

# Analyzing Factors Influencing Farmer Term of Trade for Food Crops: A Case Study of South Sulawesi, Indonesia

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**Abstract** Farmer Terms of Trade (FToT) is the ratio of agricultural produce prices to the goods and services needed to produce it. It is a pivotal indicator for assessing farmer welfare. Yet, the FToT of food crops consistently lags other subsectors despite being the primary income source for most farmers. This research explores the determinants influencing the FToT of food crops, utilizing a monthly data series from 2019 to 2022. Multiple linear regression analysis with various time lags is explored to derive an optimal estimation model. Among the six estimations with distinct time lags, time lag-4 emerges as the most promising, offering insights into the factors shaping FToT dynamics. Of the seven variables examined, six independent variables exhibit significance at a confidence level of 0.01, except the Price of Corn variable, which appears to have a negligible impact. The prominence of time lag 4 underscores its alignment with the typical age or harvest period of food crops, highlighting the importance of considering temporal dynamics when analyzing economic variables within the agricultural sector. This underscores the necessity of accounting for time lags in estimating influential factors within the agricultural domain, facilitating a more nuanced understanding of the sector's economic intricacies.

**Keywords** Farmer Income, Farmer Welfare, Food Crops, Time Lag

## 1. Introduction

The farmer's Term of Trade (FToT) is a fundamental indicator of economic stability and farmer welfare. By comparing the prices farmers receive for their agricultural produce to the costs they incur in production, the FToT provides valuable insights into agriculture's economic viability and sustainability. A favourable trade term ensures stable incomes and profitability for farmers, contributing to poverty reduction, rural development, and food security [1]. Moreover, a positive FToT incentivizes the adoption of technology and conservation initiatives, fostering environmental sustainability within the agricultural sector.

In countries like Indonesia, where a significant portion of the population relies on agriculture for livelihoods, the performance of the agricultural sector is of immense importance to national development. Given this reliance, essential knowledge of farming practices becomes indispensable for farmers to manage their operations and increase productivity effectively. This underscores the critical connection between the agricultural sector and the well-being of a substantial portion of the population sector. Therefore, prioritizing knowledge transfer and investment

in agricultural education is essential to sustain and enhance the sector's vital role in Indonesia's development trajectory [2]. By managing and improving farmers' terms of trade, policymakers can ensure a robust and economically viable agricultural sector that supports farming communities and contributes significantly to the nation's overall prosperity and well-being [3].

In 2023, 37.42% of Indonesia's population will work in the agricultural sector, totalling 104.3 million people across 28,192,693 households. From 2018 to 2021, the broader agrarian domain, including forestry and fisheries, ranked second in contributing to Indonesia's GDP, averaging 13.22%. In contrast, narrow agriculture, excluding forestry and fisheries, contributed 9.82% to the GDP during the same period. However, the manufacturing and industrial sectors significantly influence their respective GDPs, absorbing 13.31% and 21.66% [2]. It underscores the agricultural sector's crucial impact on employment and economic contributions, emphasizing its vital role in Indonesia's socio-economic development.

The research problems highlighted in the data from BPS South Sulawesi Province revolve around the significant increase in the combined farmer exchange rate of South Sulawesi Province in December 2022. Table 1 shows a 75% rise with a value of 101.12%, compared to the December 2021 farmer exchange rate of 100.37%. Specifically, the Food Crop Farmer Exchange Rate for December 2022 was recorded at 91.34, the Horticultural Farmer Exchange Rate at 125.36, and the Smallholder Plantation Crop Farmer Exchange Rate at 120.48. Additionally, the farmer exchange rate in the food crop subsector decreased by 2.61 in December 2021.

The key issue arises from the substantial increase in the farmer exchange rate in December 2022, and the research aims to understand this change. Therefore, the study analyses the factors contributing to this significant rise in the farmer exchange rate, focusing on the discrepancy between the indexes received and paid by farmers.

Agricultural sector activities predominantly occur in rural areas, with on-farm cultivation activities being the primary domain of farmers, cultivators, and farming laborers [3]. Evaluating the well-being of farmers entails considering their income relative to their expenses, and farmers' welfare is paramount for both agricultural and economic development. The Farmers' Terms of Trade (FToT) is a crucial tool in measuring farmers' welfare, emerging as a key indicator in this assessment. This metric functions to gauge the financial health of farmers, commonly employed to assess the balance between their income and expenditures.

