ECSOFiM: Journal of Economic and Social of Fisheries and Marine. 2026. 14(01): 1-14 e-ISSN: 2528-5939
Permalink/DOI: http://dx.doi.org/10.21776/ub.ecsofim.2026.014.01.01

FISHERIES GDP GROWTH AND FISHERS' TERMS OF TRADE IN INDONESIA

PERTUMBUHAN PDB SEKTOR PERIKANAN DAN NILAI TUKAR NELAYAN DI INDONESIA

Muh. Obi Kasmin[*1)], Asni[2)], Muhtar Amin[1)], and Riska[3)]

[1)] Department of Agribusiness, Universitas Sembilanbelas November Kolaka, Pemuda Street, Kolaka, Southeast Sulawesi, Indonesia
[2)] Department of Fisheries, Universitas Sembilanbelas November Kolaka, Pemuda Street, Kolaka, Southeast Sulawesi, Indonesia
[3)] Department of Marine Sciences, Universitas Sembilanbelas November Kolaka, Pemuda Street, Kolaka, Southeast Sulawesi, Indonesia

Received: September 7, 2026 / Accepted: October 30, 2026

ABSTRACT

Indonesia's fisheries sector is economically important, but sectoral growth may not improve fishers' purchasing power. This study examines the relationship between fisheries GDP growth and the Fishers' Terms of Trade (Nilai Tukar Nelayan, NTN) using quarterly data for 2020Q1–2026Q2. Monthly NTN data from the Ministry of Marine Affairs and Fisheries were averaged by quarter, yielding 26 observations. The analysis uses descriptive statistics, Pearson and Spearman correlations, and OLS regressions with HAC (Newey–West) standard errors. Mean NTN was 104.07, while average year-on-year fisheries GDP growth was 3.44%. GDP growth was positively correlated with NTN (Pearson r = 0.463, p = 0.017; Spearman ρ = 0.493, p = 0.010). The static regression indicated that a one-percentage-point increase in GDP growth was associated with a 0.30-point increase in NTN. However, after controlling for lagged NTN, the growth coefficient fell to 0.051 and was not significant at the 5% level; lagged NTN remained positive and significant. Thus, the static association was not robust to accounting for prior NTN. As NTN measures relative purchasing power rather than multidimensional welfare, these findings do not establish an overall improvement in fishers' welfare.

Keywords: economic growth, fisheries GDP, fishers' purchasing power, Fishers' Terms of Trade, inclusive growth, small-scale fisheries.

ABSTRAK

Sektor perikanan Indonesia memiliki arti penting bagi perekonomian, tetapi pertumbuhan sektor ini belum tentu meningkatkan daya beli nelayan. Studi ini mengkaji hubungan antara pertumbuhan PDB sektor perikanan dan Nilai Tukar Nelayan (NTN) dengan menggunakan data triwulanan untuk periode 2020Q1–2026Q2. Data NTN bulanan dari Kementerian Kelautan dan Perikanan dirata-ratakan per triwulan sehingga menghasilkan 26 observasi. Analisis mencakup statistik deskriptif, korelasi Pearson dan Spearman, serta regresi OLS dengan galat baku HAC (Newey–West). Rata-rata NTN tercatat sebesar 104,07, sedangkan rata-rata pertumbuhan PDB sektor perikanan secara tahunan sebesar 3,44%. Pertumbuhan PDB berkorelasi positif dengan NTN (Pearson r = 0,463, p = 0,017; Spearman ρ = 0,493, p = 0,010). Hasil regresi statis menunjukkan bahwa kenaikan pertumbuhan PDB sebesar satu poin persentase berkaitan dengan kenaikan NTN sebesar 0,30 poin. Namun, setelah NTN periode sebelumnya dikendalikan, koefisien pertumbuhan turun menjadi 0,051 dan tidak signifikan pada taraf 5%; NTN periode sebelumnya tetap positif dan signifikan. Dengan demikian, hubungan yang terlihat pada regresi statis tidak bertahan setelah NTN periode sebelumnya diperhitungkan. Karena NTN mengukur daya beli relatif, bukan kesejahteraan dalam berbagai dimensinya, temuan ini tidak membuktikan adanya peningkatan kesejahteraan nelayan secara keseluruhan.

Kata kunci: pertumbuhan ekonomi, PDB perikanan, daya beli nelayan, nilai tukar nelayan, pertumbuhan inklusif, perikanan skala kecil.

[*] *Corresponding author: Muh. Obi Kasmin, muhammadrobby441@gmail.com*
Institution and its address: Department of Agribusiness, Universitas Sembilanbelas November Kolaka, Pemuda Street, Kolaka, Southeast Sulawesi, Indonesia

INTRODUCTION

Indonesia is an archipelagic country endowed with extensive marine resources, and its fisheries sector plays a strategic role in food supply, employment, trade, and coastal livelihoods. Globally, fisheries and aquaculture contribute to food security and poverty reduction, but the extent of these contributions depends strongly on economic structures, governance arrangements, and benefit distribution (Béné et al., 2016; Boyd & Davis, 2022). In Indonesia, small-scale fisheries are economically important but remain vulnerable to resource fluctuations, environmental pressures, climate change, and income volatility (Baum et al., 2016; Halim et al., 2019; Stacey et al., 2021).

In principle, economic growth in the fisheries sector can improve welfare through higher production, productivity, employment, and value added. However, GDP is an aggregate measure and does not show how additional value added is distributed among actors within the sector. Consequently, growth in fisheries GDP does not necessarily imply that fishers, as primary producers, receive a commensurate share of the gains. Evidence from coastal communities shows that economic expansion can coexist with household vulnerability driven by resource dependence, patron-client market relations, limited access to capital, and unequal bargaining power (Fabinyi et al., 2022; McWilliam & Taufik, 2021).

