Farmer Exchange Rate and its Implications for Welfare and Poverty Alleviation in Rural Sulawesi

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ARTICLE INFORMATION

ABSTRACT

This study investigates the relationship between Farmer's Terms of Trade (NTP) and rural poverty across Sulawesi during the period 2019–2024, aiming to explore how sectoral NTP variations impact farmer welfare and poverty alleviation. Utilizing a quantitative correlational design, this research applies panel data regression on NTP indicators from five agricultural subsectors food crops, horticulture, plantations, livestock, and fisheries spanning six provinces over five years. The regression model demonstrates that these subsectoral NTPs collectively account for 47.55% of the variation in rural poverty. Plantation NTP exhibits a strong and significant negative association with poverty, indicating its efficacy in reducing rural deprivation. Similarly, food and horticulture NTPs also show negative and significant effects. However, contrary to expectations, livestock and fisheries NTPs are positively and significantly associated with poverty levels, suggesting sectoral inefficiencies or market barriers that hinder inclusive welfare outcomes. These findings reveal the complex dynamics of agricultural price mechanisms and their implications for poverty alleviation, underscoring the need for targeted, subsector-specific policy interventions. Strengthening rural infrastructure, stabilizing agricultural markets, and enhancing access to technology and social protection are crucial strategies for transforming farmer exchange conditions into sustained poverty reduction in Sulawesi.
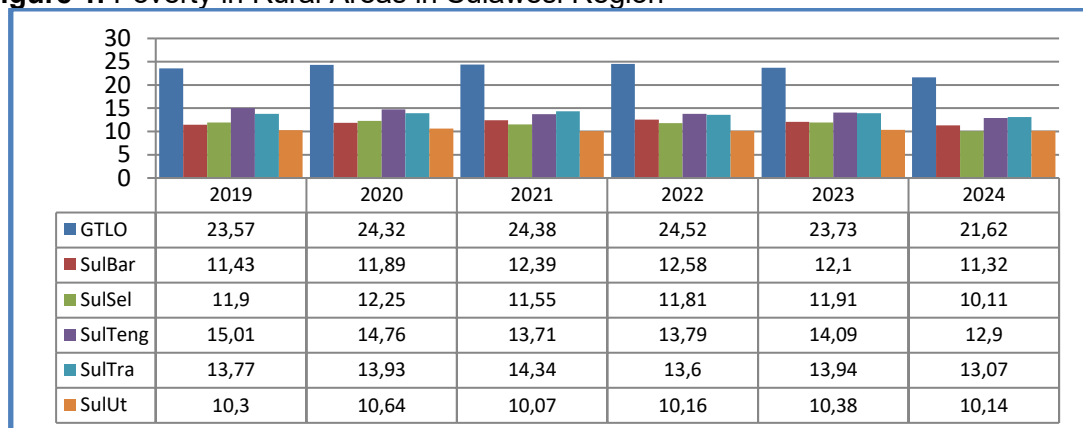
Keywords: Agricultural Subsectors; Farmer's Terms of Trade (NTP); Plantation Economy; Rural Poverty; Welfare

INTRODUCTION

Agriculture remains vital for economic and social stability in many developing countries, including Indonesia, where it sustains rural livelihoods (World Bank, 2021). Beyond food production, agriculture drives employment and local economic growth, especially in poor regions. Mechanisation access significantly boosts smallholder welfare and lowers rural poverty (Sims & Kienzle, 2017). However, despite their central role in food security and development, Indonesian farmers often face systemic issues like low output prices, high production costs, and limited market access (FAO, 2020). In Sulawesi, agriculture, especially plantations like cloves, dominates, yet challenges persist due to poor infrastructure and limited education and healthcare services (Arham et al., 2022; Toumbourou et al., 2023). These inequalities are intensified by geographic remoteness, hindering integration into value chains and income diversification (Rigg et al., 2018). Education investments and rural transformation strategies show promise in reducing poverty and enhancing productivity (Sudaryanto et al., 2023; Mariyono et al., 2020).

The poverty trend in rural areas in the Sulawesi Region during 2019-2024 is presented in the following chart:

Figure 1. Poverty in Rural Areas in Sulawesi Region

	2019	2020	2021	2022	2023	2024
GTLO	23,57	24,32	24,38	24,52	23,73	21,62
SulBar	11,43	11,89	12,39	12,58	12,1	11,32
SulSel	11,9	12,25	11,55	11,81	11,91	10,11
SulTeng	15,01	14,76	13,71	13,79	14,09	12,9
SulTra	13,77	13,93	14,34	13,6	13,94	13,07
SulUt	10,3	10,64	10,07	10,16	10,38	10,14

From 2019 to 2024, rural poverty rates across Sulawesi provinces fluctuated. Gorontalo peaked at 24.52% in 2022 before falling to 21.62% in 2024, likely due to targeted local government interventions and expanded economic programs. West Sulawesi saw poverty rise until 2022 (12.58%) before dropping to 11.32% in 2024, influenced by climate-sensitive agriculture and fisheries and limited infrastructure. South Sulawesi experienced volatility, peaking in 2020 at 12.25% and declining to 10.11% by 2024, attributed to improved rural productivity in agriculture and trade. Central Sulawesi's poverty declined steadily from 15.01% in 2019 to 12.9% in 2024, reflecting better infrastructure and access to economic resources. Southeast Sulawesi showed slight increases in some years but dropped to 13.07% in 2024. North Sulawesi remained relatively stable near 10%. Despite some progress, rural poverty remains a significant issue in Sulawesi, requiring continued structural reforms and inclusive economic development strategies.

