Journal of Agribusiness Management and Development, Vol 1 No 1, September 2020, Page 40-48
ISSN 2775-0248 (Print) ISSN 2775-0256 (Online)
Available at https://journal.ugm.ac.id/v3/JAMADEV/

PREDICTION ANALYSIS OF TOBACCO PRODUCTION IN TEMANGGUNG DISTRICT

Ruddy Chrisdiawan Poetra[1] & Masyhuri[2]
[1,2]*Department of Agricultural Socio-Economics, Faculty of Agriculture, Universitas Gadjah Mada*
Corresponding author: masyhuri@ugm.ac.id

Received : 12 August 2020 Accepted : 12 September 2020 Published : 26 September 2020

ABSTRACT

Tobacco is a raw material for making cigarettes and one of the most considerable income contributions of Indonesia. This research aims to determine tobacco productivity and predict tobacco production from 2017–2021 in Temanggung, Central Java, based on the previous tobacco production of 1987–2016. Trend analysis was used to estimate tobacco productivity in Temanggung. ARIMA method predicts tobacco production for five years, namely 2017–2021, but does not require a specific data pattern. ARIMA method also works effectively for short period time data. The research results show that tobacco productivity in Temanggung increased by 0.0053 ton/ha per year. ARIMA model (0,1,1) showed that tobacco is predicted to increase during the 2017-2021 period in Temanggung.

Keywords: Box Jenkins–ARIMA, prediction, production, tobacco

INTRODUCTION

Indonesia is one of the world's largest producers of tobacco plants. This plant is called "green gold" based on information from Tobacco Farmers. Indonesian local tobacco is also known as the highest tobacco quality. Each tobacco producer's region has its distinctive taste. The type of Indonesian tobacco is most sought after in the international tobacco market (Padmo and Djatmiko, 1991). Tobacco plants first entered Indonesia around 1630 (Dutch Tobacco Growers, 1951), then expanded to various regions in Indonesia, one of which is on the eastern and northern slopes of Mount Sumbing and Mount Sindoro, Temanggung Regency, Central Java. Finally, through a lengthy adaptation process, the tobacco population in Temanggung Regency was formed, which has distinctive morphological and physiological characteristics. Temanggung tobacco is a kind of Voor Oogst (Nicotiana tabacum). It is planted and harvested during the dry season.

Tobacco can be used in several functions. It can be used as a pesticide. In the form of nicotine tartrate, it can be used as medicine. Generally, tobacco is made into cigarettes, chewing tobacco, and other products. Tobacco has long been used as an entheogen in America. The arrival of Europeans to North America popularized the tobacco trade, especially as a sedative. This popularity led to the economic growth of the southern United States. After the United States civil war, changes in demand and labor led to the cigarette industry's development. This new product quickly developed into tobacco companies until scientific controversy broke out in the mid-20th century.

Plantation tobacco plants are Indonesia's foreign exchange earner. It means that tobacco is cultivated on an extensive production scale up to thousands of hectares. Thus, considerable capital investment is needed, and it is hoped that a large income or profit will be obtained. Tobacco in Indonesia comes from smallholder plantations, private plantations, and government plantations. Tobacco plantations are scattered in several regions in Indonesia, one of which is tobacco plantations in the Temanggung Regency. Temanggung Regency i

s the best producer of Voor-Oogst tobacco in Indonesia, unique properties, namely distinctive aroma, and high nicotine compounds. Based on data from the Directorate General of Plantations at the Ministry of Agriculture, national tobacco production in 2016 reached 196,154 tons, up 1.22 percent from the previous year, which weighed 193,790 tons. Indonesia's tobacco production once reached a record high in 2012, weighing 260,818 tons. However, after that, it tends to decline. Last year's tobacco production consisted of 195,559 tons or about 97.7 percent of which resulted from Smallholders Plantation (PR).

Meanwhile, 462 tonnes (0.24 percent) are State Large Plantations (PBN). The rest, as much as

133 tons (0.07 percent) of large private plantations (PBS). Thus the plan to increase cigarette excise will have an impact on small tobacco farmers. If cigarette production decreases, it will reduce smallholder tobacco demand.

Based on data from the Central Bureau of Statistics for 2014–2016, Central Java is one of the provinces that produce the most massive tobacco production in Indonesia. In 2014, tobacco production in Central Java produced 34,309 tons, then in 2015, it produced 34,302 tons, and in 2016 Central Java province produced 34,309 tons of tobacco. From these results, in 2014–2016, tobacco production in Central Java could be stable, or there was no significant increase or decrease in production.