The FToT calculation entails comparing the price index received by farmers and the price index paid by them. The former reflects the progression of commodity prices set by farmers [4]. FToT describes the level of exchange capacity/purchasing power of farmers for products purchased/paid for by farmers, including purchased consumption and production input [5].

FToT is closely linked to farmers' purchasing power in meeting their farming families' requirements [6]. This metric serves as a significant indicator for determining the well-being of farmers, offering insights into the highs and lows of their welfare through the lens of FToT.

Attention to farmer welfare is vital for the sustainable future of rice farming and essential food production in Indonesia, constituting a linchpin for the nation's staple food supply [7]. Initiatives aimed at agricultural goals should focus on elevating farmers' quality and income. The assessment of farmer welfare gauged through the Farmers' Terms of Trade (FToT) is crucial in discerning high and low levels [8]. Predicting the FToT index for the upcoming period becomes imperative, offering a proactive tool for stakeholders to prepare preventive measures in case of a potential decline from the previous period [9]. This approach underscores the interconnected nature of farmer welfare, agricultural sustainability, and broader food security in Indonesia.

**Table 1.** Change Value of It, Ib and FTT in December 2022 Compared to December 2021

Subsector	Dec-21			Dec-22			Year on Year		
	It	Ib	FToT	It	Ib	FToT	It	Ib	FToT
Combined Subsectors	108.25	107.86	100.37	114.13	112.86	101.12	5.43	4.64	0.75
Food Crops	101.13	107.83	93.79	103.25	113.04	91.34	2.10	4.83	-2.61
Horticulture Crops	112.76	106.93	105.45	139.98	111.66	125.36	24.14	4.42	18.88
Smallholders Estate Crops	126.41	107.44	117.66	135.53	112.49	120.48	7.21	4.7	2.40
Animal Husbandry	107.76	108.98	98.89	118.82	112.68	105.45	10.26	3.4	6.63
Fishery	116.59	108.35	107.60	124.14	113.44	109.43	6.48	4.7	1.70
Capture Fisheries	114.69	106.56	107.63	122.67	113.03	108.53	6.69	6.07	0.84
Aquaculture	117.94	109.63	107.58	125.19	113.73	110.07	6.15	3.74	2.31

It = Price Index paid by farmer, Ib = Price Index received by farmer

Source: Secondary Data after processing, 2023.

The development of the FTOT is a crucial indicator for agricultural-reliant regions [10]. It represents the relationship between farmers' sales proceeds and their expenditures on goods and services. In summary, FTOT exceeding 100 indicates a surplus for farmers, equaling 100 signifies stable welfare, and a value below 100 implies a deficit, highlighting financial challenge for farmers [11]. This concise framework provides valuable insights into the economic dynamics of the agricultural sector, aiding in assessing farmers' well-being.

The Farmers' Terms of Trade (FTOT) is a comprehensive welfare measure that evaluates the balance between a farmer's income and the associated costs of living and farming [12]. This metric provides insights into the welfare of farmers across various sub-sectors of agriculture. By measuring the exchange rate between the costs of agricultural products and goods and services consumed, FTOT becomes a valuable tool for assessing farmer welfare [13]. The calculation involves determining the percentage of the value paid by farmers, and if the resulting FTOT is above 100, it signifies a favourable welfare level for the farmer [14]. A higher FTOT indicates enhanced purchasing power for consumer products and production inputs, suggesting proximity to prosperity [15]. In essence, FTOT emerges as a nuanced indicator that gauges current farmer welfare and offers a glimpse into their potential for economic advancement and prosperity.

Determining the selling price is a multifaceted process influenced by numerous internal and external factors. Non-cost elements such as economic conditions, demand elasticity, market dynamics, competition, government interventions, and public perception significantly shape pricing decisions [16]. Additionally, the FTOT for farmers is affected by diverse factors like land area, productivity, consumption costs, subsidized urea fertilizer prices, and the exchange rate of the Indonesian rupiah [16]. Other crucial factors impacting the FTOT of food crop farmers include harvested area, price indices of Price of dried rice grain, ground corn, seed, fertilizer, and pesticide, as well as the price index of retail consumption and inflation [17]. This intricate web of considerations emphasizes the intricate nature of pricing decisions and their direct impact on the economic well-being of farmers.