Fishers' livelihoods face environmental shocks. Climate variability can alter fishing distances, the number of fishing days, and income (Azizi et al., 2017). Coral bleaching can reduce fishing-household income in the short term (Chaijaroen, 2019), while mangrove loss can depress income and prompt changes in household consumption (Yamamoto, 2023). These findings underscore the need to interpret sector-level macroeconomic indicators alongside household-level measures. The present study focuses on relative purchasing power proxied by NTN; it does not measure multidimensional welfare outcomes.

The Indonesian government uses the Fishers' Terms of Trade (*Nilai Tukar Nelayan*, NTN) to assess fishers' purchasing power. NTN compares the price index fishers receive with the price index they pay, indicating changes in relative purchasing power after household consumption and production expenditures. Evidence from Indonesia supports using NTN as a purchasing-power indicator, while noting that it does not capture all dimensions of welfare (Geni et al., 2022). Other studies, including Amandra & Zulbainarni (2022), report associations between NTN and fisheries production value, labor, and government support, with variation across regions.

Research on fishers' well-being also examines dimensions beyond purchasing power. According to Anna et al. (2019), being a fisher is not necessarily associated with lower happiness after controlling for socioeconomic characteristics. Rahman et al. (2023; 2021) found that climate-change adaptation strategies are associated with fishers' income, food security, happiness, and life satisfaction. Evidence from Putri & Abdillah (2024) suggests that internet use is positively associated with subjective well-being among small-scale fishers, while Taniu et al. (2024) link cooperative membership to higher income among capture-fisheries households.

Despite growing research on fisheries income, livelihood resilience, and the Fishers' Terms of Trade (NTN), evidence on the relationship between national fisheries GDP growth and national NTN remains limited. Previous studies have mostly examined household-level outcomes, local fisheries conditions, or provincial differences, leaving the relationship between national sectoral growth and fishers' relative purchasing power less clear. This study addresses this gap by examining the association between quarterly fisheries GDP growth and national NTN in Indonesia from 2020Q1 to 2026Q2. Its main contribution lies in comparing a static regression model with a persistence-adjusted model that incorporates lagged NTN. The static model captures the contemporaneous association between economic growth and purchasing power, while the persistence-adjusted model tests whether GDP growth remains statistically associated with purchasing power after accounting for the previous quarter's NTN. This comparison provides a more qualified assessment of inclusive fisheries growth by distinguishing a contemporaneous association from an association that persists after accounting for prior purchasing power. The findings also clarify the limits of using aggregate sectoral growth as an indicator of improvements in fishers' economic conditions.

This study has three objectives: (1) to describe the dynamics of fisheries GDP and NTN in Indonesia from 2020Q1 to 2026Q2; (2) to assess the association between fisheries GDP growth and NTN; and (3) to determine whether this association persists after accounting for prior-quarter NTN. The main hypothesis is that fisheries GDP growth is positively associated with NTN, interpreted here as an indicator of relative purchasing power rather than a comprehensive measure of welfare. The study does not directly test how value added is distributed among actors in the fisheries sector.

RESEARCH METHODS

Data and Observation Period

This study uses national time-series data from the Data Portal of Indonesia's Ministry of Marine Affairs and Fisheries (MMAF). The downloaded series include quarterly fisheries GDP at current prices (ADHB), GDP at constant prices (ADHK), and GDP distribution, as well as monthly national NTN statistics, including the Price Index Received by Fishers, the Price Index Paid by Fishers, Household Consumption, Production Costs and Capital Goods Additions (BPPBM), NTN, and the Fishers' Business Terms of Trade (NTUN).

Because NTN is reported monthly whereas fisheries GDP is reported quarterly, the quarterly NTN series was constructed as the arithmetic mean of the three monthly NTN index values in each quarter. This gives each month equal weight and aligns the NTN frequency with quarterly GDP. The series was screened for completeness; each retained quarter contained all three monthly observations, and no interpolation was applied. The overlapping period was 2020Q1–2026Q2, yielding 26 quarterly observations. Year-on-year fisheries GDP growth was calculated from real fisheries GDP at constant prices (ADHK), using $Growth_t = [(ADHK_t / ADHK_{(t-4)}) - 1] \times 100$, where $t-4$ denotes the same quarter in the preceding year. The underlying ADHK series and monthly NTN data were retrieved from the MMAF Data Portal (https://portaldata.kkp.go.id) on August 20, 2026.

The fisheries GDP series at constant prices (ADHK) was used to calculate real year-on-year fisheries GDP growth, the main independent variable in the regression analysis. The growth rate was calculated by comparing each quarter's ADHK value with the corresponding quarter in the previous year. Fisheries GDP at current prices (ADHB) represents the nominal economic value of fisheries output and was used descriptively to provide additional context on the sector's economic scale; it was not used to calculate the real GDP growth variable or as a predictor in the regression models. The Fishers' Terms of Trade (*Nilai Tukar Nelayan*, NTN) was used as the dependent variable and represents fishers' relative purchasing power. The Fishers' Business Terms of Trade (*Nilai Tukar Usaha Nelayan*, NTUN) was treated as a supplementary descriptive indicator of fishing-business conditions and was not included as an explanatory variable in the regression models. Monthly NTN observations were aggregated into quarterly arithmetic means to match the frequency of the fisheries GDP data. The analysis therefore focuses on the association between real fisheries GDP growth and NTN, while ADHB and NTUN provide supplementary descriptive context.

