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Compound Livelihood Shocks and Household Expenditure in Coastal South Sulawesi

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ABSTRACT

Coastal households in South Sulawesi remain exposed to poverty as environmental stress, labor instability, and market uncertainty disrupt fisheries-based livelihoods. This study examines how compound livelihood shocks affect monthly per capita household expenditure and identifies household capacities that strengthen resilience among poor coastal communities. Six shocks are analyzed: job loss, wage reduction, work-related accident, death of a primary earner, marital disruption, and fish-catch or aquaculture loss. A cross-sectional explanatory survey was conducted with 275 poor coastal households selected through a three-stage stratified sampling strategy across island, rural mainland, and urban littoral settlements. The dependent variable was the natural logarithm of monthly per capita expenditure, and explanatory variables included shock indicators, household size, the household head's age and education, boat ownership, cooperative membership, savings account ownership, productive credit, and reliable fourth-generation mobile connectivity. Data were analyzed using hierarchical Ordinary Least Squares regression with heteroskedasticity-consistent robust standard errors and unconditional quantile regression based on the recentered influence function approach at Q25, Q50, and Q75. The OLS results show that all six shocks significantly reduce expenditure, with fish loss and death of a primary earner producing the largest negative associations. The full OLS model explains 87.4 percent of the variation in logged expenditure in the sample. The unconditional quantile regression results confirm that all six shocks remain negative and statistically significant across Q25, Q50, and Q75, indicating that livelihood shocks depress expenditure across different segments of poor coastal households. Education, savings, credit access, reliable mobile coverage, and boat ownership are positively associated with expenditure. The findings support an integrated coastal poverty policy that combines adaptive social protection, fisheries-risk mitigation, financial inclusion, digital infrastructure, and targeted productive asset support.

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■ INTRODUCTION

Coastal households in many parts of the Global South live close to productive marine resources, yet their livelihoods face high uncertainty. Fisheries, aquaculture, fish processing, small-scale trade, and coastal services provide income for millions of households. However, these activities are sensitive to ecological change, seasonal fluctuations, unstable markets, and limited public support. In Indonesia, where coastal settlements play an important role in local economies, these pressures are especially visible among poor households whose income depends on daily work and natural-resource-based production. When environmental stress coincides with economic instability, households may face sudden income losses, reduced food consumption, debt, and declining welfare.

South Sulawesi offers a relevant setting for studying this problem. The province has active coastal economies supported by capture fisheries, brackish-water aquaculture, fish processing, marine trade, and small coastal services. At the same time, many coastal households depend on informal work arrangements and have limited access to formal protection. Their income may change quickly when fish catch declines, aquaculture production fails, market prices fall, or

employment opportunities shrink. Previous studies have shown that coastal communities are often more vulnerable than inland communities because their livelihoods depend on a narrow resource base and because environmental and market shocks can directly reduce household income (Hossain et al., 2023; Macusi et al., 2021; Balik et al., 2024). In this context, household expenditure is an important indicator because it reflects a household's ability to maintain basic consumption during shocks.

Research on coastal poverty has increasingly examined how livelihood shocks shape household welfare. Some studies have focused on environmental shocks, such as declining fish stocks, extreme weather, and aquaculture losses. Others have examined economic shocks, including job loss, falling wages, unstable prices, and reduced market access. Other studies discuss social and demographic shocks, such as migration, marital disruption, illness, injury, and the loss of a family income earner. These studies are useful, but many of them still treat shocks separately. In everyday life, poor coastal households rarely experience vulnerability in such a separated way. A household may experience reduced fish catch while also facing a wage cut, illness, a work accident, or the loss of family labor. For this reason, a model that places several shocks within one analytical framework is needed.

This study focuses on six livelihood shocks: job loss, wage reduction, work-related accident, death of a primary earner, marital disruption, and fish-catch or aquaculture loss. These six shocks were selected because they represent different but connected sources of vulnerability in coastal livelihoods. Job loss and wage reduction reflect labor-market and income shocks common in informal coastal economies, where work is seasonal, and earnings depend on catch, processing demand, and market prices. Work-related accidents represent occupational risk, since fishing, aquaculture, and coastal labor often involve physical danger and limited labor protection. The death of a primary earner and marital disruption represent household-demographic shocks because both events can reduce labor availability, weaken family support, and increase dependency burdens. Fish-catch or aquaculture loss represents an ecological and production shock central to coastal welfare because household income is often tied directly to marine and brackish-water resources.

