operational level, attention can be directed to operating times, energy efficiency, lighting selection and configuration, equipment readiness, and smooth setup and hauling. Lighting use should be considered part of the operational strategy, not simply as a matter of increasing intensity. However, the effectiveness of these strategies may vary with seasonal fish availability, vessel characteristics, fuel prices, market conditions, and institutional support. At the same time, productivity improvements need to go hand in hand with responsible resource utilization practices. Fishing ground management, seasonal adjustments, reduction of unused catch, and attention to sustainability should be part of operational management (Rizal & Nurdin, 2026). Nevertheless, recommendations concerning ecological sustainability require validation using objective fisheries and environmental indicators rather than perceived performance alone.

Overall, this discussion indicates that perceived floating lift net performance is associated with several interrelated factors rather than a single determinant. Fishermen's capabilities are positively associated with operational effectiveness, resource utilization, and floating lift net performance. Operational effectiveness is strongly related to resource utilization, but its direct association with performance is statistically inconclusive, while the indirect pathway through resource utilization is significant. These findings place Small Pelagic Fish Resource Utilization as a critical component in explaining the statistical relationships between operational processes and perceived floating lift net performance. Therefore, improving perceived floating lift net performance in the study area of the Makassar Strait waters off Sabang Village, Balaesang District, requires an integrated approach that combines strengthening fishers' capacity, decision-making based on fishing ground conditions, efficient use of fishing technology, and productive and responsible resource utilization.

CONCLUSION

The results indicate that fishermen's capabilities are positively associated with operational effectiveness ($\beta = 0.549$, $p < .001$) and resource utilization ($\beta = 0.239$, $p < .001$). Fishermen's capabilities are also directly related to floating lift net performance ($\beta = 0.327$, $p < .001$). Operational effectiveness is positively associated with resource utilization ($\beta = 0.400$, $p < .001$), while its direct association with floating lift net performance is statistically inconclusive at the 5% significance level ($\beta = 0.109$, $p = .051$). Conversely, resource utilization is positively associated with floating lift net performance ($\beta = 0.349$, $p < .001$) and is an important pathway connecting operational factors to performance ($X2 \rightarrow M \rightarrow Y$: $\beta = 0.140$, $p < .001$). The model explains 42.5% of the variance in perceived floating lift net performance. Empirically, this study contributes by developing a model that integrates human, operational, and resource dimensions to explain floating lift net performance. Its theoretical contribution lies in distinguishing direct operational associations from indirect resource-utilization pathways, suggesting that operational effectiveness alone may not sufficiently explain perceived fishing performance.

The practical implications of this research point to the need to improve fishermen's capabilities as part of floating lift net management. Strengthening knowledge regarding water characteristics, fishing seasons, fishing area selection, operating hours, use of lighting technology, and adaptability needs to be a focus in developing fishermen's capacity. At the operational level, equipment readiness, time and energy efficiency, location accuracy, and

smooth setting and hauling processes need to be managed consistently. However, increasing operational effectiveness should be accompanied by effective resource utilization. These recommendations concern perceived performance and do not establish improvements in actual catches or ecological sustainability. The cross-sectional design, purposive sampling, self-reported measurements, and potential within-unit clustering limit causal interpretation and generalizability. Future research could employ longitudinal or panel data designs, expand sampling locations and techniques, and combine perceptual data with operational data and actual catches.

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