Operational Definitions of Variables

The following table presents the variables used in this study, along with their definitions and measurement indicators.

Table 1. Operational Definitions of Variables

Variable	Definition	Unit	Role
NTN	Quarterly arithmetic mean of monthly NTN observations, representing fishers' relative purchasing power.	Index	Dependent variable; proxy for relative purchasing power, not multidimensional welfare
Growth	Year-on-year growth rate of real fisheries GDP (ADHK): [(ADHK_t / ADHK_(t−4)) − 1] × 100	Percent	Main independent variable
ADHK	Fisheries GDP measured at constant prices, used to calculate the year-on-year growth rate.	IDR billion	Input for calculating the main independent variable
ADHB	Fisheries GDP measured at current prices, reflecting nominal economic value added in the fisheries sector.	IDR billion	Supporting indicator for descriptive analysis, if reported in the study
NTUN	Index measuring the relationship between prices received and prices paid by fishing businesses.	Index	Supporting indicator of fishing-business conditions, if included in the analysis.
NTN (-1)	NTN value recorded in the preceding quarter.	Index	Lagged dependent variable in the persistence-adjusted regression model.

Analytical Methods

The analysis proceeded in four stages. First, descriptive statistics were calculated for the mean, standard deviation, minimum, and maximum. Second, Pearson and Spearman correlations assessed the direction and rank-order consistency of the bivariate association between fisheries GDP growth and NTN. Third, static OLS regressions were estimated, including a specification with a deterministic time trend. Heteroskedasticity- and autocorrelation-consistent (HAC/Newey–West) standard errors were used to account for possible non-constant variance and serial dependence. Fourth, a parsimonious persistence-adjusted specification included NTN from the previous quarter.

Given the short series, the lagged specification is treated as a descriptive robustness model rather than a structural dynamic model or causal estimator.

Static model:

$$NTN_t = \alpha + \beta\ Growth_t + \varepsilon_t \quad (1)$$

Time-trend model:

$$NTN_t = \alpha + \beta_1\ Growth_t + \beta_2\ Trend_t + \varepsilon_t \quad (2)$$

Dynamic model:

$$NTN_t = \alpha + \beta_1\ Growth_t + \rho\ NTN_{(t-1)} + \varepsilon_t \quad (3)$$

The sample contains only 26 quarterly observations, so all specifications are intentionally parsimonious. HAC/Newey–West standard errors address heteroskedasticity and serial correlation, but their finite-sample properties may be imperfect in such a short series. Including lagged NTN also reduces the estimation sample to 25 observations. Accordingly, interpret coefficient estimates and p-values cautiously, alongside effect sizes, R^2 values, and sensitivity checks. The estimates represent conditional associations, not causal effects. The loss of statistical significance for fisheries GDP growth in the lagged model indicates that the static association is not robust to conditioning on prior NTN; it does not prove that sectoral growth has no effect.

RESULTS AND DISCUSSION

Descriptive Profile of Fisheries Growth and Fishers' Terms of Trade

Table 2. Descriptive Statistics of the Study Variables

Variable	N	Mean	SD	Min	Max
NTN	26	104.07	2.54	98.80	108.45
Fisheries GDP growth (%)	26	3.44	3.87	-3.05	12.34
Fisheries GDP, ADHK (IDR billion)	26	70,677.58	6,500.34	61,748.40	86,641.10
Fisheries GDP, ADHB (IDR billion)	26	132,124.67	18,952.27	104,206.70	174,606.40
NTUN	26	106.55	3.16	100.28	113.71

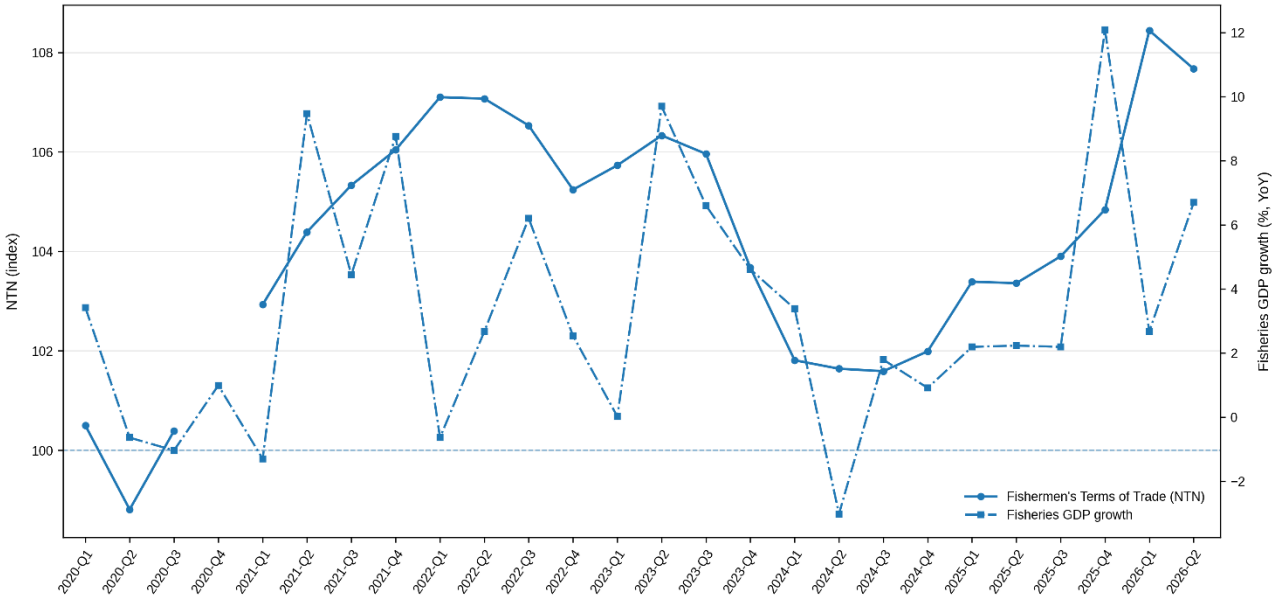
Source: Authors' calculations based on KKP data (2026)