This selection of shocks also aligns with the Sustainable Livelihoods Framework. This framework views household welfare as the result of interactions between vulnerability, livelihood assets, and institutional context. Poor coastal households are not only affected by external shocks but also by their capacity to respond to them. Human capital, physical assets, financial access, social networks, and access to information may influence whether a household can maintain expenditure after a disruption. Education may help household heads make better livelihood decisions. Boat ownership may reduce dependence on rental arrangements and support more flexible fishing activities. Savings and productive credit may help households smooth consumption or invest in income-generating activities. Cooperative membership may provide access to collective support, although its effectiveness depends on service quality and participation. Reliable mobile connectivity may help households obtain market information, weather updates, buyer contacts, and digital financial services.

Several empirical studies have examined these protective factors. Educational attainment has been linked to better coping strategies and livelihood diversification (Jin et al., 2024; Taba et al., 2023). Formal savings and credit access have been discussed as financial tools that can help poor households manage income instability (Zahra & Ajija, 2023; Duvendack & Mader, 2019). Microcredit programs, including Indonesia's Kredit Usaha Rakyat, may support small investments in productive assets and household enterprises (Dhaubhadel, 2022). Boat and fishing gear ownership can improve income stability by giving fishers more control over timing, location, and production decisions (Admasu et al., 2022). Digital connectivity may also matter because access to mobile signals can improve information flow, market participation, and the use of financial technology, although evidence in coastal settings is still developing (Agiwal et al., 2021; Jönsson, 2022; Guevara & Cheein, 2020).

Despite this growing literature, several gaps remain. First, many studies discuss multiple shocks but do not clearly distinguish shock domains, such as labor-market, occupational, household-demographic, and fisheries-related ecological shocks. Without this distinction, it is difficult to identify which forms of vulnerability are most damaging for poor coastal households. Second, many studies focus on average effects and do not examine whether shocks affect households differently across the expenditure distribution. This matters because a shock may be more damaging for households near the lower end of the poor-household distribution than for those with slightly higher expenditure. Third, the role of household capacities is often examined separately from shocks. Less is known about

how shocks and adaptive resources, such as education, savings, credit, boat ownership, cooperative membership, and mobile connectivity, jointly relate to expenditure outcomes within one model.

South Sulawesi provides a useful empirical context for addressing these gaps. Coastal households in the province depend on capture fisheries, aquaculture, fish processing, and informal coastal work, all of which face climate stress, market fluctuations, and seasonal income instability. Fish-catch failure, aquaculture loss, price changes, and unstable employment can quickly affect household consumption. At the same time, household access to assets and services varies across island, rural mainland, and urban littoral settlements. Some households own boats, maintain savings accounts, receive productive credit, or live in areas with reliable mobile coverage. Others have limited access to these capacities. This variation allows the study to examine not only the association between shocks and expenditure, but also the role of household resources in shaping resilience.

The novelty of this study is not simply that it examines multiple shocks simultaneously. Previous studies, including Hossain et al. (2023), have also considered compound or overlapping risks in coastal communities. The present study contributes in three more specific ways. First, it places six shocks into a clearer household-level framework that distinguishes labor-market shocks, occupational shocks, household-demographic shocks, and fisheries-related ecological shocks. Second, it combines hierarchical Ordinary Least Squares estimation with unconditional quantile regression using the recentered influence function approach. This allows examination of both average associations and distributional patterns at the 25th, 50th, and 75th percentiles of household expenditure. Third, it integrates several context-specific household capacities that are relevant to Indonesian coastal communities, including boat ownership, cooperative membership, savings, productive credit, and reliable 4G connectivity. By bringing these elements together, the study provides evidence on how compound risks and adaptive resources are jointly related to expenditure among poor coastal households in South Sulawesi.

Based on this background, the study has three objectives. First, it estimates the association between six livelihood shocks and monthly per capita expenditure among poor coastal households. Second, it examines whether education, asset ownership, cooperative membership, savings, credit access, and mobile connectivity are positively associated with household expenditure. Third, it investigates whether the association between livelihood shocks and expenditure differs across the 25th, 50th, and 75th expenditure percentiles.

The study addresses three research questions. First, to what extent are labor-market, occupational, household-demographic, and fisheries-related shocks associated with monthly per capita expenditure among poor coastal households in South Sulawesi? Second, do household capacities such as education, boat ownership, cooperative membership, formal savings, productive credit, and reliable 4G connectivity relate positively to expenditure? Third, do the associations between livelihood shocks and expenditure vary across lower, median, and upper expenditure percentiles within the poor-household sample?

