

Forecasting of Production and Export Indonesian Pepper Commodities Using Smoothing Exponential and Holt Winter Methods

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ABSTRACT

Purpose: The last few years the contribution of Indonesian pepper in the world market has decreased and has been replaced by Vietnam. If in 2000 and a few years before Indonesia became the world's main pepper exporter, since 2001 the position has been replaced by Vietnam. In 2006 Indonesia's position fell back to number three the world was replaced by Brazil which was ranked second. In 2006 Indonesian exports outperformed Brazil and returned to rank second. Based on data from the Directorate General of Plantations in 2015, the area under pepper in Indonesia tends to decrease from 2004 to 2015 with an average reduction of area of 3064.5 hectares per year. Based on data from the Directorate General of Plantation in 2015, the area of pepper in Indonesia tends to decline from 2004-2015 with an average reduction of 3,064.5 hectares per year. The occurrence of the deduction according to the Ministry of Agriculture (2013), among others, is caused by: (a) drought; (b) Pest and disease attacks, especially stem rot and jaundice; and (c) conversion of pepper into mining or other plantation land, such as oil palm, rubber or cocoa.

Design/methodology/approach: Methods used to predict the number of production and consumption of domestic and export of Indonesian pepper is Double exponential Smoothing Brown and the Smoothing exponential method of Holt-Winter.

Research limitations/implications: This Paper discusses the predictions of production and domestic consumption and the export of Indonesian pepper.

Originality/value: This Paper is Original

Paper type: Research paper

Keywords: Brown Double Exponential Smoothing Method, Forecasting, Holt-Winter Method Indonesian Pepper, Smoothing Method

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I. INTRODUCTION

Agriculture sector in a broad sense is one of the economic sectors based on natural resources. The agricultural sector is the main focus of most of the people of Indonesia to make a living. One of the products of the agricultural sector is pepper. Indonesia has a large contribution in the world pepper trade by becoming the second largest exporter of pepper in the world after Vietnam (Lukiawan & Suminto, 2018).

Pepper (*Piper nigrum* L.) is one of the leading commodities in the plantation sub-sector that has great potential in Indonesia's economic growth because it has a contribution to the country's foreign exchange. Besides pepper is also one type of spice that is very typical and cannot be replaced by other herbs [3]. Even since old times Indonesia has been known as a major producer of pepper in the world, especially black pepper produced in

Lampung and whit pepper produced in the province of the Bangka Belitung Island. Both types of pepper are used as world pepper trade standards (Direktorat Budidaya Tanaman Rempah Dan Penyegar, 2009).

The last few years the contribution of Indonesian pepper in the world market has decreased and has been replaced by Vietnam. If in 2000 and a few years before Indonesia became the world's main pepper exporter, since 2001 the position has been replaced by Vietnam. In 2006 Indonesia's position fell back to number three the world was replaced by Brazil which was ranked second. In 2006 Indonesian exports outperformed Brazil and returned to rank second.

Based on data from the Directorate General of Plantations in 2015, the area under pepper in Indonesia tends to decrease from 2004 to 2015 with an average reduction of area of 3064.5 hectares per year. The occurrence of these reductions according to the DIREKTORAT BUDIDAYA TANAMAN REMPAH DAN PENYEGAR (2009), among others caused by: (a) drought; (B) pests and diseases, especially stem rot disease and jaundice; and (c) conversion of pepper into the mining areas or other plantations, such as palm oil, rubber or cocoa. In addition to low productivity resulting in production of pepper also be less than the maximum.

Demand pepper itself is one of the aspects that determine the competitiveness of Indonesian pepper in the domestic market as well as on the world market. Indonesian pepper trade is generally more export oriented than for domestic consumption. National Economic Social Survey (SUSENAS) of the Central Bureau of Statistics show the development of pepper consumption for direct consumption in the year 2002 to 2014 is quite fluctuating. Indonesian pepper consumption during this period increased by 1.29% per year (Subagyo, 2000).

Therefore in order to fulfil the policy considerations demand, both domestic consumption and export needs, it would require a study to predict the amount of production, export volume and domestic consumption commodities Indonesian pepper. This study aims to forecast production, domestic consumption and commodity exports Indonesian pepper and analyse the development of international trade.

II. METHODOLOGY

The study was conducted including descriptive research with quantitative approach using secondary data production, domestic consumption and commodity exports Indonesian pepper. Data processing method used is the method of forecasting. Forecasting is an attempt to predict the circumstances in the past. But everything is uncertain in social life, it is difficult to accurately predict, therefore it is necessary to hold forecasting. Forecasting (forecasting) itself aims to acquire forecasting that minimize errors (forecast error) which can be measured by the mean squared error, mean absolute error, and so on (Pujiati, Yuniarti, & Goejantoro, 2016).