Table 2 shows that mean NTN was 104.07, with a range of 98.80–108.45, while year-on-year fisheries GDP growth averaged 3.44% and ranged from −3.05% to 12.34%. An average NTN above 100 indicates that fishers generally received a more favorable price index than they paid during the observation period. However, the minimum below 100 shows that this relative purchasing-power position was not maintained in every quarter. Evidence from Geni et al. (2022) highlights NTN's value as a purchasing-power indicator, but NTN should not be treated as a comprehensive welfare measure. Research by Bennett et al. (2024) and Basurto et al. (2025) shows that small-scale fisheries well-being also includes financial, social, institutional, food-security, and livelihood dimensions.

Temporal Dynamics of Fisheries GDP Growth and NTN

Figure 1 and Table 3 show that fisheries GDP growth and NTN moved together in some periods but diverged in others. The 2021 recovery coincided with a higher mean NTN, yet GDP growth remained high in 2023 (5.38%) while mean NTN (105.41) fell below its 2022 value (106.47).

Both indicators weakened in 2024 and improved in 2025 and the first half of 2026. This pattern shows that aggregate growth and relative purchasing power do not move in lockstep, but it does not explain their divergence. Research on the Indonesian blue swimming crab value chain documents differences in value capture and labor intensity along the chain (Lucas et al., 2024). Wibowo et al. (2024) also highlight constraints related to market access, transport, regulation, and finance in Indonesian capture fisheries. These studies provide plausible context, not mechanisms tested in the present regressions. The 2026 values cover only Q1–Q2 and should be interpreted cautiously because the source classifies them as very provisional.



Source: Data Processed (2026)

Figure 1. Trends in Fisheries GDP Growth and NTN in Indonesia, 2020Q1 to 2026Q2

Table 3. Mean NTN and Fisheries GDP Growth by Year

Year	Mean NTN	Mean Fisheries GDP Growth
2020	100.22	0.73
2021	104.69	5.48
2022	106.47	2.77
2023	105.41	5.38
2024	101.76	0.81
2025	103.86	4.81
2026 (Q1-Q2 only)	108.05	4.82

Source: Data Processed (2026)

The 2026 figures represent partial-year observations covering Q1 and Q2 only. They are not full-year annual averages and should not be compared directly with annual means based on four quarters. Provisional data status follows the classification provided by the original data source.

Bivariate Association and Static Regression Evidence

Table 4. Correlation Between Fisheries GDP Growth and NTN

Test	Coefficient	p-value	Interpretation
Pearson	0.463	0.017	Statistically significant at 5%
Spearman	0.493	0.010	Statistically significant at 5%

Source: Data Processed (2026)

Table 4 reports Pearson and Spearman coefficients of 0.463 (p = 0.017) and 0.493 (p = 0.010), respectively. Their similar magnitudes indicate a positive association in both the linear relationship and the rank ordering of quarterly observations. Thus, quarters with stronger fisheries GDP growth tended to record higher NTN. This result aligns with Amandra & Zulbainarni (2022) on the association between fisheries production value and NTN and with those of Mustaruddin et al. (2023) on the link between fishing income and fisher welfare. The correlations are descriptive and do not establish that GDP growth caused changes in NTN.

Table 5. Regression Results for NTN on Fisheries GDP Growth

Variable	Model 1 Static HAC	Model 2 Time trend	Model 3 Dynamic
Fisheries GDP growth	0.304***(0.107)	0.268***(0.101)	0.051(0.037)
Trend		0.092 (0.066)	
NTN (-1)			0.826***(0.084)
Constant	103.019***(0.794)	101.899***(1.203)	18.237**(8.660)
N	26	26	25
R^2	0.214	0.288	0.754

Notes: Standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. HAC/Newey–West standard errors are used for inference. Model 3 includes lagged NTN and therefore uses 25 observations.

Source: Data Processed (2026)

The static estimates in Table 5 reinforce the bivariate result. In Model 1, the fisheries GDP growth coefficient is 0.304 (p = 0.004; R^2 = 0.214), indicating that a one-percentage-point increase in year-on-year fisheries GDP growth is associated with an approximately 0.30-point higher NTN index in the same quarter. In Model 2, adding a deterministic time trend reduces the growth coefficient to 0.268 (p = 0.008), while the trend itself is not statistically significant at the 5% level. The positive coefficient after adding the trend suggests the static association is not driven solely by a common linear time pattern. However, the Model 1 R^2 of 0.214 indicates that contemporaneous GDP growth explains only a limited share of NTN variation. These regressions did not include other factors discussed in the literature, including access capacities and cooperative arrangements (Bennett et al., 2024; Taniu et al., 2024).

Model 3 in Table 5 qualifies the static result. After lagged NTN is included, the fisheries GDP growth coefficient falls from 0.304 to 0.051, an attenuation of approximately 83%, and becomes statistically insignificant (p = 0.162). In contrast, NTN from the previous quarter has a coefficient of 0.826 (p < 0.001), and R^2 rises to 0.754. The lag coefficient indicates that current NTN is closely associated with the previous quarter's purchasing-power position. Because the series is short and the model includes a lagged dependent variable, this coefficient should not be interpreted as a structural persistence parameter. The result instead shows that the contemporaneous GDP growth–NTN association is not robust to conditioning on prior NTN.