The empirical analysis is organized around three broad hypothesis groups. H1: Livelihood shocks are negatively associated with monthly per capita expenditure. This hypothesis covers six shock indicators: job loss, wage reduction, work-related accident, death of a primary earner, marital disruption, and fish-catch or aquaculture loss. H2: Household resilience capacities are positively associated with monthly per capita expenditure. This hypothesis covers education, boat ownership, cooperative membership, formal savings, productive credit, and reliable 4G connectivity, while household size and age of household head are included as demographic controls. H3: The magnitude of the association between livelihood shocks and expenditure differs across Q25, Q50, and Q75. This hypothesis is examined through unconditional quantile regression to assess whether shock-expenditure associations vary across the expenditure distribution.

■ METHOD

Study Area and Research Design

This study used a cross-sectional explanatory survey design to examine the association between livelihood shocks and monthly per capita expenditure among poor coastal households in South Sulawesi. The design was appropriate because the study focused on household characteristics and shock experiences reported within the previous twelve months, a recall period commonly used in poverty and household risk studies (Gautam et al., 2021). Since the data were collected at one point in time, the estimates are interpreted as statistical associations rather than definitive causal effects.

South Sulawesi was selected because it

contains diverse coastal livelihood systems, including island settlements, rural mainland fishing communities, peri-urban coastal areas, brackish-water aquaculture, fish processing, and small-scale marine trade. Coastal communities in Bulukumba, Pangkep, and Selayar were included because they represent important fisheries- and aquaculture-based livelihoods and face environmental, market, and labor-related risks.

Population, Sampling, and Sample Size

The target population consisted of poor coastal households living within ten kilometers of the shoreline whose livelihoods were connected to fisheries, aquaculture, fish processing, marine trade, coastal labor, or related small-scale activities. Because the sample was restricted to poor coastal households, interpret the findings as within-sample associations rather than estimates for the entire coastal population.

A three-stage stratified sampling procedure was applied. First, coastal settlements were grouped into island, rural mainland, and urban littoral strata. Second, villages within each stratum were selected using probability proportional to size. Third, eligible households were randomly selected from updated village household lists. This approach was used because coastal settlements are spatially dispersed and some island communities are difficult to reach. Multi-stage sampling is commonly used in remote fisheries and rural household studies because it balances field feasibility with coverage across different livelihood settings (Rahman et al., 2021). The final sample consisted of 275 poor coastal households, which was adequate for the hierarchical OLS model and for additional quantile analysis.

Data were collected using a structured household questionnaire adapted from the household consumption and socio-economic modules of the National Socio-Economic Survey (Susenas), issued by Statistics Indonesia. The questionnaire covered demographic characteristics, household expenditure, education, productive assets, financial access, cooperative membership, digital connectivity, and livelihood shocks experienced during the previous twelve months. The instrument was piloted in a non-sample coastal village to assess clarity and response flow. When needed, enumerators explained key items in the local Bugis-Makassar context while maintaining the meaning of the Indonesian questionnaire. Participation was voluntary, and enumerators obtained informed consent before the interview.

Variables and Measurement

The dependent variable was the natural logarithm of monthly household expenditure

Table 1. Summary of study variables

Variable (label)	Definition	Measurement & coding	Scale/type	Expected sign*
ln_exppc	Natural log of monthly household expenditure per capita	In Indonesian rupiah, aggregated food + non-food, then natural-log transformed	Continuous (ratio)	–
risk_jobloss	Household experienced job loss of main earner in past 12 months	1 = Yes, 0 = No	Dummy	Negative
risk_wagecut	Household experienced ≥30 % wage/omzet reduction	1 = Yes, 0 = No	Dummy	Negative
risk_accident	Work-related accident causing ≥7 days lost labor	1 = Yes, 0 = No	Dummy	Negative
risk_death	Death of primary income earner in past 12 months	1 = Yes, 0 = No	Dummy	Negative
risk_marital	Marital disruption or spousal migration reducing labour/income	1 = Yes, 0 = No	Dummy	Negative

risk_fishloss	Major fish-catch or aquaculture loss (environmental/market shock)	1 = Yes, 0 = No	Dummy	Negative
hh_size	Number of household members	Count of individuals	Discrete	Negative
age_head	Age of household head	Years	Continuous	Mixed
edu_head	Education of household head	0 = None, 1 = Primary, 2 = Junior HS, 3 = Senior HS, 4 = Diploma+	Ordinal	Positive
boat_owner	Owns at least one fishing boat	1 = Yes, 0 = No	Dummy	Positive
coop_member	Member of fisheries/coastal cooperative	1 = Yes, 0 = No	Dummy	Positive
saving_acc	Holds a formal savings account	1 = Yes, 0 = No	Dummy	Positive
credit_recv	Accessed productive credit in the last 12 months	1 = Yes, 0 = No	Dummy	Positive
signal4g	Reliable fourth-generation mobile coverage in village	1 = Yes, 0 = No	Dummy	Positive

** Expected direction denotes the hypothesized association with ln_exppc based on prior literature.*

per capita, labeled as ln_exppc. Household expenditure was calculated from food and non-food expenditure per capita, then log-transformed to reduce skewness.