The Farmer Exchange Rate (NTP) is a macroeconomic indicator reflecting farmers' real purchasing power by comparing prices received and paid (BPS, 2023). Rising NTP suggests improved farmer welfare, while a decline indicates vulnerability. NTP serves as a policy benchmark to assess agricultural inequalities and guide rural development. However, regional analyses like in Sulawesi remain scarce. Few studies explore the NTP's link with broader outcomes such as income, education, and multidimensional

poverty (Chambers & Conway, 1992; Ellis & Biggs, 2001). Recent literature highlights the role of NTP in resilience and food system equity (Rozi et al., 2025), the effect of macroeconomic shocks on household welfare (Warr & Yusuf, 2014), and NTP's integration in sustainable farming (Kasak et al., 2022).

This study aims to fill this gap by analyzing the trend of the Farmer Exchange Rate from 2019 to 2024, examining the relationship between the Farmer Exchange Rate and farmers' welfare in rural Sulawesi, and evaluating the contribution of NTP to spatial poverty alleviation efforts from 2020 to 2024. The independent variables used in this study are the NTP values from various agricultural subsectors—namely horticulture, food crops, fisheries, plantations, and livestock—each applied with a one-period lag (t–1), indicating that the impact of NTP on poverty occurs with a time delay. With a data-driven approach and empirical evidence, this study is expected to provide policy-relevant insights to strengthen the economic resilience of Sulawesi's farming communities through improved farmer exchange conditions and the development of more inclusive policies.

LITERATURE REVIEW

Farmer's Terms of Trade
Farmer's Terms of Trade (ToT) is a critical macroeconomic and sectoral indicator used to evaluate the relative prosperity of farmers by comparing the price index received by farmers (It)—representing output prices—to the price index paid by farmers (Ib)—representing input and household consumption costs. An NTP (Nilai Tukar Petani) value above 100 indicates favorable conditions where farmers gain more from their agricultural sales than their expenditures, while a value below 100 indicates unfavorable terms (Oelviani et al., 2022). This metric reflects not only income dynamics in the agricultural sector but also broader economic sustainability in rural areas.

In Indonesia, NTP has been widely adopted as an essential policy instrument to assess agricultural resilience and farmer welfare, particularly during periods of economic disruption, such as the COVID-19 pandemic (Suryani et al., 2022). Fluctuations in NTP are influenced by various factors, including commodity price volatility, production costs, climate variability, and government intervention in agricultural markets (Oelviani et al., 2022). Sustained improvements in NTP can stimulate investment in farm productivity, enhance rural employment, and promote household income growth. Conversely, a declining NTP may signal vulnerability, prompting targeted interventions such as subsidies, price stabilization policies, and rural infrastructure development. Accurate NTP analysis is thus essential for formulating inclusive agricultural and trade policies that not only combat rural poverty but also strengthen food security and sustainable rural livelihoods.

Poverty
Poverty is a multidimensional socio-economic condition that goes beyond insufficient income, encompassing limited access to education, healthcare, housing, and other fundamental services. It represents a structural manifestation of exclusion, vulnerability, and deprivation (Lang & Lingnau, 2015). Economists have increasingly criticized income-based poverty metrics for overlooking non-monetary dimensions such as subjective well-being, social participation, and human capability deprivation (Shams, 2016). The capability approach proposed by Sen underscores that poverty should be understood as the deprivation of basic capabilities, preventing individuals from living the life they value.

Easterly (2006) introduces the concept of poverty traps, wherein low-income populations remain in a cycle of deprivation due to lack of access to capital, technology, and functional institutions. In rural contexts, poverty traps can be exacerbated by geographic isolation, inadequate infrastructure, and limited market access, which collectively hinder productivity and income diversification. Recognizing poverty in this broader context is essential for designing targeted, multidimensional policy responses that align with Sustainable Development Goals (SDGs), particularly SDG 1 (No Poverty) and SDG 10 (Reduced Inequalities).

Agricultural Subsectors and Rural Welfare
The agricultural sector in Indonesia comprises various subsectors—such as food crops, horticulture, plantations, livestock, and fisheries—that contribute differently to rural income and employment. Each subsector faces distinct challenges and opportunities, from market integration and value chain development to vulnerability to climate change and commodity price fluctuations (BPS, 2023). Plantation commodities, for example, may generate higher export revenues but are often subject to international price volatility, whereas food crops are more closely tied to domestic food security policies.

Studies have shown that diversification across agricultural subsectors can enhance rural household resilience by reducing dependency on a single income source and providing year-round income streams (FAO, 2020). Furthermore, subsector-specific interventions—such as improving smallholder access to technology, extension services, and market information—can significantly raise productivity and profitability. The interaction between agricultural performance and welfare outcomes is also mediated by infrastructure availability, institutional support, and local governance capacity. This underscores the need for integrated rural development strategies that address both sector-specific productivity constraints and cross-cutting issues such as education, health, and financial inclusion.

