Analysis of Factors Influencing Potato (Solanum Tuberosum. L) Exports from North Sumatra Province

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Abstract

North Sumatra Province is one of the provinces in Indonesia which is active in carrying out international trade activities and is very well known as an exporter of agricultural products, especially horticultural commodities. Potatoes are one of the main export commodities of North Sumatra Province to Singapore and Malaysia. This study aims to analyze how developments in production, domestic prices, international prices and exchange rates in North Sumatra Province and to analyze whether production, domestic prices, international prices and the rupiah exchange rate to export destination countries affect the volume of potato exports from North Sumatra Province. The data used in this study are secondary data from the first quarter of 2016 to the fourth quarter of 2022 (time series) and 2 export destination countries, namely Singapore and Malaysia (cross-section). The research method uses Panel Data Regression. The results of the study show that developments in production, domestic prices, international prices and exchange rates in North Sumatra Province tend to fluctuate. Factors that have a significant effect on potato exports in North Sumatra Province are domestic prices and international prices, while factors that do not have a significant effect on potato exports in North Sumatra Province are production and exchange rates.

Keywords: Potato production, the domestic price of potatoes, international prices of potatoes, the rupiah exchange rate to export destination countries, volume of potato exports.

Introduction:

According to the *Badan Pusat Statistik Provinsi Sumatera Utara* (2023), several horticultural commodities for North Sumatra Province which are superior in the international market are potatoes, cabbage and carrots. Potato (Solanum tuberosum L) is one of the leading commodities and is the fourth food crop in the world after wheat, rice and corn.

The growth of potato production in North Sumatra Province in recent years has tended to increase. North Sumatra Province potato production in 2022 is 148,432 tons. North Sumatra

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Province is an area that is active in carrying out international trade activities and is very well known as an exporter of agricultural products, especially horticultural commodities.

To face the era of international trade or commonly called free trade, the agricultural products produced are expected to be of high quality and safe for consumption (Sastrahidayat & Tulus, 2011).

The volume of potato exports from North Sumatra Province to destination countries from 2016 to 2022 shows fluctuating numbers. In 2022, the total export volume of potatoes from North Sumatra Province is 1,984.37 tons. This export volume has decreased compared to previous years where in 2021, the total export volume of potatoes from North Sumatra Province was 2,230.00 tons.

Based on data from the Central Statistics Agency for North Sumatra Province (2023), the destination countries for fresh potato exports from North Sumatra Province during the period from 2016 to 2022 are Singapore, Malaysia and the Maldives. Singapore and Malaysia are the main export destination countries for North Sumatra Province potatoes. This can be seen from the number of potato exports to these countries which are routine every year. Meanwhile, potato export activities from North Sumatra Province to the Maldives were only carried out from 2018 to 2020 in small quantities.

The influence of domestic prices, international prices and the rupiah exchange rate on the volume of potato exports to export destination countries as well as fluctuations in the development of potato production in North Sumatra have affected the development of potato export volume from North Sumatra Province. The trend of the volume of potato exports from North Sumatra Province to the main export destination countries of Singapore and Malaysia which continues to decline has made researchers interested in examining the Analysis of Factors Influencing Potato Exports from North Sumatra Province. North Sumatra Province is listed as an exporter of fresh potatoes to Singapore and Malaysia as destinations. In 2022, North Sumatra Province exported 1,265.98 tons of potatoes to Singapore and 718.39 tons to Malaysia.

Potato production which tends to increase indicates that potato farmers in North Sumatra Province are experiencing good development in running their potato farming so that this can increase the volume of potato exports from North Sumatra Province. Based on data derived from *Badan Pusat Statistik Provinsi Sumatera Utara.* (2023), the highest volume of potato exports to Singapore occurred in 2020, namely 2,565.52 tons and the highest volume of potato exports to Malaysia occurred in 2016, 1,024.8 tons. With the growing development of a region, it encourages the level of potato production, especially in North Sumatra Province which has many areas producing potato commodities. The increase in potato production that occurred in North Sumatra Province is expected to increase the supply of potato exports from North Sumatra Province. However, in reality, the development of potato export volume from North Sumatra Province to Singapore and Malaysia from 2016 to 2022 has fluctuated. Based on this background, the researcher is interested in researching the Analysis of Factors Influencing Potato Exports from North Sumatra Province.