Persistence-Adjusted Evidence on Purchasing Power

The contrast between Models 1–2 and Model 3 indicates a possible short-run divergence between sectoral growth and changes in NTN. The static models show a positive contemporaneous association, but current GDP growth adds little explanatory power after prior NTN is included. This

pattern may reflect delayed or indirect links, or factors omitted from the model; the present analysis cannot distinguish among these explanations. Previous research by Bennett et al. (2024) identifies social, financial, cultural, and political access capacities as predictors of small-scale fishers' well-being. Evidence from Kushardanto et al. (2022) indicates that household finance and trust shape benefits from fisheries co-management. These findings provide possible context for the persistence observed in NTN, but those factors were not estimated in this study.

The attenuation in Model 3 should not be interpreted as evidence that fisheries growth is irrelevant to fishers. It shows that GDP growth alone is not a robust predictor of quarter-to-quarter changes in relative purchasing power once prior NTN is considered. Research by Taniu et al. (2024) suggests that cooperative membership may improve access to credit, markets, information, and prices, while Lucas et al. (2024) show that value-chain position can affect the income retained by fishers. These are plausible policy considerations, not mechanisms established by the present regression models.

The study's main empirical contribution is therefore the comparison of a positive static association with a much weaker persistence-adjusted association. This contrast supports a cautious interpretation: fisheries GDP growth can coincide with higher NTN, but the available estimates do not establish that growth independently improves purchasing power. Previous studies by Béné et al. (2016) and Fabinyi et al. (2022) emphasize the importance of distributional, institutional, and livelihood conditions, but future research should test their roles directly.

Robustness of the Main Inference

Table 6 presents the numerical results of the diagnostic and robustness checks. The intercept-only ADF tests reject the unit-root null hypothesis for fisheries GDP growth (statistic = −4.634, $p < 0.001$) and NTN (statistic = −3.055, $p = 0.030$). However, when a linear trend is included, the ADF test for NTN does not reject the unit-root null hypothesis (statistic = −1.321, $p = 0.883$). Therefore, the evidence regarding NTN stationarity is sensitive to the deterministic specification and should be interpreted cautiously. The complete KPSS test statistics and p-values should be reported alongside these results to allow independent assessment of the stationarity evidence.

Table 6. Summary of Robustness Checks and Inferential Implications

Diagnostic / robustness check	Test statistic/ coefficient	SE	p-value	N	Interpretation
ADF: Fisheries GDP growth (intercept)	−4.634	—	<0.001	26 initially; effective N to verify	Rejects the unit-root null hypothesis.
ADF: NTN (intercept)	−3.055	—	0.030	26 initially; effective N to verify	Rejects the unit-root null hypothesis.
ADF: Fisheries GDP growth (linear trend)	−4.730	—	<0.001	26 initially; effective N to verify	Rejects the unit-root null hypothesis.
ADF: NTN (linear trend)	−1.321	—	0.883	26 initially; effective N to verify	Does not reject the unit-root null hypothesis.

Diagnostic / robustness check	Test statistic/ coefficient	SE	p-value	N	Interpretation
KPSS: GDP growth and NTN	Test statistics not reported	—	Individual values not reported; manuscript states ≥0.10	To verify	Full numerical results are required for independent assessment.
Breusch–Godfrey: Static model, lag 4	LM = 11.228	—	0.024	26 in static model	Significant residual serial correlation detected.
Ljung–Box: Static model, Q(4)	Q = 11.744	—	0.019	26 in static model	Significant residual serial correlation detected.
Breusch–Godfrey: Dynamic model, lag 4	LM = 3.874	—	0.423	25 in dynamic model	No significant residual serial correlation detected.
Ljung–Box: Dynamic model, Q(4)	Q = 1.986	—	0.738	25 in dynamic model	No significant residual serial correlation detected.
Breusch–Pagan: Static and dynamic models	Test statistics not reported	—	Not reported	26 / 25; verify	Manuscript reports no significant heteroskedasticity; numerical results are needed.
Baseline static OLS with HAC SE	β = 0.304	0.107	0.004	26	Positive and statistically significant association.
Static OLS with time trend	β = 0.268	0.101	0.008	26	Positive and statistically significant association.
Dynamic model including lagged NTN	β = 0.051	0.037	0.162	25	GDP growth coefficient is not significant at 5%.
Lagged NTN in dynamic model	β = 0.826	0.084	<0.001	25	Positive and statistically significant conditional association.
Newey–West bandwidths (1, 2, 4, 6 quarters)	β = 0.304	0.099–0.111	0.005–0.012	26	Positive association remains significant across reported bandwidths.
Excluding 2026Q1–Q2	β = 0.286	0.096	0.007	24*; verify	Positive association remains statistically significant.
Excluding 2025Q1–2026Q2	β = 0.337	0.105	0.005	20*; verify	Positive association remains statistically significant.
Excluding provisional observations from 2024Q1 onward	β = 0.311	0.173	0.094	16	Positive, but not significant at 5%.
Leave-one-quarter-out analysis	β = 0.256–0.365	Not reported	All estimates reported significant at 5%	25 per estimation*; verify	Reported results suggest no single quarter dominates the positive association.