RESEARCH METHOD

This study adopts a quantitative research approach with descriptive and correlational methods. The descriptive method is applied to illustrate the trend of rural poverty and Farmer's Terms of Trade (NTP) in the Sulawesi region, while the correlational method is used to examine the relationship between the variables.

Data and Sources
The data employed in this research consist of time series and cross-sectional (panel) data covering six provinces in the Sulawesi region over a five-year period (2020–2024). This yields a total of 30 panel observations. The main variables include rural poverty rates and NTP across five agricultural subsectors: food crops, horticulture, plantations, livestock, and fisheries. All data were obtained from the publications of *Badan Pusat Statistik* (BPS) for each province in Sulawesi.

Data Collection Technique
Data were collected using documentation techniques by compiling verified and standardized official statistics from BPS publications, including press releases, statistical bulletins, and relevant reports for each province.

Data Analysis
The analysis began with descriptive statistical techniques to present and compare the trends of rural poverty and the NTP of each subsector in the Sulawesi region. Subsequently, a multiple linear regression analysis was conducted to determine the

effect of NTP in each subsector on rural poverty levels. Multiple regression was chosen because the model includes more than one independent variable.

The regression model used is as follows:

$$POV_{\{it\}} = \alpha + \beta_{\{1\}PGN_{\{it\}}} + \beta_{\{2\}HRTK_{\{it\}}} + \beta_{\{3\}PKB_{\{it\}}} + \beta_{\{4\}PTNK_{\{it\}}} + \beta_{\{5\}PRKN_{\{it\}}} + \varepsilon_{\{it\}}$$

Where:
POV = Rural poverty rate
PGN = Food crops NTP
HRTK = Horticulture NTP
PKB = Plantation NTP
PTNK = Livestock NTP
PRKN = Fisheries NTP
α = Constant
β = Regression coefficient
ε = Error term

Hypothesis Testing
Hypothesis testing in this study was conducted through three main procedures. The partial test (t-test) was applied to determine the significance of each independent variable individually in explaining variations in rural poverty. The simultaneous test (F-test) was used to assess the combined effect of all independent variables on rural poverty. In addition, the coefficient of determination (R^2) was calculated to measure the proportion of variation in rural poverty that can be explained by the regression model, thereby indicating the overall explanatory power of the analysis.
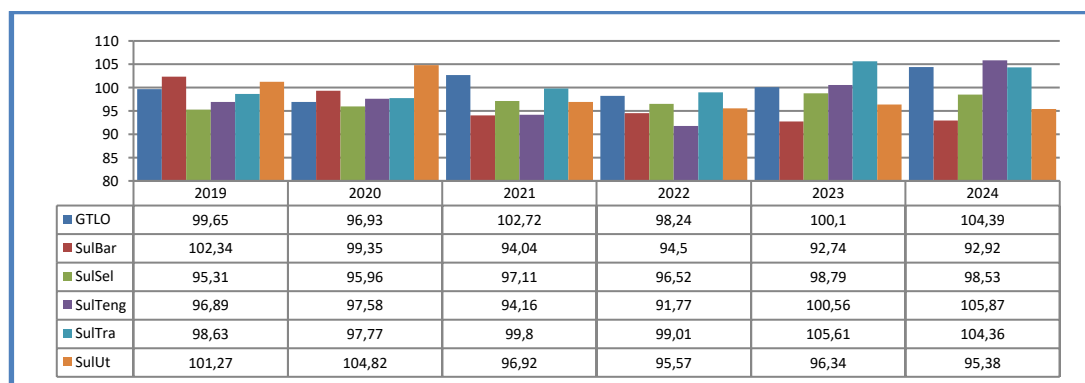
RESULTS

Descriptive Statistics
Description of the exchange rate of food subsector farmers in Sulawesi Region
The trend of exchange rate of food sub-sector farmers in Sulawesi Region during 2019-2024 is presented in the following graph:

Figure 2. Exchange Rate of Farmers in The Food Sub-Sector in Sulawesi Region

	2019	2020	2021	2022	2023	2024
GTLO	99,65	96,93	102,72	98,24	100,1	104,39
SulBar	102,34	99,35	94,04	94,5	92,74	92,92
SulSel	95,31	95,96	97,11	96,52	98,79	98,53
SulTeng	96,89	97,58	94,16	91,77	100,56	105,87
SulTra	98,63	97,77	99,8	99,01	105,61	104,36
SulUt	101,27	104,82	96,92	95,57	96,34	95,38