Price level determination is a crucial factor influencing farmer welfare, with macroeconomic indicators for example, the inflation rate plays a pivotal role. The inflation rate, assessed from both consumer and producer perspectives through the consumer and producer price indexes, respectively, provides valuable insights into overall price movements [18]. These indicators offer a comprehensive understanding of the pricing landscape, underscoring the direct impact on farmer welfare. In an agricultural context, well-informed pricing strategies are imperative to navigate the challenges posed by fluctuating price levels.

According to data from BPS South Sulawesi Province, the aggregate farmers' Terms of Trade (FTOT) for the

region witnessed a notable increase of 75% in December 2022, reaching a value of 101.12%, compared to the FTOT of 100.37% in December 2021. The Food Crop FTOT for December 2022 stood at 91.34, the Horticultural Farmer FTOT at 125.36, and the Smallholder Plantation Crop FTOT at 120.48. In the food crop subsector, the farmer FTOT experienced a decrease of 2.61 in December 2021. The substantial 75% increase in the farmer FTOT in December 2022 is attributed to a more significant increase in the index received by farmers (5.43%) compared to the increase in the index paid by farmers (4.64%) [19]. This data highlights the positive economic trend in the agricultural sector in South Sulawesi Province, contributing to improved welfare for farmers in the region [13].

The Farmers' Terms of Trade (FTOT) for Food Crop farmers, reflecting the lowest value compared to other subsectors, signifies that farmers within the food crop subsector are operating at a comparatively lower level of welfare than their counterparts in horticulture, fisheries, and plantation subsectors. The attention to farmers' welfare is particularly pertinent as indications point towards a continuous decline, signifying a potential increase in impoverished individuals [20].

It underscores the urgency for targeted interventions and support mechanisms to uplift the welfare of food crop farmers, addressing the broader issue of declining agricultural well-being and its implications for the overall socio-economic landscape [21]. Despite the pivotal role of the food crops subsector in supporting the majority of farmers and serving as the primary income source in South Sulawesi Province, the Farmers' Terms of Trade for this subsector ranked the lowest compared to other agricultural subsectors in January 2020 [22].

FTOT is further categorized across agricultural subsectors, including Food Crops (FC), Horticultural Crops (HC), People's Plantation Crops (PPC), Livestock (LVs), and Fisheries (FSi) [23], providing a nuanced understanding of welfare variations in different agricultural contexts.

The persistent decline in FTOT in Indonesia reflects an alarming trend of diminishing farmer welfare intricately tied to the agribusiness system in the country. Farmers in the input market face monopsonistic pressures, notably concerning crucial inputs like fertilizer.[24]

The persistent decline in FTOT in Indonesia reflects an alarming trend of diminishing farmer welfare intricately tied to the agribusiness system in the country. Farmers in the input market face monopsonistic pressures, notably concerning crucial inputs like fertilizer [25]. Despite efforts to enhance production and income in the food crop sector through dominant agribusiness activities, the correlation with increased prosperity remains contingent on a parallel rise in farmers' purchasing power [26]. This highlights the multifaceted challenges farmers face within the agribusiness system and emphasizes the need for holistic strategies to address both production dynamics and the economic well-being of farmers.

Inflation factors can affect the FTOT where the inflation rate is high causing farmers to be unable to afford the operational cost of agricultural production. Farmers must save and some use alternative means of production even though it's not of good quality. The impact is that a decrease in the amount of production which has an impact on the FTOT farmers become low [27].

High inflation rates pose a significant challenge to FTOT as farmers struggle to meet the operational costs of agricultural production. The financial strain compels farmers to cut expenses, resorting to alternative, albeit lower quality, means of production. Consequently, this compromises overall production volume, leading to a decline in FTOT as farmers contend with reduced productivity and financial difficulties [27]. The intricate relationship between inflation and farmers' operational costs highlights the vulnerability of agricultural livelihoods to economic fluctuations, emphasizing the need for strategic interventions to safeguard FTOT and the well-being of farmers.