Notes: ADF denotes the Augmented Dickey–Fuller test; KPSS denotes the Kwiatkowski–Phillips–Schmidt–Shin test. The ADF null hypothesis is a unit root, whereas the KPSS null hypothesis is stationarity. LM denotes the Lagrange multiplier statistic; Q(4) denotes the Ljung–Box statistic at four lags. HAC refers to heteroskedasticity- and autocorrelation-consistent Newey–West standard errors. Coefficients represent conditional associations, not causal effects. An em dash (—) indicates a value not reported or not applicable. Values marked * are inferred from the stated exclusion/procedure and must be confirmed against the original estimation output. Effective sample sizes for unit-root tests depend on lag selection and test specification.
Source: Authors' calculations based on the study dataset and numerical results (2026).

ADF denotes the Augmented Dickey–Fuller test, and KPSS denotes the Kwiatkowski–Phillips–Schmidt–Shin test. The ADF null hypothesis is that the series contains a unit root, whereas the KPSS null hypothesis is stationarity. LM denotes the Lagrange multiplier statistic, and Q(4) denotes the Ljung–Box statistic evaluated at four lags. HAC refers to heteroskedasticity- and autocorrelation-consistent standard errors using the Newey–West estimator. Coefficients represent conditional associations rather than causal effects. Statistical significance is evaluated at the 5% level unless otherwise stated. Sample sizes for restricted specifications should be verified against the original estimation output.

The sensitivity analyses apply progressively stricter sample restrictions based on the provisional status of the source data. The first specification excludes the two available quarters of 2026, while the second excludes observations from 2025Q1 onward. A further restriction excludes all observations identified as provisional or subject to revision beginning in 2024Q1. These exclusions assess the sensitivity of the estimates to potentially revised data rather than implying that the excluded observations are invalid.

Taken together, the sensitivity checks indicate that the positive association in the static models is not an artifact of a single technical choice or observation within the available sample. They do not change the persistence-adjusted result: once prior NTN is included, the contemporaneous GDP growth coefficient is small and statistically insignificant. The static association is therefore reasonably stable across the reported checks, but conditioning on prior NTN does not robustly support its interpretation as an independent short-run improvement in purchasing power.

Synthesis of Empirical Findings and Literature-Based Interpretation

Table 7 integrates the empirical evidence from Table 2, Figure 1, Tables 3–5, and the sensitivity checks with relevant literature. It distinguishes results produced by the present analysis from explanations supported by prior research but not directly estimated here.

Table 7. Synthesis of Empirical Findings and Literature-Supported Interpretation

Empirical Finding	Interpretation	Literature Supporting the Interpretation
Mean NTN = 104.07, but the range includes 98.80 (Table 2).	NTN suggests that relative purchasing power was generally above parity during the sample, although the minimum indicates periods below parity. NTN is not a comprehensive measure of welfare.	Geni et al. (2022); Bennett et al. (2024); Basurto et al. (2025)
GDP growth and NTN do not move one-for-one over time (Figure 1; Table 3).	Uneven value capture, market frictions, and operating costs may interrupt the transmission of sectoral value added to primary producers; these channels were not directly tested.	Lucas et al. (2024); Wibowo et al. (2024); Fabinyi et al. (2022)
Positive Pearson/Spearman correlations and positive static HAC coefficient (Tables 4-5).	Stronger fisheries activity is contemporaneously associated with a better NTN position.	Amandra et al. (2022); Mustaruddin et al. (2023)

Empirical Finding	Interpretation	Literature Supporting the Interpretation
Growth coefficient falls to 0.051 and becomes insignificant after lagged NTN is included; NTN (-1) = 0.826*** (Table 5).	Current NTN is strongly associated with prior-quarter NTN in the dynamic specification. Access, financial, and institutional capacities are plausible contextual factors, but were not tested in this model.	Kushardanto et al. (2022); Taniu et al. (2024); Bennett et al. (2024)
Static association survives multiple sensitivity checks (Table 6).	The positive static relationship is sample-robust, but remains associational and does not establish a causal transmission mechanism.	This study's robustness analysis: Béné et al. (2016) for distribution-sensitive interpretation

Source: Author Description (2026)

Table 7 points to several plausible explanations for the divergence between fisheries GDP growth and NTN. First, value added may be distributed unevenly among fishers, aggregators, processors, and traders, while labor intensity differs along the chain (Lucas et al., 2024). Second, input and transaction costs may offset improvements in prices received by fishers, and limited access to finance, transport, cold chains, and markets may weaken bargaining power (Taniu et al., 2024; Wibowo et al., 2024). Third, climate and ecosystem shocks may affect fishing income independently of national sectoral performance (Azizi et al., 2017; Chaijaroen, 2019; Yamamoto, 2023). These explanations are drawn from previous literature and are consistent with the observed pattern, but the present regressions do not test them as mediating mechanisms.

Toward Inclusive Fisheries Growth

The findings support evaluating fisheries development through an inclusive-growth perspective. A sectoral assessment centered on GDP, production, exports, or investment may overlook whether gains coincide with improvements in fishers' purchasing power and livelihood security. The report on Blue Transformation by FAO (2024) frames fisheries management, value-chain upgrading, sustainability, and community participation as key priorities. Studies by Basurto et al. (2025) also show that small-scale fisheries contribute to economic value, employment, livelihoods, nutrition, and governance. In this context, divergence between GDP growth and NTN warrants further investigation into the distribution and quality of sectoral growth.

NTN and NTUN can complement fisheries GDP as indicators of purchasing power and fishing-business conditions, but they should not replace broader measures such as household income, food security, assets, debt, resilience, and subjective well-being. Research by Yulisti et al. (2024) indicates that eco-friendly fishing technology may support both fisher well-being and resource sustainability, while research by Rahman et al. (2023; 2021) indicates that climate adaptation capacity is associated with income, food security, and subjective well-being. These broader dimensions should be examined directly in future evaluations of inclusive and sustainable fisheries growth.