Between 2019–2024, the Farmer Exchange Rate (NTP) in Gorontalo showed a fluctuating but rising trend. After dropping to 96.93 in 2020 due to COVID-19, it rebounded to 104.39 in 2024, supported by economic recovery, rising commodity prices, and policy support (BPS, 2023). In contrast, West Sulawesi experienced a consistent decline from 102.34 in 2019 to 92.92 in 2024, due to price instability, rising production costs, and limited policy response at the farm level. South Sulawesi's NTP showed gradual growth with minor fluctuations, indicating resilience supported by stable market
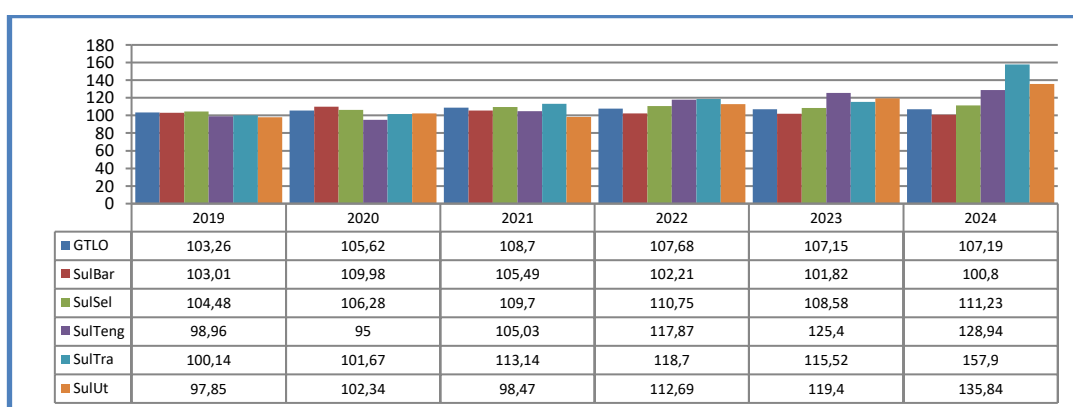
and governance conditions. Central Sulawesi's NTP fell sharply until 2022 but rose significantly to 105.87 in 2024 due to improved infrastructure and better market access (Kasak et al., 2022). Southeast Sulawesi saw steady gains, reaching 105.61 in 2023, driven by higher output prices and production efficiency. North Sulawesi's NTP fluctuated considerably, peaking in 2020 but falling again due to volatile input costs and export market dependence.

Overall, these variations reflect disparities in infrastructure, climate resilience, and regional policy implementation (Rozi et al., 2025; Warr & Yusuf, 2014). Studies show that improving rural transport and stabilizing agricultural prices can significantly impact NTP trends and farmers' welfare (McCarthy, 2020; Rahmawati et al., 2023). Addressing local constraints and enhancing access to inputs and markets is essential for maintaining farmer purchasing power and supporting rural economic growth.

Description of the exchange rate of farmers in the horticultural sub-sector in Sulawesi Region
The trend of the exchange rate of farmers in the horticultural sub-sector in the Sulawesi Region during 2019-2024 is presented in the following graph:

Figure 3. Exchange Rate of Farmers in The Horticultural Sub-Sector in Sulawesi Region

	2019	2020	2021	2022	2023	2024
GTLO	103,26	105,62	108,7	107,68	107,15	107,19
SulBar	103,01	109,98	105,49	102,21	101,82	100,8
SulSel	104,48	106,28	109,7	110,75	108,58	111,23
SulTeng	98,96	95	105,03	117,87	125,4	128,94
SulTra	100,14	101,67	113,14	118,7	115,52	157,9
SulUt	97,85	102,34	98,47	112,69	119,4	135,84

From 2019–2024, Gorontalo's horticultural NTP rose from 103.26 to 108.7 by 2021, driven by rising commodity prices and government support, but declined to 107.19 in 2024 due to rising input costs and unfavorable weather. West Sulawesi showed a sharp increase to 109.98 in 2020, likely due to high demand, but then declined steadily to 100.8 in 2024, influenced by rising production costs, interregional market competition, and policy shifts. South Sulawesi showed an upward trend from 104.48 in 2019 to 111.23 in 2024, despite minor drops in 2023, supported by modern technologies and efficient production. Central Sulawesi had the most dramatic increase, from 98.96 in 2019 to 128.94 in 2024, due to expanded cultivation, infrastructure improvements, and stronger market connections. Southeast Sulawesi also surged from 100.14 to 157.9 in 2024, driven by technology adoption, policy support, and increased interregional demand. North Sulawesi rose steadily from 97.85 to 135.84, thanks to export expansion and capacity-building initiatives.
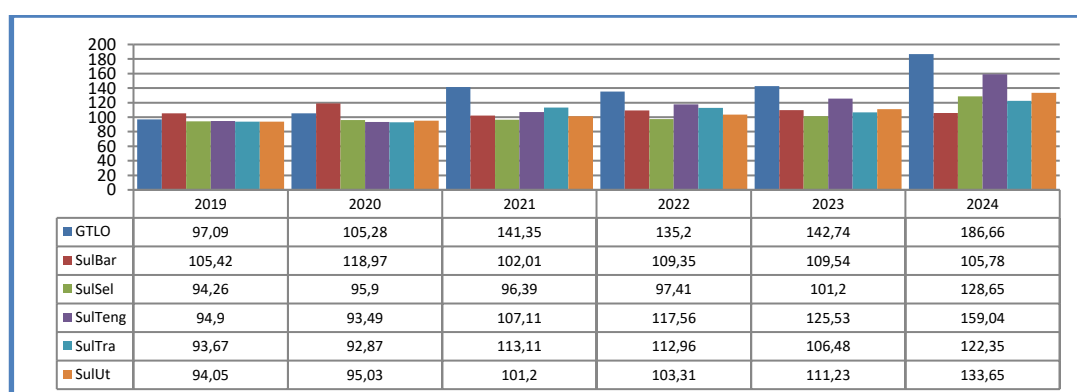
These trends affirm that infrastructure, climate conditions, and access to markets are key to sustaining horticultural farmer welfare (Oelviani et al., 2022; Vroegindeweij et al., 2016). Weather variability, agrochemical costs, and digital access also significantly influence NTP fluctuations (Mukah et al., 2023; Singh et al., 2024). Horticultural