The FTOT for food crop farmers in West Java Province, spanning from 2008 to 2020, saw simultaneous influences from key factors such as land area, rice productivity, fertilizer costs, and seed costs. Notably, while the variable of land area did not individually exert a significant impact on FTOT, factors like rice productivity, fertilizer costs, and seed costs showed partial yet significant effects on the economic dynamics of food crop farmers in the region [28]. This underscores the complex relationship between various agricultural variables and FTOT, emphasizing the importance of a nuanced understanding for effective policymaking and sustainable agricultural development [29]. Factors such as household consumption expenditure, seedling prices, costs of medicines and feed, land rent, taxes, transportation expenses, capital goods addition costs, and wages of farmworkers collectively influenced the FTOT within the food crop sector [30].

Notably, only the price of seeds had a significant individual impact on the FTOT. Researchers use these findings as a basis to analyze determinants for policymakers, providing insights into the persistent decline in the Food Crop sector's FTOT. This analysis aligns with the idea that understanding these factors is crucial for shaping effective agricultural development policies [3]. The hope is that this knowledge, combined with other analyses, will contribute to government planning efforts, fostering a more productive, advanced, and sustainable farming landscape in the future through the FTOT.

The study focuses on the factors influencing FTOT, which is essential to understanding farmers' economic conditions, assessing the price of food commodities, the cost of input used and macroeconomic indicators, such as consumer price index and inflation. By identifying these factors, policymakers can develop targeted interventions to improve farmer welfare and enhance agricultural productivity. Additionally, analyzing FTOT provides insights into the interplay between agricultural economics

and broader economic indicators, guiding informed decision-making to a resilient and equitable agricultural sector.

## 2. Materials and Methods

### 2.1. Location and Time Research

The research, undertaken in September 2023, focused on the agricultural landscape of South Sulawesi Province. The selection of South Sulawesi was strategic, given its status as a prominent rice-producing province, ranking as the fourth largest in Indonesia. South Sulawesi holds significant importance in the agricultural sector, with a vast harvest area totalling 976,258.14 hectares, accounting for 9.2% of the nation's total harvest area. This choice aimed to provide comprehensive insights into the dynamics of rice production, factors influencing the agricultural economy, and the broader implications for the province and the country. By concentrating on this region, the research seeks to contribute valuable information to enhance understanding and guide strategic decision-making in the agricultural domain.

### 2.2. Data Sources and Data Collection

The data for this research was meticulously sourced from various reliable outlets, including the Central Statistics Agency (BPS), the Food Crops, Horticulture, and Plantation Office of South Sulawesi, the official website of the Ministry of Agriculture, and relevant literature on the research topic. The dataset utilized in this study comprises secondary data in the form of a monthly time series spanning from 2019 to 2022. Subsequently, the processed data underwent analysis utilizing SPSS software. The dataset encompasses information on diverse variables, including the price of dried rice grain, the price of unhusked corn, the price index of seeds, the price index of fertilizers and pesticides, labour wages, household consumption price index, inflation, and the FTOT of Food Crops in South Sulawesi Province. This comprehensive data collection and analysis approach ensures a robust foundation for the research findings and insights into the dynamics of the agricultural sector in the specified region.

### 2.3. Data Analysis

The analysis technique is a method or model of analysis technique used to test the relationship or opportunity between the independent variable and the dependent variable. The data analysis techniques in this study are multiple linear regression analysis with tools using EVIEWS and SPSS applications.

#### 2.3.1. Farmer FTOT

The FTOT is a crucial indicator for assessing the

purchasing power of farmers in rural areas. It reflects the exchange power of agricultural products for goods and services needed for household consumption and agricultural production costs. The FTOT's value directly correlates with the farmer's ability to meet expenses, and an increase in purchasing power leads to a higher FTOT, indicating a relatively more prosperous condition for farmers [28]. This metric encapsulates the economic well-being and sustainability of agricultural practices in rural communities.

The FTOT calculation involves a meticulous comparison between the price index received by farmers and the price index paid by farmers. An instrument's validity lies in accurately measuring the intended aspects of the variables under study. Conceptually, the formulation of the farmer FTOT is expressed through a carefully crafted equation, capturing the intricate dynamics of pricing relationships within the agricultural sector. This approach ensures a rigorous and precise assessment of the FTOT, aligning with the principles of validity and reliability in research methodology.