Research methods:

The research was conducted in North Sumatra Province. The data collected in this research is secondary data. The secondary data used is cross-sectional data for two export destination countries (Singapore and Malaysia) and quarterly time series data (2016; Q1-2022; Q4) obtained from the Central Bureau of Statistics of North Sumatra Province, as well as from various literature related to this research.

To analyze the Factors Influencing Potato (Solanum Tuberosum. L) Exports from North Sumatra Province, we use Panel Data Regression Analysis with a Fixed Effect Model (FEM), which consists of two assumptions, namely the assumption of the constant slope but the intercept varies between units and the assumption of slope constant but the intercept varies between periods (Sriyana, 2014). Data processing is carried out using Eviews 10. Then the following equation is obtained:

$$LN\ Y_{it} = \beta_0 + \beta_1\ LN\ PK_{it} + \beta_2\ LN\ HD_{it} + \beta_3\ LN\ HI_{it} + \beta_4\ LN\ NT_{it} + \mathcal{E}_{it}$$

Descriptions:

Yit: The dependent variable is the i-th cross-section of the t-time series
β0: Intercept or constant
PK: Potato Production (Tons)
HD: Domestic Price (Rp)
HI: International Price (US$)
NT: Exchange Rate
i: Number of observation units (Singapore and Malaysia)
t: Number of time periods (2016; Q1 - 2022; Q4)

Results and Discussion:

The following are the results of panel data regression analysis using the Fixed Effect Model (FEM):

The estimation equation with the differential intercepts cross-section:

Table 1. Cross-Effect Coefficient Estimation Results[2]

Fixed Effect (Cross-Section Effect)	Coefficient
Singapore	1.734954
Malaysia	-1.437954

Based on the estimation results in Table 1, the equation for each country by considering each cross effect can be written as follows:

The equation for Singapore:

$$LN\ Y_{it} = \beta_0 + \beta_1\ LN\ PK_{it} + \beta_2\ LN\ HDK_{it} + \beta_3\ LN\ HI_{it} + \beta_4\ LN\ NT_{it} + \mathcal{E}_{it}$$

$$Eks\ S = (1{,}73 + 130{,}61) + 0{,}02\ PK_t - 11{,}03\ HD_t + 0{,}15\ HI_t - 2{,}05\ NT_t + \mathcal{E}_{it}$$

$$= 132{,}34 + 0{,}02\ PK_t - 11{,}03\ HD_t + 0{,}15\ HI_t - 2{,}05\ NT_t + \mathcal{E}_{it}$$

The equation for Malaysia

$$LN\ Y_{it} = \beta_0 + \beta_1\ LN\ PK_{it} + \beta_2\ LN\ HDK_{it} + \beta_3\ LN\ HI_{it} + \beta_4\ LN\ NT_{it} + \mathcal{E}_{it}$$

[2] (Source: Data Processing Results, 2023)

$$\text{Eks M} = (-1{,}44 + 130{,}61) + 0{,}02\ PK_t - 11{,}03\ HD_t + 0{,}15\ HI_t - 2{,}05\ NT_t + \mathcal{E}_{it}$$

$$= 132{,}34 - 3{,}17 + 0{,}02\ PK_t - 11{,}03\ HD_t + 0{,}15\ HI_t - 2{,}05\ NT_t + \mathcal{E}_{it}$$

$$= 129{,}17 + 0{,}02\ PK_t - 11{,}03\ HD_t + 0{,}148\ HI_t - 2{,}05\ NT_t + \mathcal{E}_{it}$$

From the estimation results, it can be seen that there is a cross effect in each country on potato exports in North Sumatra Province. Of the two countries, which had the greatest influence on the potato exports of North Sumatra Province were Singapore with a value of 132.34 per cent and then Malaysia with a value of 129.17 per cent.

The results of this study are in line with Rangkuti's research (2014), entitled "Analysis of Coffee Exports in North Sumatra Province". The results of the study show that the influence of the cross effect on coffee exports in North Sumatra Province is Italy, England and Singapore respectively.