transformation is feasible with integrated support for logistics, input subsidies, and remote environment monitoring (Vroegindeweij et al., 2016; Ames et al., 2024).

Description of the exchange rate of farmers in the plantation sub-sector in Sulawesi Region
The trend of the exchange rate of farmers in the plantation sub-sector in the Sulawesi Region during 2019-2024 is presented in the following graph:

Figure 4. Exchange Rate for Farmers in The Plantation Sub-Sector in The Sulawesi Region

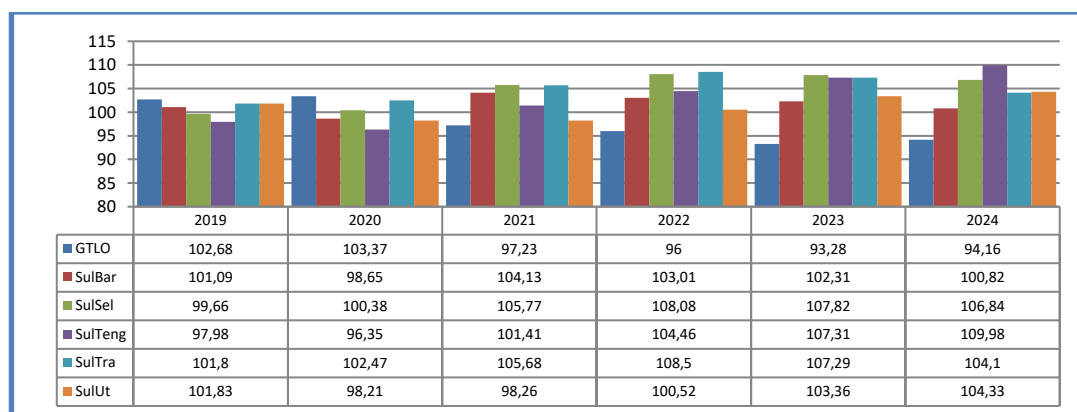|	2019	2020	2021	2022	2023	2024
GTLO	97,09	105,28	141,35	135,2	142,74	186,66
SulBar	105,42	118,97	102,01	109,35	109,54	105,78
SulSel	94,26	95,9	96,39	97,41	101,2	128,65
SulTeng	94,9	93,49	107,11	117,56	125,53	159,04
SulTra	93,67	92,87	113,11	112,96	106,48	122,35
SulUt	94,05	95,03	101,2	103,31	111,23	133,65

From 2019–2024, the plantation NTP in Gorontalo rose significantly from 97.09 to 186.66, driven by higher coconut and clove prices, with a notable surge in 2021 due to export demand and domestic price growth. A minor dip in 2022 was linked to price fluctuations and external shocks. West Sulawesi showed a more stable trend, with NTP fluctuating from 105.42 (2019) to 105.78 (2024), shaped by volatile cocoa and palm oil prices and rising input costs. South Sulawesi saw growth from 94.26 to 128.65, supported by rising coffee and cocoa prices, export expansion, and infrastructure programs. Central Sulawesi's NTP increased from 94.9 in 2019 to 159.04 in 2024 after initial stagnation during the pandemic, thanks to market recovery and export strength. Southeast Sulawesi also recorded growth—from 93.67 to 122.35—fueled by increased demand and improved supply chains despite earlier price shocks. North Sulawesi's NTP rose steadily from 94.05 to 133.65, especially after 2021, supported by export-led clove and nutmeg markets.

This regional growth aligns with broader studies showing that global commodity prices, climate, and market access strongly influence plantation NTP trends (Oelviani et al., 2022). Improvements in logistics, government subsidies, and sustainable practices also boost farmer resilience (Vroegindeweij et al., 2016; Singh et al., 2024). However, rising fertilizer costs and climate risks remain challenges (Mukah et al., 2023; Ames et al., 2024).