The main independent variables were six binary livelihood shock indicators: job loss, wage reduction, work-related accident, death of a primary earner, marital disruption, and fish-catch or aquaculture loss. Each shock was coded 1 if the household experienced the event during the previous twelve months and 0 otherwise. Binary coding was used to reduce recall burden and to allow several types of shocks to be compared within one model. However, this approach does not capture severity, duration, or repeated exposure. For this reason, we interpret the results as associations between shock occurrence and expenditure, not estimates of shock intensity.

The household capacity and control variables included household size, age of household head, education of household head, boat ownership, cooperative membership, formal savings account ownership, access to productive credit, and reliable fourth-generation mobile signal. These variables were selected because previous studies have linked household demographics, human capital, productive assets, financial inclusion, and connectivity with coping capacity and income stability in vulnerable household settings (Ndue et al., 2023; Gautam et al., 2021).

Data Analysis

The analysis began with descriptive statistics and a correlation matrix. Descriptive statistics were used to describe household characteristics, shock prevalence, asset ownership, financial access, and digital connectivity. The correlation matrix was prepared as an appendix to show bivariate relationships among the study variables. Hierarchical Ordinary Least Squares regression was then used to estimate the association between livelihood shocks and logged monthly per capita expenditure. Model 1 included the six shock indicators and household size. Model 2 added age, education, boat ownership,

cooperative membership, savings account ownership, productive credit, and reliable 4G signal. The full model is specified as follows:

$$ln_exppc_i = \beta_0 + \beta_1 risk_jobloss_i + \beta_2 risk_wagecut_i + \beta_3 risk_accident_i + \beta_4 risk_death_i + \beta_5 risk_marital_i + \beta_6 risk_fishloss_i + \gamma_1 hh_size_i + \gamma_2 age_head_i + \gamma_3 edu_head_i + \gamma_4 boat_owner_i + \gamma_5 coop_member_i + \gamma_6 saving_acc_i + \gamma_7 credit_recv_i + \gamma_8 signal4g_i + \varepsilon_i$$

Because the data are cross-sectional, heteroskedasticity-consistent robust standard errors were used to reduce sensitivity to unequal error variance. The term HAC or Newey-West was not used because the data do not have a time-series or panel structure. Descriptive statistics and hierarchical OLS were run in SPSS, while unconditional quantile regression was estimated in Stata 17.

Unconditional quantile regression was estimated using the recentered influence function approach at Q25, Q50, and Q75. The same explanatory variables from the full OLS model were included in the quantile models. This analysis was used to examine whether the association between livelihood shocks and expenditure differed across the lower, median, and upper segments of the poor-household expenditure distribution.

Model diagnostics included tolerance values, variance inflation factors, condition indices, residual plots, and a Q-Q plot. Heteroskedasticity was assessed through residual inspection, and robust standard errors were used in the main interpretation. Spatial autocorrelation was not reported as a formal diagnostic because the study did not define a spatial weights matrix. Without such a matrix, Moran's I cannot be interpreted as a valid test for spatial dependence.

■ RESULT AND DISCUSSION

Descriptive Statistics

Table 2 reports the main descriptive statistics. The logged monthly per capita expenditure has a mean of 14.427 and a standard deviation of 0.271. The spread is not wide, which is reasonable because the study focuses on poor coastal households rather than on the whole coastal population. The average household has 5.23 members. The mean age of the household head is 46.72 years, while the average education score is 2.20 on a scale from 0 to 4. In practical terms, many household heads have around junior secondary-level schooling.

The binary variables give a useful picture of household resources and exposure to shocks. About one-third of households own a fishing boat, and fewer than one-third belong to a fisheries or coastal cooperative. Formal financial access is uneven: 48.7 percent of households have a savings account, while 40.7 percent received productive credit during the previous twelve months. Reliable 4G signal is available for 64.7 percent of households. On

Table 2. Descriptive statistics of continous and binary variables (n=275)

Variable	Mean or %	SD	Min	Max	N
Continous variables					
ln_exppc	14.427	0.271	13.573	14.986	275
hh_size	5.23	1.822	2	8	275
age_head	46.72	14.261	22	70	275
edu_head	2.20	1.059	0	4	275
Binary variables					
boat_owner	34.5%	-	0	1	275
coop_member	27.3%	-	0	1	275
saving_acc	48.7%	-	0	1	275
credit_recv	40.7%	-	0	1	275
signal4g	64.7%	-	0	1	275
risk_jobloss	20.7%	-	0	1	275
risk_wagecut	27.6%	-	0	1	275
risk_accident	12.0%	-	0	1	275
risk_death	8.0%	-	0	1	275
risk_marital	17.5%	-	0	1	275
risk_fishloss	36.4%	-	0	1	275

Note. Percentages in Panel B indicate the proportion of households coded 1 for each dummy variable. The table separates continuous and binary variables to avoid empty cells and to make the descriptive information easier to read.

the shock side, fish-catch or aquaculture loss is the most common event, reported by 36.4 percent of households. Wage reduction follows at 27.6 percent, while job loss affects 20.7 percent. The death of a primary earner is less frequent at 8.0 percent, but the regression results later show a large association with expenditure.