The farmer FTOT is determined through a comparison between the price index received by farmers and the price index paid by farmers. In line with [31] assertion, an instrument is deemed valid when it accurately measures the intended aspects of the variables under study. Conceptually, the calculation of the farmer FTOT is formulated by employing the following equation:

$$FTOT = \frac{I_t}{I_b} \times 100 \% \quad (1)$$

Description:

FTOT = Farmers' Terms of Trade  
 $I_t$  = Price index received by farmers  
 $I_b$  = Price index paid by farmers

This equation encapsulates the essence of the exchange rate, indicating the relationship between what farmers receive for their produce and what they pay for inputs. A valid calculation instrument ensures precision in assessing these variables, providing a reliable measure of the farmer exchange rate.

### 2.3.2. Multiple Linear Regression Analysis

Multiple linear regression analysis emerges as a vital tool in understanding the dynamics of FTOT for food crops in South Sulawesi Province. This statistical methodology adeptly dissects the myriad factors shaping the agricultural landscape, offering a concise equation that encapsulates their intricate interconnections. Beyond a numerical representation, this equation serves as a gateway to unravelling the nuanced relationships governing FTOT, contributing crucial insights to enhance our comprehension of the complexities within food crop farming in the region.

Lagged independent variables are used in agricultural product analysis to account for the time lag between certain events or actions and their effects on making farm products. Academics employ this approach to comprehend the temporal and cumulative ramifications of previous circumstances on current results, acknowledging that alterations in market conditions, technological adoption, or policies have a limited impact on agricultural progress. Analysts can optimise the prediction and development processes of farming systems by simulating the inherent complex temporal relationships by incorporating these latent variables. In contrast to traditional linear regression models, time series data analysis for regression considers the impact of antecedent periods and recognises the temporal aspect of the data. This analysis extends beyond the current observation period.

$$FTOT_t = a_0 + b_1PRg_{t-n} + b_2PCn_{t-n} + b_3PIS_{t-n} + b_4PIF_{t-n} + b_5PIC_{t-1} + b_6WL_{t-n} + b_7Ift_{t-n} + e_t \quad (2)$$

Description:

FTOT = FTOT for food crops  
 $a$  = Constant  
 $b_1$ - $b_7$  = Regression coefficient  
 $PRg$  = Price of dried rice grain (IDR/kg)  
 $PCn$  = Price of shelled corn (IDR/kg)  
 $PIS$  = Price Index of seed  
 $PIF$  = Price Index of fertilizer  
 $PIC$  = Price Index of Consument  
 $WL$  = Farm labor wage (IDR/month)  
 $Ift$  = Inflation (%)  
 $e_t$  = Error  
 $n$  = 1, 2, ..., 5.

### T-Statistics Test

The significance value of the T-Statistical Test is  $\alpha = 5\%$ , for example, if the value significance  $t < 0.05$ , then the alternative hypothesis is accepted, thus it can be seen that an independent variable partially and significantly influences the dependent variable [32].

The statistical t-test can be calculated with the formula:

$$t_h = \frac{b_1}{SE_{b_1}} \quad (3)$$

Information:

$t_h$  : Calculated value of significance test

$b_1$  : Partial regression coefficient

$SE_{b_1}$  : Standard deviation of the regression Coefficient.

### Coefficient of Determination (R<sup>2</sup>)

The determination Coefficient is usually used to indicate whether all independent variables influence the dependent variable. This can be seen from the resulting regression equation [33].

### Lag Distribution

Lag Distribution is a model linear regression that considers the influence of time [34]. The interval required for the independent variable to exert its influence on the dependent variable is referred to as a lag, or colloquially termed "a lag" or "a time lag" [35]. A regression model that contains an independent variable that is influenced by the independent variable at time  $t$ , and is also influenced by the independent variable at time  $1-t$ ,  $2-t$  and so on, is called a lag distribution dynamic model, because the effect of one or several independent variables on the independent variable is spread (spread or distributed) to several time periods with the Lag - $n$  model.

## 3. Results and Discussion

In a meticulous examination of the fluctuating trajectory of farmers' Food Terms of Trade (FToT) within the food crop subsector, a comprehensive inquiry delves into the intricacies using data sourced from South Sulawesi Province spanning the four-year period from January 2019 to December 2022. Employing a robust regression analysis methodology, the study endeavors to elucidate the nuanced interplay between FToT and the multifaceted factors that exert influence. This analytical framework serves as a keen instrument, facilitating the discernment of discernible patterns and correlations that have molded FToT levels over time.