Description of the exchange rate of livestock sub-sector farmers in the Sulawesi Region
The trend in the exchange rate of livestock sub-sector farmers in the Sulawesi Region for the period 2019-2024 is presented in the following graph:

Figure 5. Exchange Rate of Livestock Sub-Sector Farmers in The Sulawesi Region

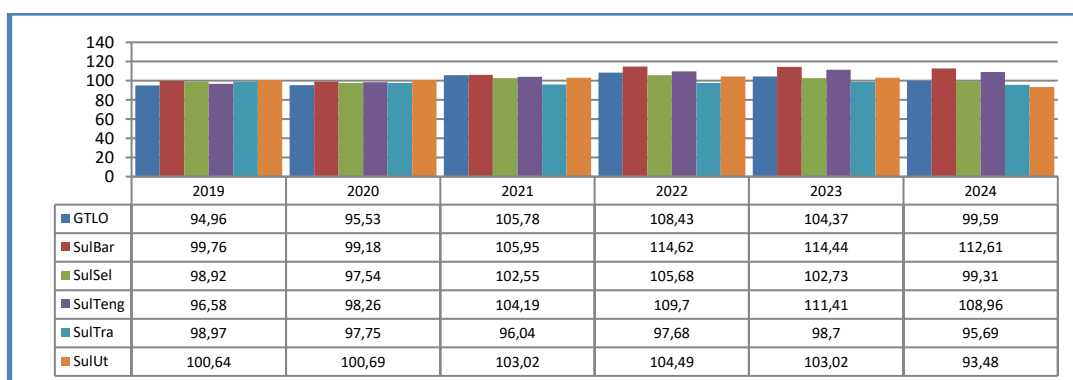|	2019	2020	2021	2022	2023	2024
■ GTLO	102,68	103,37	97,23	96	93,28	94,16
■ SulBar	101,09	98,65	104,13	103,01	102,31	100,82
■ SulSel	99,66	100,38	105,77	108,08	107,82	106,84
■ SulTeng	97,98	96,35	101,41	104,46	107,31	109,98
■ SulTra	101,8	102,47	105,68	108,5	107,29	104,1
■ SulUt	101,83	98,21	98,26	100,52	103,36	104,33

The livestock Farmer's Terms of Trade (NTP) across Sulawesi from 2019 to 2024 showed varied trends. Gorontalo's NTP declined from 103.37 in 2020 to 93.28 in 2023 due to high feed and medicine costs, weak market demand, and COVID-19 impacts, before a slight rebound in 2024. West Sulawesi remained relatively stable, but production cost hikes led to a decline from 104.13 in 2021 to 100.82 in 2024. South Sulawesi showed consistent growth to 108.08 in 2022, driven by livestock programs and market expansion, though demand fluctuations led to slight drops afterward. Central Sulawesi's NTP grew from 96.35 in 2020 to 109.98 in 2024, reflecting improved market access and recovery. Southeast Sulawesi peaked in 2022 at 108.5 but declined slightly thereafter due to increased feed costs. North Sulawesi rose from 98.26 in 2021 to 104.33 in 2024, boosted by demand recovery and export market access. These variations highlight the sensitivity of livestock NTP to input prices, policy support, and global demand (Nguyen et al., 2024; Oelviani et al., 2022; Azlan et al., 2024). Enhancing feed access and market connectivity remains crucial to ensure stable NTP and farmer welfare (Turvey, 2019; Mukah et al., 2023).

Description of the exchange rate of fisheries sub-sector farmers in the Sulawesi Region

The trend in the exchange rate of fisheries sub-sector farmers in the Sulawesi Region for the period 2019-2024 is presented in the following graph:

Figure 6. Exchange Rate of Fisheries Sub-Sector Farmers in The Sulawesi Region

	2019	2020	2021	2022	2023	2024
■ GTLO	94,96	95,53	105,78	108,43	104,37	99,59
■ SulBar	99,76	99,18	105,95	114,62	114,44	112,61
■ SulSel	98,92	97,54	102,55	105,68	102,73	99,31
■ SulTeng	96,58	98,26	104,19	109,7	111,41	108,96
■ SulTra	98,97	97,75	96,04	97,68	98,7	95,69
■ SulUt	100,64	100,69	103,02	104,49	103,02	93,48

The trend of the Fisheries Farmer Exchange Rate (NTP) across six provinces in Sulawesi reveals dynamics shaped by market prices, production costs, and policy interventions. In Gorontalo, the NTP rose from 94.96 in 2019 to 108.43 in 2022, driven by infrastructure improvements and export growth, but declined to 99.59 in 2024 due to

rising feed and fuel prices. Similar downturns occurred in South and Southeast Sulawesi during 2023–2024, mainly due to unstable market prices and increased input costs.

Central Sulawesi recorded a positive trajectory, from 96.58 in 2019 to 111.41 in 2023, supported by expansion in aquaculture—particularly seaweed and shrimp—and technological improvements. However, rising production costs and climate change pressures began to suppress NTP in 2024. West Sulawesi experienced a sharp increase between 2021–2023 (from 105.95 to 114.44), followed by a slight decline in 2024 due to operational costs and climate variability. North Sulawesi showed stable growth until 2022, but fell significantly to 93.48 in 2024, driven by declining export demand and weak market regulations.

Key factors influencing these fluctuations include climate change, rising input prices, and volatile market demand (Tran et al., 2023). Energy optimization and climate adaptation strategies are crucial for enhancing resilience in the fisheries sub-sector (Chokesanguan, 2011; Gopal & Anbumozhi, 2019).