Correlation Overview

The correlation matrix, prepared as an appendix table, shows the expected direction of association. The six shock indicators are negatively related to logged per capita expenditure, with fish-catch or aquaculture loss showing the strongest bivariate association. Education, savings, productive credit, boat ownership, and reliable 4G signal are positively related to expenditure. These correlations are not final evidence, but they suggest that the regression model follows a plausible pattern.

The diagnostic checks did not point to serious multicollinearity. The variance inflation factors ranged from 1.02 to 1.09, with high tolerance values and a maximum condition index below 18. Because the VIF values are very low, they are reported alongside tolerance and the condition index rather than interpreted in isolation. Residual inspection also showed no major pattern that would invalidate the OLS estimates. The residual Q-Q plot showed small deviations at the tails, which is common in household expenditure data. For this reason, the results are interpreted with attention to heteroskedasticity-consistent standard errors. Moran's I is not reported as a formal result because the empirical model does not define a spatial weights matrix.

Hierarchical OLS Results

Table 3 presents the hierarchical OLS estimates. Model 1 includes the six shock variables and household size. Model 2 adds age, education, boat ownership, cooperative membership, savings account, productive credit, and reliable 4G signal. This structure follows the logic of the original manuscript: first estimate the relationship between shocks and expenditure, then examine whether household capacities add explanatory power.

The first model already explains much of the expenditure variation in the sample, with an R-squared of 0.757 and an adjusted R-squared of 0.751. All six shocks are negative and significant. After adding the capacity variables, R-squared increases to 0.874 and adjusted R-squared to 0.867. The change in R-squared is 0.117 and is statistically significant. This does not mean the model explains coastal poverty

Table 3. Ordinary least squares estimates

Variable	Model 1 beta (SE)	Model 2 beta (SE)
Constant	14.851 (0.027)***	14.463 (0.034)***
Job loss	-0.235 (0.020)***	-0.249 (0.015)***
Wage cut	-0.236 (0.018)***	-0.229 (0.014)***
Work-related accident	-0.156 (0.026)***	-0.172 (0.019)***
Death of primary earner	-0.400 (0.030)***	-0.373 (0.022)***
Marital disruption	-0.242 (0.022)***	-0.238 (0.016)***
Fish-catch or aquaculture loss	-0.269 (0.017)***	-0.270 (0.013)***
Household size	-0.023 (0.005)***	-0.020 (0.003)***
Age of household head		0.003 (0.000)***
Education of household head		0.055 (0.006)***
Boat ownership		0.056 (0.013)***
Cooperative membership		0.022 (0.014)
Savings account		0.085 (0.012)***
Productive credit		0.076 (0.013)***
Reliable 4G signal		0.057 (0.013)***
R-squared	0.757	0.874
Adjusted R-squared	0.751	0.867
Standard error of estimate	0.135	0.099
Delta R-squared		0.117***
F-statistic	119.080***	129.010***
N	275	275

*Note. Standard errors are reported in parentheses. *** p < .01.*

causally. It means that, within this poor-household sample, the included shocks and household characteristics are closely related to the observed differences in expenditure.

The individual coefficients are quite consistent across the two models. In Model 2, job loss is associated with a 0.249 reduction in logged expenditure, wage cut with a 0.229 reduction, work-related accident with a 0.172 reduction, death of a primary earner with a 0.373 reduction, marital disruption with a 0.238 reduction, and fish-catch or aquaculture loss with a 0.270 reduction. The largest negative coefficient is attached to the death of a primary earner, followed by fish loss. This ordering is plausible in a coastal setting where both family labor and resource-based production are central to household welfare.

The added capacity variables also carry meaningful information. Education, boat ownership, savings, credit, and reliable 4G signal are all positive and significant in the full model. Cooperative membership is positive but not significant. This last result should not be overread as proof that cooperatives do not matter. It may simply mean that membership status alone is too weak a measure to capture the quality of cooperative services, member participation, or actual access to collective support.