The findings, as detailed in Table 2, provide insights into the relationships and effect of each independent variable on the FToT of food crop. The inclusion of diverse factors such as the price of dried grain rice, the price of shelled corn, seed price index, fertilizer-pesticide price index, consumer price index, farm labor wages, and inflation allows for a comprehensive analysis of the multifaceted determinants shaping the FToT in this agricultural context.

The regression model analyzed is good with a coefficient of determination  $R^2$  of 79.87 % FToT, which shows that more than three quarters of the variation in FToT can be explained from the seven independent variables observed [36]. The coefficient of determination (R<sup>2</sup>) is a quantity that provides information on the goodness of fit of the regression equation, which provides a proportion or percentage of the strength of the influence of the independent variables on the FToT of food crop. All observed independent variables have a significant effect on the FToT of food crops with F-test.  $F = 20.360$  (Sig.= 0.000). Of the seven variables, the fertilizer price index and farm labor wage have a negative effect on the FToT of food crops.

**Table 2.** The estimate regression coefficient with lag independent variance lag 0 to lag-5 on the dynamic equation of FTOT of food crops in South Sulawesi

Item	Lag0	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5
Constant	99.949	99.093	105.223	117.402	122.520**	122.036
Std. Error	8.588	8.906	8.475	7.799	8.834	10.987
t	10.589	11.127	12.416	15.054	13.870	11.107
Probability	0.000	0.000	0.000	0.000	0.000	0.000
Price of dried rice grain (PRc)	0,004	2.689	1.092	-1.532	-4.087**	-4.549
Stand. Error	0.001	1.543	1.439	1.272	1.420	1.699
Standardized Coefficients	0.095	0.184	0.077	-0.109	-0.294	-0.329
t	2.970	1.742	0.759	-1.204	-2.877	-2.677
Probability	0.005	0.089	0.452	0.236	0.007	0.011
Price of shelled corn (PCn)	1,341	0.013	0.014	0.018	0.007 <sup>ns</sup>	0.002
Stand. Error	1.333	0.013	0.012	0.011	0.013	0.016
Standardized Coefficients	0.038	0.111	0.118	0.153	0.062	0.022
t	1.010	1.011	1.112	1.537	0.554	0.155
Probability	0.318	0.318	0.273	0.133	0.583	0.878
Price Index of seed (PIS)	0,729	0.951	1.055	1.057	0.870**	0.611
Stand. Error	0.410	0.140	0.327	0.289	0.319	0.394
Standardized Coefficients	-1.342	3.305	3.804	3.888	3.236	2.289
t	1.776	-4.550	3.227	3.658	2.729	1.553
Probability	0.083	0.000	0.003	0.001	0.010	0.129
Price Index of fertilizer (PIF)	-0,641	-0.638	-0.600	-0.566	-0.412**	-0.353
Stand. Error	0.154	0.140	0.133	0.123	0.142	0.181
Standardized Coefficients	0.100	-1.116	-1.076	-1.020	-0.744	-0.637
t	-4.162	-4.550	-4.504	-4.586	-2.894	-1.953
Probability	0.000	0.000	0.000	0.000	0.006	0.059
Price Index of Consument (PIC)	0,251	0.614	0.855	1.141	0.901**	0.730
Stand. Error	0.387	0.366	0.337	0.299	0.334	0.400
Standardized Coefficients	-0.532	2.687	3.878	5.276	4.215	3.437
t	0.649	1.679	2.534	3.820	2.696	1.826
Probability	0.519	0.101	0.016	0.000	0.011	0.076
Farm labor wage (WL)	-1.070	-1.070	-1.423	-1.742	-1.357**	-0.961
Stand. Error	0.461	0.461	0.428	0.376	0.424	0.514
Standardized Coefficients	-4.399	-4.399	-6.068	-7.564	-5.960	-4.244
t	-2.321	-2.321	-3.324	-4.628	-3.203	-1.871
Probability	0.026	0.026	0.002	0.000	0.003	0.070
Inflation (Ift)	0.001	0.001	-0.004	-0.014	-0.011**	-0.003
Stand. Error	0.005	0.005	0.004	0.004	0.004	0.005
Standardized Coefficients	0.022	0.022	-0.093	-0.306	-0.261	-0.071
t	0.223	0.223	-0.955	-3.537	-2.685	-0.605
Probability	0.825	0.825	0.346	0.001	0.011	0.549
Determinant Coefficient (R <sup>2</sup> )	0.761	0.761	0.787	0.833	0.798	0.716
F	17.749	17.749	20.049	26.446	20.360**	12.599
Probability	0.000	0.000	0.000	0.000	0.000	0.000

Notes: \*\* = Sig. 0.05, \* Sig.= 0.10, ns = nonsignificant.