Multiple Regression Analysis Results
The results of multiple regression analysis to describe the effect of farmer exchange rates on poverty in rural areas in the Sulawesi Region. The results of panel data regression using E-Views 9 are shown in the following Table 1:

Table 1. Regression Analysis Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	34.03035	4.747748	7.167682	0.0000
Food_NTP	-0.304342	0.022691	-13.41274	0.0000
Horticulture_NTP	-0.237149	0.032007	-7.40935	0.0000
Plantation_NTP	-0.282498	0.022422	-12.58987	0.0000
Livestock_NTP	0.243273	0.011759	20.68769	0.0000
Fisheries_NTP	0.350202	0.038524	9.090539	0.0000

Statistic	Value	Statistic	Value
R-squared	0.565967	Mean dependent var	10.99867
Adjusted R-squared	0.475543	S.D. dependent var	0.565967
S.E. of regression	1.897734	Sum squared resid	86.43348
F-statistic	6.259068	Durbin-Watson stat	1.181551
Prob(F-statistic)	0.000753		

Source: E-Views 9 Data Processing, 2025

Based on the results of the analysis using the E-Views 9 program above, the following regression model was obtained:

$$Poverty_{\{it\}} = 34.0303 - 0.3043\, Food_{\{it\}} - 0.2371\, Horticulture_{\{it\}}$$
$$- 0.2824\, Plantation_{\{it\}} + 0.2432\, Livestock_{\{it\}} + 0.3502\, Fisheries_{\{it\}}$$
$$+ \varepsilon_{\{it\}}$$

Coefficient of Determination
Based on Table 1, it was found that 47.55% of the poverty rate in rural areas in the Sulawesi Region can be explained by the food NTP, horticulture NTP, plantation NTP, livestock NTP and fisheries NTP. The ability of other variables to explain poverty in rural areas is 52.45% (100% -47.55%). Other variables that have an impact on poverty in rural areas such as unemployment, labor force participation rate, HDI, per capita income, gini

ratio and government fiscal policy in the form of social function spending, education function, health function, infrastructure function and economic function.

Simultaneous Test Results (F Test)

Based on Table 1, the probability or probability value (P-Value) obtained is smaller than the alpha value of 0.05 (0.000753 < 0.05). So it is concluded that the food NTP, horticulture NTP, plantation NTP, livestock NTP and fisheries NTP simultaneously have a significant effect on poverty in rural areas in the Sulawesi Region.

Partial Test Results (t-Test)
The Effect of Food NTP on Rural Poverty in the Sulawesi Region
The probability value (P-Value) for food NTP is less than the significance threshold of 0.05 (0.0000 < 0.05), indicating that food NTP has a statistically significant negative influence on rural poverty levels in Sulawesi. The negative regression coefficient implies an inverse relationship between food NTP and poverty, suggesting that higher food NTP values are associated with lower poverty levels. However, the extent of this reduction appears to be limited and not entirely optimal for comprehensive poverty alleviation.

The Effect of Horticultural NTP on Rural Poverty in the Sulawesi Region
Similarly, the P-Value for horticultural NTP is also below 0.05 (0.0000 < 0.05), confirming a negative and statistically significant relationship with rural poverty. The negative coefficient indicates that as horticultural NTP increases, poverty tends to decrease. Nevertheless, the magnitude of this reduction is relatively modest, reflecting only a partial alleviation effect.

The Effect of Plantation NTP on Rural Poverty in the Sulawesi Region
The plantation NTP presents a P-Value of 0.0000, signifying a significant and negative impact on rural poverty. The negative sign of the regression coefficient indicates that an increase in plantation NTP substantially contributes to reducing poverty among rural communities in Sulawesi, marking it as one of the more effective subsectors in promoting welfare improvements.

The Effect of Livestock NTP on Rural Poverty in the Sulawesi Region
The statistical result for livestock NTP shows a P-Value below 0.05 (0.0000 < 0.05) with a positive regression coefficient. This outcome indicates a significant and positive relationship between livestock NTP and rural poverty, which is counterintuitive. Rather than contributing to poverty alleviation, rising livestock NTP appears to coincide with increasing poverty levels. This anomalous finding suggests that structural inefficiencies or market barriers may undermine the potential of the livestock subsector to reduce poverty effectively.

The Effect of Fisheries NTP on Rural Poverty in the Sulawesi Region
The fisheries NTP also shows a P-Value less than 0.05 (0.0000 < 0.05) and a positive coefficient, indicating a direct and significant association with rising rural poverty. This result implies that as the fisheries NTP increases, poverty in rural areas also tends to rise. The finding may point to an imbalance between sectoral economic performance and equitable welfare distribution, possibly due to high production costs or market constraints within the fisheries sector.

DISCUSSION

The Farmer Terms of Trade (NTP) trends across Sulawesi sub-sectors from 2019–2024 vary significantly. Central and Southeast Sulawesi show steady growth in the food sub-

sector, while West Sulawesi declined, and other provinces fluctuated due to price volatility and input costs. Horticulture NTP rose significantly in Central and Southeast Sulawesi, driven by market expansion and government support, while West Sulawesi declined due to production constraints. Plantation NTP generally improved, with Gorontalo leading, followed by gains in Central and South Sulawesi, influenced by global demand and infrastructure development. West Sulawesi's stagnation was due to unstable prices and rising input costs (Oelviani et al., 2022).