Unconditional Quantile Regression Results

Table 4 presents unconditional quantile regression results because mean-based OLS estimates do not show whether associations vary across the expenditure distribution. Table 4 addresses that gap by presenting recentered influence function estimates at Q25, Q50, and Q75. The purpose is not to replace OLS. Rather, the quantile estimates show whether the same broad pattern appears at different parts of the expenditure distribution within the poor-household sample.

The main message is straightforward. All six shocks remain negative and significant across Q25, Q50, and Q75. This matters because the shock-expenditure relationship is not driven by an average effect alone. Households at the lower, median, and upper ends of the poor-household distribution all show lower expenditure when shocks are present, although the size of the association differs across quantiles.

At Q25, the largest negative coefficients are attached to the death of a primary earner, fish-catch or aquaculture loss, and marital disruption. This suggests that households at the lower end of the distribution are especially exposed when family labor or fisheries production is disrupted. At Q50, the death of a primary earner remains the largest shock, while wage cuts, marital disruption, and fish loss also remain sizeable. At Q75, fish loss and job loss are still strongly negative. In other words, households with slightly higher expenditure within the poor sample are not free from vulnerability when their livelihood base is affected.

The capacity variables vary more across the quantiles. Education is positive and

Table 4. Unconditional quantile regression estimates

Variable	Q25 beta (SE)	Q50 beta (SE)	Q75 beta (SE)
Job loss	-0.260 (0.044)***	-0.221 (0.035)***	-0.267 (0.039)***
Wage cut	-0.253 (0.038)***	-0.246 (0.033)***	-0.200 (0.036)***
Work-related accident	-0.205 (0.062)***	-0.176 (0.054)***	-0.210 (0.039)***
Death of primary earner	-0.387 (0.062)***	-0.375 (0.057)***	-0.264 (0.054)***
Marital disruption	-0.303 (0.054)***	-0.264 (0.038)***	-0.169 (0.038)***
Fish-catch or aquaculture loss	-0.304 (0.035)***	-0.238 (0.032)***	-0.291 (0.034)***
Household size	-0.019 (0.009)**	-0.034 (0.008)***	-0.034 (0.009)***
Age of household head	0.002 (0.001)*	0.002 (0.001)	0.002 (0.001)**
Education of household head	0.035 (0.015)**	0.057 (0.014)***	0.075 (0.016)***
Boat ownership	0.022 (0.035)	0.009 (0.032)	0.066 (0.035)*
Cooperative membership	-0.000 (0.039)	0.025 (0.035)	-0.040 (0.038)
Savings account	0.111 (0.033)***	0.072 (0.030)**	0.016 (0.033)
Productive credit	0.044 (0.034)	0.110 (0.031)***	0.131 (0.035)***
Reliable 4G signal	0.088 (0.037)**	0.082 (0.032)***	0.057 (0.032)*
Constant	14.388 (0.089)***	14.565 (0.086)***	14.690 (0.097)***
R-squared	0.532	0.536	0.479
N	275	275	275

*Note. Robust standard errors are reported in parentheses. * p < .10. ** p < .05. *** p < .01.*

significant throughout, with a larger coefficient at Q75. Savings account ownership is significant at Q25 and Q50 but not at Q75. Productive credit is not significant at Q25, then becomes positive and significant at Q50 and Q75. Reliable 4G signal is significant at Q25 and Q50 and marginal at Q75. Boat ownership is only marginally significant at Q75. Cooperative membership remains insignificant across all quantiles. These patterns matter because they show that resilience resources do not operate the same way for all poor households.

The estimates tell a consistent story, but it is not a simple one. Poor coastal households in South Sulawesi face more than one dominant risk. Their expenditure falls when labor income declines, fisheries production fails, family labor is disrupted, or work accidents reduce earning capacity. This pattern fits the broader coastal livelihood literature, which has linked maritime poverty to environmental uncertainty, market instability, and limited institutional support (Hossain et al., 2023; Macusi et al., 2021; Balik et al., 2024; Vallarino et al., 2024). The present results add a household-level picture showing that these shocks remain important even after accounting for education, assets, financial access, and connectivity.

Fish-catch or aquaculture loss deserves particular attention. It is the most commonly reported shock and one of the largest negative predictors in the OLS and UQR models. For households that depend on fishing, aquaculture, processing, or small marine trade, a production shock does not stay at the enterprise level. It quickly affects food consumption, education spending, health expenditure, and household debt decisions. Similar concerns have appeared in studies on coastal communities and fisheries-related food security in Indonesia and other settings (Nazriansyah et al., 2023; Purwanti et al., 2023; Muringai et al., 2019; Tidd et al., 2023). Evidence on post-harvest losses and preservation constraints in Zambia also shows how biological and logistical losses can affect household welfare, although the policy setting differs from Indonesia (Maulu et al., 2020). For South Sulawesi, this means that fisheries policy and poverty policy cannot be treated as separate agendas.