Source: Secondary Data after processing, 2023

$$FTOT_t = 122.520 - 4.087PRg_{t-4} + 0,007PCn_{t-4} + 0.870PIS_{t-4} - 0.412PIF_{t-4} + 0.901CPI_{t-4} - 1.357 WL_{t-54} - 0.011ft_{t-4} + e_t \quad (4)$$

From the regression analysis results, meticulously chosen based on the robustness of its R-squared value and the significance of observed dependent variables, the selected model incorporates a lag of four months (Lag t-4). This chosen regression equation captures the intricate dynamics of the studied phenomena and can be expressed as follows:

Through this selected model, we aim to uncover the nuanced relationships and predictive insights that emerge when considering the lagged effects over four months. This strategic approach enhances our analysis's predictive accuracy and offers valuable insights into the temporal dynamics and causality underlying the observed data.

Six of the seven macroeconomic variables scrutinized exhibit significance and consistency within the time lag-4 (four-month lag) regression model. The estimation outcomes underscore a notable alignment between pertinent information and the lifecycle of food crops, particularly those that mature or are harvested within four months. Consequently, the time lag-4 configuration emerges as the most fitting among the five equations incorporating varying time lags. This finding not only enhances our understanding of the temporal dynamics governing the studied variables but also reinforces the efficacy of the chosen regression model in capturing the intricacies of the relationship between macroeconomic factors and agricultural outcomes.

### **Price of Dried Rice Grain (PRg)**

In the agricultural expanse of South Sulawesi province, the price of dry grain exhibits a substantial and adverse impact on the Food Terms of Trade (FToT), with a regression coefficient of -4.087. A mere one per cent uptick in the marginal price of rice (PRc) can precipitate a decline of approximately -4.087 per cent in the FToT over the subsequent four months. This scenario is further complicated by the significant contribution of rice prices to inflation in Indonesia. As rice prices escalate, inflationary pressures mount, inflating the prices of all goods farmers' purchase. Such dynamics underscore the intricate interplay between rice prices, FToT, and broader economic indicators, shaping the livelihoods of agricultural stakeholders in the region.

The significant influence exerted by farmers' selling prices on the income levels of rice farmers underscores the crucial interplay between pricing strategies and economic outcomes within the agricultural sector. To harness additional gains and bolster income, close attention must be paid to grain prices in sales and marketing endeavors. By enhancing the stability of grain prices, farmers can effectively mitigate production costs, thereby creating a conducive environment for income augmentation [37]. This aligns seamlessly with prior research findings, indicating a positive and substantial correlation between the selling price of agricultural products, particularly grain prices, and the exchange rate of food crop farmers. As such,

strategic adjustments in pricing mechanisms hold the potential to not only optimize farmers' economic returns but also foster sustainable growth and prosperity within agricultural communities [38].

### **Price of Shelled Corn (PCn)**

The price of shelled corn (PCn) has a positive but not significant effect on the exchange rate for food crop farmers (NTP-TP) in South Sulawesi province. The selling price of unhusked maize at the producer level plays a pivotal role in shaping the exchange rate of food crop farmers, notably the Net Transfer Price to Total Production Price (NTP-TP). Unlike rice, which traditionally serves as a staple food, maize has evolved into a significant commodity primarily utilized for animal feed production, particularly in poultry farming for laying hens and broilers. Consequently, fluctuations in maize prices directly impact the economic dynamics of food crop farmers, influencing their exchange rate and overall profitability. This shift in agricultural focus underscores the intricate relationship between market demands, crop diversification, and farmers' livelihoods, emphasizing the need for strategic pricing and production strategies to ensure sustainable growth and resilience amidst evolving consumer preferences and market trends.