Livestock NTP grew in Central and South Sulawesi but declined in Gorontalo and West Sulawesi, mainly due to feed price hikes and limited purchasing power. Fisheries NTP showed sharp fluctuations; Central and West Sulawesi increased before slightly declining in 2024, while North Sulawesi and Gorontalo fell more sharply due to declining exports and climate effects. Broadly, NTP trends are shaped by input prices, climate variability, infrastructure gaps, and policy responses (Malahayati, 2024; Kerstens et al., 2016).

When considered collectively, the NTPs for food, horticulture, plantations, livestock, and fisheries exhibit a statistically significant influence on rural poverty levels in the Sulawesi Region. The model's coefficient of determination (R^2) is 47.55%, indicating that these five subsectoral NTPs explain nearly half of the variation in rural poverty. The remaining 52.45% is attributable to other influential factors, such as unemployment, labor force participation, the Human Development Index (HDI), per capita income, income inequality (Gini ratio), and various components of government fiscal policy—including expenditures on social welfare, education, healthcare, infrastructure, and economic development. These findings support the conclusions of Ayoo (2022), who asserted that NTP can be a useful instrument in poverty reduction strategies.

On a disaggregated basis, the analysis reveals that the food subsector's NTP has a significant negative association with rural poverty in Sulawesi. This inverse relationship suggests that increases in food NTP are associated with a marked reduction in poverty, underscoring the potential of this subsector to contribute meaningfully to poverty alleviation efforts. This observation aligns with the arguments presented by Ediwijoyo et al. (2023), who noted that although higher NTPs do not always equate to improved welfare due to consistently low values, under appropriate conditions, an increase in NTP can indeed help reduce poverty.

A similar pattern is observed with the horticultural NTP, which also demonstrates a statistically significant negative impact on rural poverty. The regression results indicate that improvements in the horticulture NTP are linked to a decline in poverty rates, reinforcing the idea that targeted development within specific agricultural subsectors can enhance farmer welfare. These findings further corroborate Ediwijoyo et al.'s (2023) view that progress in selected subsectors despite the overall stagnation of NTP can still yield tangible benefits for poverty reduction and rural livelihoods.

The plantation NTP also exerts a negative and significant influence on rural poverty in the Sulawesi Region. The regression result suggests that increases in plantation NTP are effective in significantly reducing poverty levels in rural areas. This finding is in line with Ayoo (2022), who concluded that plantation NTP can play an important role in driving poverty reduction due to its stronger market integration and economic contribution to rural households.

In contrast, the livestock NTP displays a positive and significant effect on rural poverty in the Sulawesi Region. This positive relationship is considered anomalous, as it implies

that despite higher exchange values in the livestock sector, poverty levels continue to rise. This may point to structural inefficiencies, market access limitations, or distributional issues within the livestock subsector that hinder its capacity to support poverty alleviation. These findings correspond with Yacoub & Mutiaradina (2020), who argue that Indonesian farmers are generally less prosperous and that an increase in NTP does not automatically lead to improved welfare, particularly when the increase is not accompanied by broader sectoral reforms.

Likewise, the fisheries NTP also shows a positive and significant effect on rural poverty in the Sulawesi Region. The positive coefficient suggests that increases in fisheries NTP are associated with rising poverty levels, indicating a potential disconnect between sectoral performance and inclusive welfare gains. This supports the assertion of Setiyowati et al. (2018), who noted that agricultural land conversion can increase poverty, particularly in rural areas. Furthermore, Setiawan (2016) highlights that rising NTP, especially in the fisheries sector, can lead to inflationary pressures that disproportionately affect non-sector households, ultimately exacerbating rural poverty.

These findings also resonate with Kuntjorowati et al. (2024), who emphasized the importance of collaboration among government, private sector, academia, and communities in strengthening social protection programs. Their study shows that such collaborative efforts are crucial in addressing poverty in rural areas, especially when sector-specific gains fail to translate into equitable welfare improvements.

This statement refers to the findings in a study by Kuntjorowati et al. (2024), which shows that collaboration between the government, private sector, academics, and the community in strengthening social protection programs has succeeded in reducing poverty in rural areas.

CONCLUSION

The analysis shows that variations in Farmer Exchange Rates (NTP) across agricultural subsectors in Sulawesi reflect differences in farmer welfare and significantly influence rural poverty. Food NTP, horticulture NTP, and plantation NTP have a negative and significant relationship with rural poverty, indicating their role in poverty reduction. Conversely, livestock NTP and fisheries NTP have a positive and significant effect, suggesting that rising NTP in these subsectors may be linked to increased poverty due to higher production costs or structural challenges. The regression results indicate that 47.55% of rural poverty variation is explained by NTP, while the remaining 52.45% is influenced by factors such as unemployment, labor force participation, human development index (HDI), per capita income, Gini ratio, and government fiscal policies in social protection, education, health, infrastructure, and economic development. These findings emphasize the need for sustainable, targeted, and subsector-specific strategies to enhance farmer welfare and reduce rural poverty in Sulawesi.

DECLARATION OF CONFLICTING INTERESTS
The authors have declared no potential conflicts of interest concerning the study, authorship, and/or publication of this article.

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