The death of a primary earner is less frequent than fish loss, but its coefficient is consistently large. This result is understandable in poor households where one person's labor may carry much of the family's consumption capacity. Losing a main earner can remove income, skills, social ties, and access to work networks at once. Studies on household shocks and coping strategies have made similar points: families without savings, insurance, or stable alternative income have little space to absorb a sudden income loss (Gautam et al., 2021; Rahman et al., 2021; Xu & Huang, 2023). In this sense, social protection for coastal households should not only respond to storms, floods, or fishery failures. It also needs to recognize family-level shocks that have immediate economic consequences.

The labor-market shocks, especially job loss and wage reduction, reflect the informal character of many coastal economies. Fish processing, boat labor, coastal trading, tourism services, and daily work are often seasonal and offer little protection. When demand falls or income declines, households cannot always replace lost income quickly. This finding aligns with broader evidence that job and income shocks can worsen poverty risk, including during major economic disruptions (McNamara et al., 2023; An et al., 2025). It also explains why wage reduction remains important in the model even after including fisheries loss. Many households do not rely on fishing alone. They combine several fragile income sources, and a shock in one source can still matter.

Work-related accidents and marital disruption are also significant. These are sometimes treated as secondary risks in coastal poverty research, but the estimates suggest they should not be overlooked. Fishing and other coastal work expose households to physical danger, and accident-related income loss may be serious where formal labor protection is weak (Barrow et al., 2022). Marital disruption, including separation or spousal migration, may reduce labor availability, increase care responsibilities, and weaken informal support. This gendered dimension deserves more attention. Research on household disruption and welfare shows that women and children often bear much of the cost when household structures change (Huang & Lin, 2023; Lau et al., 2021; Zamzami et al., 2023).

The quantile estimates help avoid a narrow reading of the OLS results. The negative shock coefficients are not confined to one point in the distribution. They appear at Q25, Q50, and Q75. Still, the intensity differs. The lower part of the poor-household distribution appears particularly sensitive to the death of a primary earner, marital disruption, and fish loss. Households at Q75 are still affected by job loss and fish loss, suggesting that slightly higher expenditure within a poor sample does not remove exposure to coastal livelihood risk. This distributional evidence is useful for policy because it cautions against designing assistance only around the average poor household.

Education is one of the more stable positive predictors. It is significant in the OLS model and across all three quantiles. This is consistent with evidence that schooling can support better livelihood choices, information use, and income diversification (Jin et al., 2024; Taba et al., 2023; Simangunsong et al., 2023). The larger coefficient at Q75 may indicate that education brings stronger returns when households already have some assets, networks, or opportunities to use it. For poorer households at Q25, education still matters, but it may not be enough without complementary access to credit, assets, and markets.

Financial inclusion shows a similarly practical pattern. Savings account ownership matters most at Q25 and Q50, which makes sense because savings can provide immediate liquidity when income is disrupted. Productive credit becomes more visible at Q50 and Q75, suggesting that credit works better when households already have some capacity to invest and repay. This interpretation aligns with studies linking financial inclusion to poverty reduction, consumption smoothing, and economic inclusion (Duvendack & Mader, 2019; Zahra & Ajija, 2023; Liu et al., 2022; Gutiérrez-Romero & Ahamed, 2021; Jing & Li, 2023). In policy terms, savings and credit should not be treated as the same tool. Savings may be more protective in the short term, while productive credit may support recovery and livelihood upgrading when households are ready to use it.

Boat ownership has a positive coefficient in the OLS model and becomes marginally significant at Q75. This result aligns with studies that link productive assets to livelihood stability and diversification (Admasu et al., 2022; Eyasu, 2020; Haule, 2021; Obayelu & Edewor, 2022). Still, readers should interpret the results carefully. Owning a boat can reduce dependence on rental arrangements and give households more control over fishing activity. However, it does not protect them from ecological loss, fuel costs, bad weather, or weak market prices. This is why asset support should be linked to fisheries-risk management, market access, and insurance-like instruments. Related work on microinsurance and disaster-risk financing supports this combined approach (Le et al., 2023; Handoyo et al., 2023).

Reliable 4G connectivity also has a positive association with expenditure. This does not mean that signal coverage alone reduces poverty. Rather, connectivity may help households obtain price information, contact buyers, use mobile banking, receive transfers, and access weather or safety information. The finding is consistent with studies on digital infrastructure and rural or household economic outcomes (Agiwal et al., 2021; Huang & Bao, 2023; Jönsson, 2022; Ullah et al., 2022; Polák et al., 2024). It also suggests including digital infrastructure in coastal development policy, not only in communication policy. Without financial literacy and practical services, however, the benefit of connectivity may remain limited.