CONCLUSION AND SUGGESTION

Conclusion

Using 26 quarterly observations from 2020Q1 to 2026Q2, this study finds a moderate positive association between fisheries GDP growth and NTN. The Pearson correlation is 0.463 ($p = 0.017$), and the static HAC regression coefficient is 0.304 ($p = 0.004$). With a time trend, the coefficient remains positive at 0.268 ($p = 0.008$). However, after prior-quarter NTN is included, the GDP growth coefficient falls to 0.051 and is not statistically significant ($p = 0.162$), while lagged NTN is positive and significant at 0.826 ($p < 0.001$). Thus, the positive static association is not robust to conditioning on previous NTN. These findings concern relative purchasing power as measured by NTN, not overall or multidimensional welfare. They establish conditional associations rather than causal effects. The divergence between the static and lagged estimates may be described as a possible gap between sectoral growth and changes in purchasing power, but the study does not identify its causes. The small sample, the use of provisional 2025–2026 GDP data, and the absence of direct measures of prices, costs, market access, institutions, technology, adaptation, and ecosystem conditions limit the conclusions. These factors should be treated as plausible explanations for future testing, not as mechanisms confirmed by this analysis.

Suggestion

For policy monitoring, fisheries GDP growth should be assessed alongside NTN and other household-level indicators, including real income, food security, debt, assets, and livelihood resilience. Improving market access, transport and cold-chain infrastructure, access to credit, cooperative capacity, production-cost management, and climate adaptation may be relevant policy priorities in light of the wider literature. However, this study does not estimate the effects of these factors, so the recommendations should be treated as policy considerations rather than as causal implications of the regression results.

Future research should use longer time series and, where possible, regional or household-level data to examine whether changes in fisheries GDP are associated with changes in fishers' real income and other welfare dimensions. Studies should directly test the roles of output and input prices, value-chain position, market and credit access, cooperative membership, technology, climate adaptation, and ecosystem conditions.

ACKNOWLEDGMENT

The authors acknowledge the Ministry of Marine Affairs and Fisheries (MMAF) Data Portal for providing valuable data resources that supported this research. These datasets contributed substantially to the analysis and development of the study findings.

REFERENCES

Amandra, M. N., Widyastutik W. & Zulbainarni N. (2022). Determinan Nilai Tukar Nelayan di Indonesia dengan pendekatan Geographically Weighted Panel Regression (GWPR). *Jurnal Sosial Ekonomi Kelautan dan Perikanan.* 17(02). 195. https://doi.org/10.15578/jsekp.v17i2.10940

Anna, Z., Yusuf A. A., Alisjahbana A. S., Ghina A. A., & Rahma. (2019). Are fishermen happier? Evidence from a large-scale subjective well-being survey in a lower-middle-income country. *Marine Policy.* 106. https://doi.org/10.1016/j.marpol.2019.103559

Azizi, A., Putri E. I. K. & Fahrudin A. (2017). Analisis faktor-faktor yang mempengaruhi perubahan pendapatan nelayan akibat variabilitas iklim. *Jurnal Sosial Ekonomi Kelautan dan Perikanan.* 12(02). 225. https://doi.org/10.15578/jsekp.v12i2.5320

Basurto, X., Gutierrez, N. L., Franz, N., Mancha-Cisneros, M. M., Gorelli, G., Aguión, A., Funge-Smith, S., Harper, S., Mills, D. J., Nico, G., Tilley, A., Vannuccini, S., Virdin, J., Westlund, L., Allison, E. H., Anderson, C. M., Baio, A., Cinner, J., Fabinyi, M., Hicks, C. C., Kolding, J., Melnychuk, M. C., Ovando, D., Parma, A. M., Robinson, J. P. W., & Thilsted, S. H. (2025). Illuminating the multidimensional contributions of small-scale fisheries. *Nature.* 637. 875-884. https://doi.org/10.1038/s41586-024-08448-z

Baum Kusumanti I. Breckwoldt A. Ferse S. C. A. Glaser M. Dwiyitno Adrianto L. van der Wulp S. & Kunzmann A, G. (2016). Under pressure: Investigating marine resource-based livelihoods in Jakarta Bay and the Thousand Islands. *Marine Pollution Bulletin*. *110*(2). 778-789. https://doi.org/10.1016/j.marpolbul.2016.05.032

Béné, C., Arthur, R., Norbury, H., Allison, E. H., Beveridge, M., Bush, S., Campling, L., Leschen, W., Little, D., Squires, D., Thilsted, S. H., Troell, M., & Williams, M. (2016). Contribution of fisheries and aquaculture to food security and poverty reduction: Assessing the current evidence. *World Development.* 79. 177-196. https://doi.org/10.1016/j.worlddev.2015.11.007

Bennett, N. J., Calò, A., Guidetti, P., Milazzo, M., Prato, G., Ben Lamine, E., Scianna, C., & Di Franco, A. (2024). Access and well-being in small-scale fisheries. *Marine Policy.* 169. 106328. https://doi.org/10.1016/j.marpol.2024.106328

Boyd, C. E., McNevin, A. A., & Davis, R. P. (2022). The contribution of fisheries and aquaculture to the global protein supply. *Food Security.* 14. 805-827. https://doi.org/10.1007/s12571-021-01246-9

Chaijaroen, P. (2019). Long-lasting income shocks and adaptations: Evidence from coral bleaching in Indonesia. *Journal of Development Economics.* 136. 119-136. https://doi.org/10.1016/j.jdeveco.2018.10.002

Fabinyi, M., Belton, B., Dressler, W. H., Knudsen, M., Adhuri, D. S., Abdul Aziz, A., Akber, M. A., Kittitornkool, J., Kongkaew, C., Marschke, M., Pido, M., Stacey, N., Steenbergen, D. J., & Vandergeest, P. (2022). Coastal transitions: Small-scale fisheries, livelihoods, and maritime zone developments in Southeast Asia. *Journal of Rural Studies.* 91. 184-194. https://doi.org/10.1016/j.jrurstud.2022.02.006

FAO. (2024). The State of World Fisheries and Aquaculture 2024: Blue Transformation in action. Roma. Food and Agriculture Organisation of The United Nations.

