Farmers’ term of trade in Indonesia: an overview during pandemic COVID-19

M Pinilih1*, D Rakhmawati2, R Rosyidi1
1 Department of Information System, Universitas Amikom Purwokerto
2 Department of Informatics, Universitas Amikom Purwokerto

*Email: mpinilih@amikompurwokerto.ac.id

Abstract. The COVID-19 pandemic has an impact on the economic sector, including the agricultural sector. This research will look at the agricultural sector's condition, especially the welfare of farmers represented in the value of the Farmers’ Term of Trade (FTT) during the COVID-19 pandemic and will forecast FTT for September 2020. This research uses Farmers' Term of Trade (FTT) data obtained from the Indonesian Statistics Bureau (BPS). FTT data were used from January 2016 to August 2020. The Single Exponential Smoothing (SES), used to forecast the FTT value in September 2020, and the determination of the most optimal forecasting value used Mean Absolute Percentage Error (MAPE). The results showed that the FTT value, recorded during the COVID-19 pandemic, experienced a drastic decline in May 2020 with a FTT value of 99.46. The forecasting calculations using the SES and MAPE methods showed that the most optimal FTT value for September 2020 was 100.63, with a MAPE value of 19.97 percent.

1. Introduction
COVID-19 is an unexpected problem that Indonesia must face. The first patient of COVID-19 was identified on March 2, 2020 [1], and it has an immediate impact on the Indonesian economy. However, the economic sector's impact varies, and one of the economic lines affected by this pandemic is the agricultural sector. Globally, the effects of COVID-19 on the farming sector are still questionable and still need to be studied in depth [2]. In Indonesia, the impact received by the agricultural sector is inseparable from the PSBB (imposing large-scale social restriction) regulation implemented by the government to diminish the spread of COVID-19. The beginning of the implementation of the PSBB and stay at home policy caused tremendous panic from the community, which led to panic buying. Panic buying was recorded on large-scale agricultural products, especially foodstuffs, to fulfill food needs during the PSBB period [3].

The panic buying has impacted the demand and the availability of agricultural products. If transportation access is also restricted, it will result in the food supply chain [4]. This disruption will indirectly hamper the distribution of foodstuffs and cause food shortages. In these conditions, it will have an impact on rising food prices. Simultaneously, another effect arising from the PSBB is work from home for workers so that their income has decreased significantly, thus reducing people’s purchasing power. This situation is extremely unfavorable for farmers since they do not receive benefits from their agricultural products.
Based on several studies, the impact of this pandemic condition is starting to be felt by farmers. Farmers in Indonesia are starting to experience losses due to this pandemic in May 2020. The decline in food prices and the disruption of supply chains are increasingly burdening farmers [5]. This condition significantly affects the income received by farmers. The agricultural sector is a sector with the largest employer of labor in Indonesia. Based on Agricultural Census 2018, Indonesia’s farmer households are 27,682,117 households [6] and based on Agricultural Census 2013, which only amounted to 26,126,000 households. Then there was an increase of 1,556,117 farmer households over six years [7].

As many Indonesians depend on the agricultural sector, farmers’ welfare conditions need to be analyzed during pandemic COVID-19. In various studies, the measure of welfare uses Farmers’ Term of Trade (TFF) approach. TFF is an indicator made by Indonesian Statistics Bureau regularly and is considered the most appropriate measure in describing farmer welfare [8]. Based on the FTT data obtained, we can describe farmers’ welfare conditions during the COVID-19 pandemic. This research also forecasts the farmers’ welfare. Therefore, this study aims to analyze conditions and make predictions on farmers’ welfare during the Covid-19 pandemic in Indonesia.

2. Material and Methods
The approach used in describing farmer welfare is FTT. FTT is a Farmers’ Term of Trade calculated from the ratio of price received by farmers and costs paid by farmers. If the PR rate is higher than the PP rate, the FTT will increase. If the PR rate is lower than the PP rate, the FTT will decrease [9]. The TFF data needed to conduct the research is time-series data from January 2016 to August 2020 obtained from the Indonesian Statistics Bureau (BPS). The method of analysis to forecast will use Single Exponential Smoothing (SES). This method is done using past data sources and is relatively easy to do. The mathematical calculation can describe as follows [10].

\[ F_t = F_{t-1} + \alpha(A_{t-1} - F_{t-1}) \]