The cooperative result is less straightforward. Membership is positive in the OLS model but not significant, and it remains insignificant in the quantile estimates. This does not justify the conclusion that cooperatives are irrelevant. It is more likely that the variable captures only formal membership, not service quality, governance, credit access, collective marketing, or members' actual participation. This is where the quantitative model reaches its limit. Studies on the blue economy and community-based institutions show that collective arrangements can matter, but only when they function as real channels of support and bargaining (Su-lan et al., 2020; Groshev et al., 2021). A qualitative follow-up would help explain why cooperative membership does not translate into a clearer expenditure advantage in this sample.

Household size is consistently negative. Larger households have more members to feed, educate, and care for, so the same income shock is spread across more consumption needs. This result is consistent with studies on household dependency and poverty dynamics (Rambe et al., 2024; Arif & Farooq, 2022). It also matters for policy design. Transfers that ignore household composition may understate the needs of larger households, especially those with children, elderly members, or dependents who cannot work.

The full OLS model's high R-squared should be interpreted with caution. It does not establish causality. The study uses a restricted sample of poor coastal households and includes shock variables that are closely tied to expenditure. A high explanatory value is therefore plausible, but it should not be overstated. The cross-sectional design limits causal interpretation, and the binary shock variables do not measure duration or severity. These limitations are common in household shock surveys but still need to be stated clearly (Gautam et al., 2021; Saputra, 2022; Xu & Huang, 2023).

For policy, the results point toward a combined agenda. Adaptive social protection is needed for job loss, wage reduction, death of an earner, and fisheries-related shocks. Fisheries-risk mitigation should include early warning, better weather and ecological information, and

support after fish-catch or aquaculture loss. Financial inclusion should be designed around the actual cash flow of fishing and aquaculture households, not only around standard loan products. Asset programs can help, but they need to be linked to training, market access, and risk transfer. Digital infrastructure can support all these efforts if paired with usable services and financial literacy. This combined agenda fits broader debates on sustainable coastal livelihoods and poverty reduction in Indonesia and comparable maritime settings (Akbar et al., 2023; Prannisa et al., 2023).

■ CONCLUSION

This study examined how six livelihood shocks relate to monthly per capita expenditure among poor coastal households in South Sulawesi. The results show a clear pattern. Job loss, wage reduction, work-related accident, death of a primary earner, marital disruption, and fish-catch or aquaculture loss are all negatively associated with expenditure. The finding holds in the hierarchical OLS model and remains visible in the unconditional quantile regression estimates at Q25, Q50, and Q75. The death of a primary earner and fisheries-related loss are among the most damaging shocks, reflecting the importance of family labor and resource-based production in coastal livelihoods.

The study also shows that household capacities matter, although not all capacities work in the same way. Education is consistently positive across the models. Savings and productive credit are associated with higher expenditure, but their relevance differs across the expenditure distribution. Boat ownership and reliable 4G connectivity also show positive associations, while cooperative membership shows no significant relationship. This mixed result matters because it suggests resilience is not created by membership or access in name only. The quality, usability, and timing of support matter.

The study's contribution lies in its integrated treatment of different shock domains within a poor coastal household sample. Rather than examining only one event or one type of household asset, the analysis combines labor-market shocks, household-demographic shocks, occupational risk, fisheries-related ecological loss, and household capacities in one empirical framework. Unconditional quantile regression adds another contribution by showing that the negative association between shocks and expenditure is present not only at the mean but also across different parts of the poor-household distribution.

Several policy implications follow from the findings. Coastal poverty programs in South Sulawesi should connect adaptive social protection with fisheries-risk mitigation, financial inclusion, asset support, and digital infrastructure. Emergency assistance needs to respond not only to environmental hazards but also to job loss, wage reduction, and the death of a primary earner. Savings and credit programs should align with the income cycle of fishing and aquaculture households. Boat or gear support should be accompanied by training, market access, and protection against ecological shocks. Treat digital connectivity as part of the resilience system because it can support information access, financial services, and market participation.

The study has limitations. The cross-sectional design does not allow strong causal claims. The shock indicators are binary, so they do not capture severity, duration, or repeated exposure. The sample is limited to poor coastal households, so the results describe variation within this group rather than the whole coastal population. Future studies should use longitudinal data, include measures of shock intensity, and combine survey analysis with qualitative fieldwork. More detailed research on cooperative governance, gendered effects of marital disruption, and the practical use of financial and digital services would also help clarify how coastal households build resilience in everyday life.

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