The estimation equation with the period effect differential intercept:

Table 2: Period Effect Coefficient Estimation Results[3]

Fixed Effect (Period Effect)	Coefficient
2016Q1—C	1.324751
2016Q2—C	-0.002336
2016Q3—C	-0.243869
2016Q4—C	-1.052739
2017Q1—C	-0.903484
2017Q2—C	-1.754218
2017Q3—C	-0.349763
2017Q4—C	-1.462572
2018Q1—C	0.592414
2018Q2—C	15.62441
2018Q3—C	-0.655529
2018Q4—C	-1.001751
2019Q1—C	-1.902995
2019Q2—C	-0.485854
2019Q3—C	-1.022294
2019Q4—C	-2.733493
2020Q1—C	-0.036052
2020Q2—C	0.789135
2020Q3—C	0.433451
2020Q4—C	0.565109
2021Q1—C	-2.075665
2021Q2—C	-0.478808
2021Q3—C	-1.077614
2021Q4—C	-2.749240
2022Q1—C	-0.406686
2022Q2—C	0.617146
2022Q3—C	-0.055853
2022Q4—C	0.504398

[3] (Source: Data Processing Results, 2023)

Based on the estimation results in Table 2, each equation based on the period effect can be written as follows:

2016 Equations:

1st quarter

$$Ex = (1.32 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 131.93 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

2nd quarter

$$Ex = (-0.00 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 130.61 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

3rd quarter

$$Ex = (-0.24 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 130.37 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

4th quarter

$$Ex = (-1.05 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 129.56 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

2017 Equations:

1st quarter:

$$Ex = (-0.90 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 129.71 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

2nd quarter

$$Ex = (-1.75 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 128.86 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

3rd quarter

$$Ex = (-0.35 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 130.26 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

4th quarter

$$Ex = (-1.46 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 129.15 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

2018 Equations:

1st quarter

$$Ex = (0.59 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 131.20 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

2nd quarter

$$Ex = (15.62 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 146.23 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

3rd quarter

$$Ex = (-0.65 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 129.96 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

4th quarter

$$Ex = (-1.00 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 129.61 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

2019 Equations:

1st quarter

$$Ex = (-1.90 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 128.71 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

2nd quarter

$$Ex = (-0.49 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 130.12 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

3rd quarter

$$Ex = (-1.02+ 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 129.59 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

4th quarter

$$Ex = (-2.77+ 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 127.84 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

2020 Equations:

1st quarter

$$Ex = (-0.04 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

$$Ex = 130.57 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

2nd quarter

$$Ex = (0.79 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 131.40 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

3rd quarter

$$Ex = (0.43 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 131.04 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

4th quarter

$$Ex = (0.56 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 131.17 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

2021 Equations:

1st quarter

$$Ex = (-2.07 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 128.54 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

2nd quarter

$$Ex = (-0.48 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 130.13 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

3rd quarter

$$Ex = (-1.08 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 129.53 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

4th quarter

$$Ex = (-2.75 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 127.86 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

2022 Equations:

1st quarter

$$Ex = (-0.41 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 130.20 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

2nd quarter

$$Ex = (0.61 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

$$Ex = 131.23 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

3rd quarter

$$Ex = (-0.05 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 130.56 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

4th quarter

$$Ex = (0.50 + 130.61) + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$
$$Ex = 131.11 + 0.02\ PK\ t - 11.03\ HDt + 0.148\ HIt - 2.05\ NTt$$

In each of the equations above, it can be seen that there is a period effect (time) on the development of potato exports from North Sumatra Province. The time that had the greatest influence was in the second quarter of 2018 at 146.23 per cent. The results of this study are in line with Sriyana's research (2014), entitled "Analysis of the Effects of CAR, QR, and GWM Variables on ROA". The research method uses Panel Data Regression. The results showed that the biggest period effect (time) on ROA was in the second quarter of 2012, which was 10.98 per cent.

Statistical Testing

Table 3: Fixed Effect Model (FEM) Estimation Results[4]

Variable	Coefficient	t-Statistic	Prob.
C	130.6135	3.280423	0.0033
PK?	0.017760	0.155878	0.8775
HD?	-11.03311	-3.191549	0.0041
HI?	0.147527	2.213643	0.0370
NT?	-2.050943	-1.210954	0.2382
R^2	0.964758		
F-Statistik	19.67610		

The coefficient of determination (R2) is 0.964758, which means that 96.48% of the variation in the independent variables (production, domestic prices, international prices and exchange rates) can explain the dependent variable (potato export volume), while the remainder is 3. 52% can be explained by other independent variables that are not included in this estimation model.