Where \( F_t \) = forecast for period \( t \), \( F_{t-1} \) = forecast for the previous period, \( A_{t-1} \) = actual demand for the last period, \( \alpha \) = smoothing constant \((0 \leq \alpha \leq 1)\). Furthermore, Karmaker [10] stated that performing this calculation will depend on the exponential smoothing constant obtained. To determine the most optimal predictive value using the Mean Absolute Percentage Error (MAPE). MAPE is a method commonly used in forecasting. The mathematical formulation is as follows [11].

\[ MAPE = \frac{1}{n} \sum_{t=1}^{n} \frac{|y_t - \hat{y}_t|}{y_t} \]

The criteria obtained from MAPE are if the MAPE value is smaller than 10%, it is said to be excellent accurate forecasting, between 10% - 20% is called good forecasting, between 20-50% is considered acceptable forecasting, and over 50% is said to be inaccurate forecasting [12].

3. Result and Discussion
The agricultural sector is an occupation that is dominated by the Indonesian, so that farmers’ welfare is one of the things that need to be scrutinized. FTT is the most appropriate approach to describing farmer welfare. FTT is calculated every month so that it can describe the real welfare conditions of farmers. The movement of FTT values from January 2016 to August 2020 in Figure 1.

The FTT values in Figure 1 appear to be fluctuating. Some periods have increased, decreased, or stabilized. The period before the COVID-19 pandemic started from January 2016 to March 2020. In March 2020, the identification of COVID-19 in Indonesia and this pandemic started from May 2020 to August 2020. The FTT value was stable on the 32nd data (August 2018) until the data 38 (February 2019) of 102.56. The FTT value touched the highest record on the 48th data (December 2019) with a value of 104.46. However, FTT has consistently decreased from January 2020 until finally reaching its lowest point in May 2020. From January 2016 to August 2020, it noted that the FTT value touched a value below 100. The FTT value was in the 15th data, namely in March 2017, data 53rd is May 2020,
and the 54th data is the June 2020 period. However, the lowest FTT value occurred in May 2020 with an FTT value of 99.46, and this increase continued until August 2020 with an FTT value of 100.65. The May 2020 period's conditions reflected that the PR value was lower than PP, so that the FTT value decreased. Several things can cause this decline condition. In May 2020, Indonesia's position was to implement the PSBB (imposing large-scale social restriction), limiting community activities. Restrictions on community activities have an impact on economic activity. The application of work from home, employment termination, and the number of informal workers makes individuals' income decrease. People find it challenging to meet their daily needs [13], resulting in decreased purchasing power. Farmers also face this condition. This restriction also hinders the distribution of agricultural products into the hands of the community. As a result, the price received by farmers will decrease.

![Figure 1](image)

**Figure 1.** FTT in Indonesia from January 2016 until August 2020

On the other hand, farmers' price for the production process of agricultural products has also increased. Bappenas [9] showed that production costs could be land rental costs, production facility costs, or even labor costs, which cause even more significant costs incurred. It has resulted in a decrease in the welfare of farmers, as reflected in the TFF. This condition is supported by research conducted by Hermanto [3], the condition of the PSBB resulted in a shock of demand and supply. Disturbances on the production side can be seen in factory closures and hampered distribution so that production decreases, but the need for agricultural products does not decrease.

From June 2020 until August 2020, the TFF value gradually increased, which indicates an increase in farmer welfare. From June 2020 until August 2020, Indonesia began to enter a new normal phase. The economic movement has gradually improved, and the PSBB has already started to be loosened. Also, the government's various policies have overcome economic problems and impact the agricultural sector. According to Hadiutomo [14], increasing the farmers' welfare can be encouraged by making policies to support food availability, such as ensuring the food supply chain for priority food commodities, scheduling harvest times, or conducting market operations.