A. Double Exponential Smoothing Brown's Methods

Brown's double exponential smoothing of a linear model proposed by Brown. This method is used when the data indicate a trend. Trend is a smoothed estimate of average growth at the end of each period (Makridakis, Wheelwright, & Hyndman, 2003).

Steps and formulas used in the implementation of Brown's double exponential smoothing is shown below (Simou, Maniadakis, Pallis, Foundoulakis, & Kourlaba, 2010):

Determining the value of the parameter

Calculating the value of the first smoothing

$$S't = \alpha X_t + (1 - \alpha)'t-1 \tag{1}$$

Calculating the value of the second smoothing

$$S'' = \alpha S't + (1 - \alpha)S''t-1 \tag{2}$$

Calculating the value of a constant

$$at = 2S't - S''t \tag{3}$$

Calculating the value of slope

$$b_t = \frac{a}{1-a} (S't - S''t) \tag{4}$$

Counting results forecast

$$F_{t+} = at + bt m \tag{5}$$

B. Holt-Winter’s Multiplicative Methods

This model is used to predict the data with seasonal patterns and elements of the emerging trends simultaneously. In contrast to the double exponential smoothing method, exponential smoothing method winter triple uses three parameters to obtain the results of forecasting are α , β , and γ . So that the weaknesses of this method is the third parameter must be optimized by finding the best combination of these three parameters (Simou et al., 2010). The formula used for forecasting the Holt-Winter smoothing method is shown below (Wardah & Iskandar, 2017) :

1. Determining parameters
2. Calculating the value of smoothing level

$$L_t = \alpha \frac{X_t}{S_{t-L}} + (1 - \alpha)L_{t-1} + b_{t-1} \tag{6}$$

Calculating the value of smoothing trend

$$b = \beta(L_t - L_{t-1}) + (1 - \beta)b_{t-1} \tag{7}$$

Calculating the value of smoothing seasonal

$$S_t = \gamma \frac{X_t}{L_t} + (1 - \gamma)S_{t-s} \tag{8}$$

Counting results forecast

$$F_{t+m} = (L_t + btm)S_{t-c+m} \tag{9}$$

To use the method of calculation Holt-Winter necessary initialization initial value, because the value of each smoothing is not available. To initialize the initial value used the following formula (Wardah & Iskandar, 2017):

$$S_c = \frac{1}{c} (X_1 + X_2 + X_3 + \dots + X_c) \tag{10}$$

$$b_c = \left(\frac{X_{c+1} - X_1}{c} + \frac{X_{c+2} - X_2}{c} + \frac{X_{c+3} - X_3}{c} + \dots + \frac{X_{2c} - X_c}{c} \right) \tag{11}$$

$$L_t = \frac{X_t}{S_c}, t = 1, 2, 3, \dots, c \tag{12}$$

C. Forecasting Accuracy

The size of the forecasting accuracy of measurement of the size difference between the forecasting value with the value actually happened. This difference is called the error or residual (Wardah & Iskandar, 2017). The equation calculates the original error or residual value of each of the forecast period are as follows:

$$e = X_t - F_t \tag{1}$$

3)

Size of forecasting accuracy used is MAD and MAPE by the following equation:

$$MAD = \sum_{t=1}^n \frac{|X_t - F_t|}{n} \tag{14}$$

$$MAPE = \left(\frac{100}{n} \right) \sum_{t=1}^n \frac{|X_t - F_t|}{X_t} \tag{15}$$

III. RESULT AND DISCUSSION

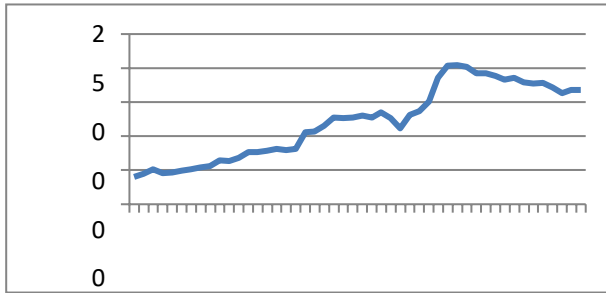


Figure 1. The pattern of production data

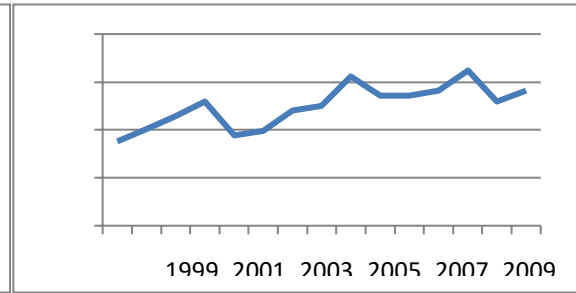


Figure 2. The pattern of domestic consumption data

In this study, the data used is the amount of production, domestic consumption and commodity exports pepper Indonesia. Data obtained from the Directorate General of Plantation Indonesia.