### **Price Index of Seed (PIS)**

The analysis of the seed price index reveals a significant and positive impact on the FToT of food crop farmers within South Sulawesi province. Seeds constitute a fundamental component in the production process of food crop farming, and farmers increasingly recognize the pivotal role of high-quality seed plants in enhancing yields and overall productivity. The decision to invest in quality seeds is directly translated into improved production outcomes, bolstering the value of production and subsequently augmenting farmers' income levels. Consequently, this influx of higher-quality seeds can lead to a surplus in production, propelling the NTP in a positive trajectory. This correlation aligns with the perspective articulated by Mubyarto (2008), which emphasizes the intrinsic link between productivity and agricultural cultivation techniques aimed at amplifying production volumes [39]. Thus, the proactive adoption of quality seeds not only underscores the resilience and adaptability of farmers but also contributes significantly to the sustainable growth and prosperity of the agricultural sector.

### **Price Index of fertilizer (PIF)**

Fertilizer stands as a pivotal input in food crop production, alongside seeds, and a comprehensive examination of the fertilizer price index underscores its significant and adverse impact on the FToT for food crops in South Sulawesi province. Investing in fertilizer directly

correlates with enhanced yields, thereby bolstering the overall value of production. However, it constitutes a substantial cost component for food farming operations, diminishing farmers' income levels. Recognizing this challenge, the government alleviates the burden by providing fertilizer subsidies. These subsidies serve a dual purpose: reducing production costs for farmers while improving the quality and quantity of their crops. This strategic intervention not only has the potential to stimulate surplus production and increase farmer income but also aims to steer the FTOT in a direction that favors the agricultural community, thereby fostering a more sustainable and prosperous farming sector in the region.

### Consumer Price Index (CPI)

The Consumer Price Index (CPI) for agricultural products significantly and positively affects FTOT for food crops. The CPI is a widely used economic indicator that reflects changes in the general price level of goods and services purchased or sold by households, so it directly impacts FTOT, including food products that farmers dominantly produce. This suggests that fluctuations in consumer prices exert a significant influence on the economic dynamics experienced by farmers in terms of their trading conditions. Therefore, while the CPI is a valuable metric for assessing inflationary pressures and consumer purchasing power, its relevance to farmers' trading conditions is immense.

### Farm Labor Wage (LW)

The wage of labor in the agricultural sector wields a substantial and statistically significant impact on farmer exchange rates, with a discernible negative correlation. Given the pivotal role of labor wages in determining agricultural production costs, their fluctuations influence the Food Terms of Trade (FTOT). This intricate relationship underscores how variations in labor wages directly shape the economic landscape experienced by farmers, amplifying the significance of labor costs in the profitability and sustainability of agricultural operations. As such, understanding and managing labor expenses emerge as crucial considerations for farmers aiming to navigate the complexities of market dynamics and optimize their agricultural enterprises effectively.

### Inflation (If)

The correlation between the inflation rate, akin to the Consumer Price Index (CPI), and the food production sector highlights their joint influence on farmers' exchange rates. Both serve as pivotal economic indicators, reflecting shifts in the price levels of goods and services, yet their impact on farmers' exchange rates is noteworthy. While inflation is paramount in gauging overall economic stability and facilitating strategic planning, its direct effect

on farmers' trade balance appears relatively minor. This observation suggests that price fluctuations within the food production sector align closely with the broader economic conditions experienced by farmers. Consequently, while inflation retains its significance in comprehensive economic analyses, efforts to enhance its relevance to farmers' trade balance are imperative for a more nuanced understanding of agricultural economics and effective policymaking.

## 4. Conclusions

Employing multiple linear regression analysis with various time lags, mainly focusing on a lag of four months, is explored to derive an optimal estimation model. Among the six estimations with distinct time lags, time lag-4 emerges as the most promising, offering valuable insights into the factors shaping Farmer Terms of Trade (FTOT) dynamics. Of the seven variables examined, six independent variables exhibit significance at a confidence level of 0.01, except for the Price of Corn variable, which appears to have a negligible impact. The price of dried rice grain, the quality of the seed, and the consumer price Index demonstrate significant and positive effects on FTOT and farmer income and welfare. Conversely, the price of fertilizer, labor, and inflation show negative impacts on FTOT. Specifically, regarding inflation, its substantial influence on the costs of goods purchased by farmers is highlighted compared to the returns from farmers' sold products. The significance of time lag 4, aligning with the typical age or harvest period of food crops, emphasizes the importance of accounting for temporal dynamics in analyzing economic variables within the agricultural sector. This underscores the necessity of incorporating time lags when estimating influential factors, enabling a deeper understanding of the sector's economic intricacies.

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