Geni, P. L., Wisudo, S. H., Iskandar, B. H., & Yuwandana, D. P. (2022). Tingkat kesejahteraan nelayan jaring rampus di Pangkalan Pendaratan Ikan Cituis dengan pendekatan Nilai Tukar Nelayan. *ALBACORE: Jurnal Perikanan dan Laut.* *5*(1). 57-69. https://doi.org/10.29244/core.5.1.057-069

Halim, A., Wiryawan, B., Loneragan, N. R., Hordyk, A., Sondita, M. F. A., White, A. T., Koeshendrajana, S., Ruchimat, T., Pomeroy, R. S., & Yuni, C. (2019). Developing a functional definition of small-scale fisheries in support of marine capture fisheries management in Indonesia. *Marine Policy.* 100. 238-248. https://doi.org/10.1016/j.marpol.2018.11.044

Kushardanto, H., Jakub, R., Suherfian, W., Subarno, T., Ansyori, A. I., Sara, L., Alimina, N., Fajriah, Kardini, L. O., de la Rosa, E., Yuliani, A., Medianti, E., Pradana, I., Setiawan, H., Muhammad, Y., Djafar, L. F., Box, S., Cox, C., & Campbell, S. J. (2022). Household finances and trust are key determinants of benefits from small-scale fisheries co-management. *Marine Policy.* 145. 105284. https://doi.org/10.1016/j.marpol.2022.105284

Lucas, V., Serra, S. B., Ooteman, M., & Petti, M. (2024). Fisher poverty, value chain equity, and resilience: The case of the Indonesian Blue Swimming Crab and the Peruvian Mahi-Mahi. *Marine Policy.* 170. 106409. https://doi.org/10.1016/j.marpol.2024.106409

McWilliam, A. R., Wianti, N. I., & Taufik, Y. (2021). Poverty and prosperity among Sama Bajo fishing communities (Southeast Sulawesi, Indonesia). *Singapore Journal of Tropical Geography. 42*(1). 132-148. https://doi.org/10.1111/sjtg.12349

Mustaruddin, M., Handayani, N., & Wisudo, S. H. (2023). Usaha jaring rampus permukaan sebagai penopang kesejahteraan nelayan di Eretan Wetan, Indramayu. *ALBACORE: Jurnal Perikanan dan Laut. 6*(1). 91-100. https://doi.org/10.29244/core.6.1.091-100

Putri, R. D., Rahman, M. S., Abdillah, A. A., & Huang, W. C. (2024). Improving small-scale fishermen's subjective well-being in Indonesia: Does the internet use play a role? *Heliyon*. *10*(7), e29076. https://doi.org/10.1016/j.heliyon.2024.e29076

Rahman, M. S., Huang, W.C., Toiba, H., Putritamara, J. A., Nugroho, T. W., & Saeri, M. (2023). Climate change adaptation and fishers' subjective well-being in Indonesia: Is there a link? *Regional Studies in Marine Science*. 65. 103030. https://doi.org/10.1016/j.rsma.2023.103030

Rahman, M. S., Toiba, H., & Huang, W.C. (2021). The impact of climate change adaptation strategies on income and food security: Empirical evidence from small-scale fishers in Indonesia. *Sustainability. 13*(14). 7905. https://doi.org/10.3390/su13147905

Stacey, N., Gibson, E., Loneragan, N. R., Warren, C., Wiryawan, B., Adhuri, D. S., Steenbergen, D. J., & Fitriana, R. (2021). Developing sustainable small-scale fisheries livelihoods in Indonesia: Trends, enabling and constraining factors, and future opportunities. *Marine Policy.* 132. 104654. https://doi.org/10.1016/j.marpol.2021.104654

Taniu, S., Sari, D. W., Satria, D., Haryanto, T., & Wardana, W. W. (2024). Impact evaluation of cooperative membership on welfare: Evidence from captured fishery households in Indonesia. *Marine Policy*. 159. 105923. https://doi.org/10.1016/j.marpol.2023.105923

Wibowo, M., Anwar, K., Mubarok, F., Khurniawan, A. W., & Wongsuwatt, S. (2024). Value chain analysis: Business model, operation, and finance management of capture fisheries business. *Indonesian Fisheries Research Journal. 30*(2). 7-21. https://doi.org/10.15578/ifrj.30.2.2024.7-21

Yamamoto, Y. (2023). Living under ecosystem degradation: Evidence from the mangrove–fishery linkage in Indonesia. *Journal of Environmental Economics and Management.* 118. 102788. https://doi.org/10.1016/j.jeem.2023.102788

Yulisti, M., Hidayat, A. S., Firdausy, C. M., Mu'awanah, U., Kurniasari, N., & Nurjati, E. (2024). Effects of eco-friendly fishing gears on we's welfare and sustainable fisheries: Lessons learned from Indonesia. *Marine Pollution Bulletin.* 198. 115888. https://doi.org/10.1016/j.marpolbul.2023.115888