A. Data

In Figure 1 and Figure 2 shows the data of production and domestic consumption data, the data patterns indicate a trend (trend) increases. Therefore, it can be used a double exponential smoothing Brown methods.

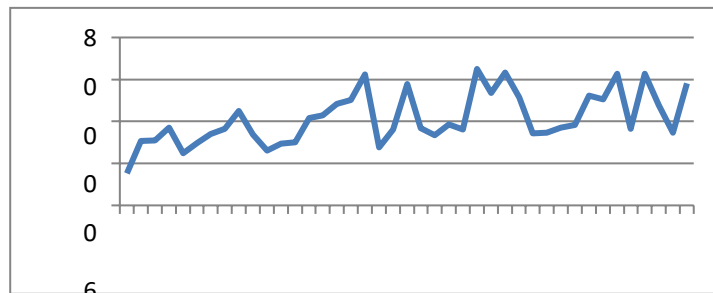


Figure 3. Export data pattern

In Figure 3, shows the Indonesian pepper export data. The data show a trend pattern with fluctuating pattern repeat previous patterns every 10 years. It means having a seasonal element to the length of the season 10-year period. Because the data pattern shows the same trend and seasonal patterns, then the method can be used are Holt-Winter Multiplicative Methods.

B. Production Forecasting

By using the formula of Brown's double exponential smoothing. The result of production pepper Indonesia is as follows:

Table 1. Result Production Forecast

Period	Year	Production (tons)
45	2019	80914.43
46	2020	80147.07
47	2021	79379.7
48	2022	78612.34
49	2023	77844.98

The results showed total pepper production forecasts Indonesia from 2019-2023 year decreased by an average rate of decline of 0.96%.

C. Domestic Consumption Forecast

By using the formula of Brown's double exponential smoothing. The results obtained with the domestic consumption forecast at 0.1306 MAD and MAPE 10.25% as follows:

Table 2. Domestic Consumption Forecast

Period	Year	Consumption (kg / capita)
21	2019	.1605
22	2020	.1464
23	2021	.1633
24	2022	.1661
25	2023	.1690

The results above forecast consumption in units of kg / capita, to calculate the total consumption can be multiplied by the total population of Indonesia. Assuming the population of Indonesia next 5 years is equal to the population of Indonesia in 2018 as many as 267 million people (Pertivi, 2014), then the total consumption calculation results obtained Indonesian pepper in the following table:

Table 3. Total Domestic Consumption Forecast

Year	Consumption (kg /Total capita)	population (million)	Consumption (tons)
2019	.1605	267	43606.29
2020	.1464	267	44358.89
2021	.1633	267	45111.5
2022	.1661	267	45864.1
2023	.1690	267	46616.7

Based on forecast results, Indonesian domestic consumption will continue to rise with an average growth rate of 1.68%. The total consumption of pepper Indonesia progressively with increasing the population of Indonesia.

D. Export Forecast

By using the formula of Holt Winter multiplicative exponential smoothing. The result of divination by MAD and MAPE 7364.51 at 18.36% as follows:

Table 4. Result Export Forecast

Period	Year	Exports (tons)
45	2019	55620.93
46	2020	73939.99
47	2021	58794.65
48	2022	78474.37
49	2023	62559.51

Forecast results show Indonesian pepper export fluctuated next 5 years with an average growth in the period was 6.4%.