The F-Statistics value is 19.67610 > and the F-table is 2.55. It means that Ho is rejected, and H_1 is accepted. This means that together the independent variables (potato production, domestic prices, international prices and exchange rates) affect the volume of potato exports in North Sumatra Province.

The probability value of potato production is 0.8775 > $\alpha = 0.05$, then Ho is rejected, and H_1 is accepted. This shows that potato production has no significant effect on the export volume of potatoes in North Sumatra Province. The regression coefficient value of potato production has a positive relationship with potato exports in North Sumatra Province, which is 0.017760, which means that if there is an increase in potato production by 1 per cent, it will increase the volume

[4] (Source: Data Processing Results, 2023)

of potato exports by 0.017760 per cent from North Sumatra Province. The results of this study are in line with Simbolon's research (2022), with the title "Factors Influencing Cabbage Exports from North Sumatra Province to Malaysia. The results showed that cabbage production had no significant effect on the export volume of cabbage from North Sumatra Province.

The probability value of domestic prices is 0.0041 < α = 0.05, then Ho is accepted, and Hı is rejected. This shows that domestic prices have a significant effect on the export volume of potatoes in North Sumatra Province. The value of the domestic price regression coefficient has a negative relationship with potato exports in North Sumatra Province, which is equal to 11.03311, which means that if there is an increase in domestic prices by 1 per cent, it will reduce the volume of potato exports by 11.03311 per cent from North Sumatra Province. The results of this study are in line with Faisal's research (2020), entitled "Analysis of Factors Influencing Potato Export Volume at PT Bumi Sari Lestari, Temanggung Regency, Central Java". The results showed that domestic prices had a negative and significant effect on the volume of potato exports from Temanggung Regency, Central Java.

The international price probability value is 0.0370 < α = 0.05, then Ho is accepted, and Hı is rejected. This shows that international prices have a significant effect on the export volume of potatoes in North Sumatra Province. The international price regression coefficient has a positive relationship with North Sumatra Province potato exports, namely 0.147527, which means that if there is an increase in international prices by 1 per cent, it will increase the volume of potato exports by 0.147527 per cent from North Sumatra Province. The results of this study are in line with Rangkuti's research (2014), with the title "Analysis of Coffee Exports in North Sumatra Province". The results of the study show that international coffee prices positively and significantly influence changes in coffee exports in North Sumatra Province.

The exchange rate probability value is 0.2382 > α = 0.05, then Ho is rejected, and Hı is accepted. This shows that the exchange rate has no significant effect on the volume of potato exports in North Sumatra Province. The regression coefficient value of the exchange rate has a negative relationship with potato exports in North Sumatra Province, which is -2.050942, which means that if there is an increase in the rupiah exchange rate against export destination countries by 1 per cent, it will reduce the volume of potato exports by 2.050942 per cent in the province of North Sumatra.

The results of this study are in line with Pinem et al.'s research (2022), titled "Analysis of Factors Influencing Cabbage Exports from North Sumatra Province to Malaysia". The results showed that the exchange rate had a negative effect on the export volume of cabbage from North Sumatra Province.

Conclusion:

i. Potato production in North Sumatra Province from the first quarter of 2016 to 2022 fourth quarter tends to show fluctuating numbers. From the first quarter of 2016 to the fourth quarter of 2021, potato production has increased by 67,616 tons. However, in 2022, there will be a decrease in production of 10,584 tons from the previous year. The highest domestic potato price occurred in the fourth quarter of 2021 at IDR 17,028/Kg. International prices of potatoes to Singapore and Malaysia from 2016 first quarter to 2022 fourth quarter. Developments in the international price of potatoes seem to have fluctuated in both countries. International potato prices in Singapore in 2020 have increased compared to the previous year and international potato prices in Malaysia in 2021 have increased

compared to the previous year. Exchange rate developments in export destination countries fluctuate but tend to be constant.

ii. Factors that have a significant effect on potato exports in North Sumatra Province are domestic prices and international prices, while factors that do not have a significant effect on potato exports in North Sumatra Province are potato production and exchange rates.

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