Forecasting the FTT value in the period September 2020 uses the Single Exponential Smoothing (SES) method. The scenario will be using smoothing constant (α) 0.025, 0.05 and 0.075. The prediction results obtained are presented in Table 1, Figures 2a, 2b, and 2c. Based on Table 1, with α = 0.025, the FTT prediction value for September was 102.07 and a MAPE is 53.23 percent. The prediction value is 100.63 and MAPE is 19.97 percent if using α = 0.05. The last, α = 0.075, FTT for September 2020 is 100.60 with MAPE 20.46 percent.
| Period       | $\alpha=0.025$ | $\alpha=0.05$ | $\alpha=0.075$ |
|-------------|----------------|----------------|----------------|
| September 2020 |                |                |                |
| Result FTT  | 102.07         | 100.63         | 100.60         |
| MAPE        | 53.23%         | 19.97%         | 20.46%         |

Based on the MAPE value, the best forecasting value $\alpha = 0.05$ because the MAPE value 19.97 percent is the smallest error. Based on Figures 2a, 2b, and 2c, the actual and forecast value is calculating with Single Exponential Smoothing (SES) using $\alpha = 0.25$, $\alpha = 0.05$ and $\alpha = 0.075$. The
result shows that the forecast value that is close to the actual value in a graphical manner has a value of $\alpha = 0.05$ and $\alpha = 0.075$. However, based on the MAPE value, the best forecasting value when using $\alpha = 0.05$.

4. Conclusion
The FTT value provides an overview of the welfare conditions of farmers in Indonesia. The welfare of farmers affected by many factors, both internal and external. Even so, the progress of FTT in Indonesia shows a reasonably good movement. In the observation period, the highest FTT value was in December 2019 and continued to decline during COVID-19. The lowest FTT score was in May 2020, but the FTT value increased from June 2020 to August 2020. In September 2020, the optimal FTT value was 100,63. This result is because the MAPE value is the value with the smallest error, so it is the best prediction value. This research can redevelop by identifying the factors that affect the value of FTT so that it can provide a comprehensive picture of the welfare of farmers in Indonesia.

References
[1] Ihsanuddin 2020 Fakta Lengkap Kasus Pertama Virus Corona di Indonesia Kompas.
[2] Jámbor A, Czine P and Balogh P 2020 The impact of the coronavirus on agriculture: First evidence based on global newspapers Sustain. 12, 11 p. 1–11.
[3] Hermanto 2020 Dampak Ekonomi Penyebaran Covid-19 Terhadap Kinerja Sektor Pertanian Bul. Perenc. Pembang. Pertan. 1, 2.
[4] Gray R S 2020 Agriculture, Transportation, and The COVID-19 Crisis Can J. Agric. Econ. p. 1-5.
[5] Rahman D F 2020 Indonesia Farmers Suffer Pandemic- Related Losses In May The Jakarta post.
[6] Badan Pusat Statistik 2018 Hasil Survey Pertanian Antar Sensus (SUTAS) 2018 (Jakarta: Badan Pusat Statistik).
[7] Badan Pusat Statistik 2013 Ringkasan Eksekutif Sensus Pertanian 2013 (Jakarta: Badan Pusat Statistik).
[8] Siregar H 2004 Changes in Farmer Terms of Trade and Agricultural Net-Barter Terms of Trade: An Empirical Analysis J. Manaj. &Agribisnis 1, 1 p. 1–19.
[9] Bappenas and JICA 2013 Farmers Terms of Trade Analysis As Preparation of National Midterm Development Planning 2015-2019.
[10] Karmaker C L 2017 Determination of Optimum Smoothing Constant of Single Exponential Smoothing Model: A Case Study Int. J. Res. Ind. Eng. 6, 3 p. 184–192.
[11] Liu H, Li C, Shao Y, Zhang X, Zhai Z, Wang X, Qi X, Wang J, Hao Y, Wu Q and Jiao M 2020 Forecast of the Trend in Incidence of Acute Hemorrhagic Conjunctivitis in China from 2011–2019 using the Seasonal Autoregressive Integrated Moving Average (SARIMA) and Exponential Smoothing (ETS) models J. Infect. Public Health 13, 2 p. 287–294.
[12] Ostertagova E and Ostertag O 2012 Forecasting Using Simple Exponential Smoothing Method Acta Electrotech. Informatics 12, 3 p. 62–66.
[13] Caraka R E, Lee Y, Kurniawan R, Herfiansyah R, Kaban P A, Nasution B I, Gio P U, Chen R C, Tharudin T and Pardamean B 2020 Impact of COVID-19 Large Scale Restriction on Environment and Economy in Indonesia Glob. J. Environ. Sci. Manag. 6, Special Issue: COVID-19 p. 65–84.
[14] Hadiutomo K 2020 Kebijakan Pertanian untuk Menangani Dampak COVID-19 Bul. Perenc. Pembang. Pertan. 1, 2 p. 18–27.