E. Analysis of Result Forecast

Projections between exports, domestic consumption, and the production of pepper conducted until 5 years from the year 2019 to 2023, show a pattern of domestic consumption demand pepper Indonesia continued to rise while domestic production levels pepper Indonesia is expected to continue to decline. If both types of demand for exports and domestic consumption are combined and compared with a forecast of domestic production deals, the projection can be seen in the following table:

Table 5. Total Offer and Demand Forecast

Year	Demand (tons)			Supply (tons)	
	Export	Consumption	Total	Production	Lack (tons)
2019	55620.93	43606.29	99227.22	80914.43	18312.79
2020	73939.99	44358.89	118,298.88	80147.07	38151.81
2021	58794.65	45111.5	103,906.15	79379.7	24526.45
2022	78474.37	45864.1	124,338.47	78612.34	45726.13
2023	62559.51	46616.7	109,176.21	77844.98	31331.23

Based on the forecast results, if there is no increase in production and export controls, the number of Indonesian pepper domestic production can not meet demand for exports and domestic consumption by a considerable margin and is likely to increase each year. This deficiency is very large when compared to the largest shortfall in 2006-2016 were met by imports only amounted to 6,029 tons.

If the conditions in the case then the excess amount will be met by imports. Assuming prices in 2019- 2023 equal to the average prices in 2006-2016, it can be calculated the value of exports and imports in 2019-2023 and Indonesian pepper contribution to Indonesia's trade balance, Obtained results of export-import value in the following 2019-2023 :

Table 6. Value Export and Import Forecast

Exports (tonnes)	Export Value (000US\$/ tons)	Imports (tons)	Import Value (000US\$ / tons)	Value of Export- Import Value (000US\$ / tons)
55620.93	323,268.85	18312.79	55524.38	267,744.47
73939.99	429,739.22	38151.81	115,676.3	314,062.93
58794.65	341,714.51	24526.45	74364.2	267,350.31
78474.37	456,093.04	45726.13	138,641.6	317,451.41
62559.51	363,595.87	31331.23	94996.29	268,599.58

Based on the table above can be seen trade balance of Indonesia based on the value of exports minus the value of imports remain in surplus. However, Indonesian pepper trade balance is smaller than the average of the pepper trade balance of Indonesia in 2012-2016 amounted to 381 038 (000US \$ / ton).

F. Indonesian Pepper Production Policy

Based on the results forecast demand and supply of pepper in 2019-2023 Table 4:36 Indonesian pepper production can not meet the demand for domestic consumption and export. Indonesia can overcome the deficiencies or the difference between demand and supply by importing. However, based on the availability of data from the years 2007-2012 the world pepper decreased with a growth rate of -1.54%.

Due to the declining number of availability pepper the world and considering the potential of the international market and domestic market pepper Indonesia sizable as well as the existence and characteristic pepper Indonesia, which has been known in the international market should be able to make Indonesia could develop commodity pepper and can increase the contribution of commodities pepper on the trade balance Indonesia, For that there are some things that can be done to increase the production of pepper Indonesia among which the expansion and improvement of productivity of pepper.

With Indonesian pepper productivity reached 0.4 tons / hectare, the area of additional land required to meet production shortfalls as follows:

Table 7. Additional land required land area

Year	Difference in Demand and Supply Indonesian Pepper (tons)	Additional Required Land Area (Hectare)
2019	18312.79	40107.73
2020	38151.81	83558.12
2021	24526.45	53716.56
2022	45726.13	100,147.01
2023	31331.23	68620.04

The additional land area can be reduced by increasing the productivity of pepper Indonesia. Judging from the data, the productivity of Indonesian pepper is said to be low when compared with competitor countries such as Vietnam country capable of producing at 2.65 tonnes / hectare / year. and Malaysia were able to produce by 2.13 tonnes / hectare.tahun. meaning that Indonesia is able to increase the productivity of pepper at least up to 1.5 tonnes / hectare / year.

The strategies that can be done in order to increase the productivity of pepper namely:

1. Development of high yielding varieties of seeds.
2. Training pepper cultivation techniques to farmers a better starting from planting, the use of pole climbing, fertilization, pest control and harvesting.
3. Strengthening agricultural institutions pepper.

With this strategy Indonesia is expected to increase the productivity of national pepper.

IV. CONCLUSION

Based on the results of the discussion in the previous chapter, it can be concluded that the results forecast domestic consumption and exports of pepper Indonesia in 2019-2023 showed a rising trend, while the pepper production in Indonesia in 2019-2023 is predicted to continue to decline forecast. The results also showed in 2019-2023 Indonesian pepper output can not meet the demand for domestic consumption and export demand by a considerable margin. based on the analysis of the results of the forecast production, domestic consumption, export of pepper Indonesia in 2019-2023, international trade pepper Indonesia is expected to decline. With pepper Indonesia's trade balance is smaller than the years 2019-2023 the average balance of trafficking pepper Indonesia in 2012-2016. Strategies that can be taken to develop pepper farming are to increase the area of land for pepper and increase productivity.

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