One way to determine the Temanggung Regency's ability to produce tobacco is to make forecasts for the next few years. Forecasts are needed as necessary information for planning and making decisions in the future. Forecasting is an essential tool in planning effectively and efficiently.

Forecasting is an activity of the business function that estimates the sales and use of products to be made in the right quantity. A forecast estimates future demand based on several forecasting variables, often based on historical time-series data. Forecasting uses forecasting techniques that are both formal and informal (Gaspersz, 1998).

METHOD

This research's primary method is descriptive quantitative analytic based on solving actual problems that exist today. Data is shown, compiled, explained, and analyzed to provide an overview of the phenomena that occur, explain relationships, test hypotheses, make predictions, and get the meaning and implications of a solved (Assauri,1984). The data obtained in this study were analyzed using Eviews 4.0 and Microsoft Excel 2007 software.

This study uses secondary data. Secondary data is data that is recorded systematically in the form of time-series data. The data used are production data, area size, and tobacco productivity in the Temanggung Regency for the last 30 years. Secondary data is a literature study or literature sourced from the Directorate General of Plantation's internal reports, the Central Bureau of Statistics (2017), data from related agencies, and other relevant literature. The data presented are:

1. The total area of tobacco plantations in Temanggung District, 1987-2016.
2. Tobacco Plantation Production in Temanggung Regency according to its exploitation in 1987–2016.
3. The productivity of tobacco plantations in the Temanggung Regency according to their exploitation from 1987 to 2016.

Each variable and its measurements need to be explained to obtain a common understanding of the concepts in this study, namely:

1. Production is the number of tobacco products produced from tobacco leaves in the Temanggung district with a scale (ton/land).
2. The area is the amount of land used for tobacco cultivation in Temanggung district (hectare/land)
3. Productivity is the ability of existing resources to produce tobacco products (ton/hectare/year)

One of the statistical tools used to estimate a business's state in the future based on past data is a trend. The trend predicts a variable with time-independent variables or the occasional series movement over several years and tends to go in a direction, where the direction can be up, flat, or down (Soejoeti, 1987). Forecasting is a continuation of the trend line from the last observation to the time for the forecast to be made. Trend analysis was conducted to see the trend of tobacco area development, productivity, and production in the Temanggung Regency. The trend equation with the regression model is as follows:

$$Y = a + bx + e \quad \text{..}(1)$$

in which:

Y = predicted variable (tobacco productivity)

a = constanta

b = trendline coefficient

x = time (year)

e = residual

Trend analysis tests several variables, one of which is testing using the coefficient of determination (R^2). The coefficient of determination is expressed in percent form, which shows the magnitude of the independent variable's influence on the dependent variable (Widarjono, 2007). The coefficient of determination is used to measure the correctness of the relationship from the model used, namely a number that shows the amount of variance/distribution ability of the independent variable, which explains the dependent variable. The general Box-Jenkins model is denoted as follows:

ARIMA (p,d,q)

$= (1-B)^d (1 - \theta_1 B - \theta_2 B^2 - \ldots - \theta_p B^p) Y_t$

$= \delta + (1 - \theta_1 B - \theta_2 B^2 - \ldots - \theta_q B^q) \varepsilon_t$.........................(2)

in which:

p = autoregressive degree (AR)

d = differencing degree (difference)

q = moving average degree (MA)

ε_t = forecast error period t

δ = constants

B^2Y_t = Y_{t-2}

B^pY_t = Y_{t-p}

$B^q\varepsilon_t$ = ε_{t-q}

The steps in the ARIMA method are as follows (Mulyono, 1999):

1. Data Stationing Stage

The model identification stage determines whether the time series data to be used is stationary or not. If the time series data is not stationary, it can usually be converted into stationary time series data using the differencing method. If the time series data is stationary, the analyst must identify the model's form to be used. This stage is carried out by comparing the autocorrelation coefficient and the partial autocorrelation coefficient of the data with the distribution for various ARIMA models accordingly. Data stationarity checks can be done in the following ways:

a. Graph, that is, with a simple data plot, if the data is close to the average and there is no tendency to have an up or down trend, then the data is stationary.
b. Correlogram, namely by looking at the ACF (autocorrelation function) and PACF (partial autocorrelation function). Autocorrelation is the correlation between members of a series of observations ordered by time. The value of autocorrelation characterizes stationary data, and partial autocorrelation decreases with a time lag.
c. The unit root test compares the absolute ADF value with the critical value test value or critical area boundary. If |ADF| < |critical limit| then the data is stationary

2. Temporary Model Identification Stage

The next critical stage of identification is to determine the tentative ARIMA model. It is done by analyzing the behavioral patterns of the ACF and PACF. As mentioned earlier, autocorrelation for stationary non-seasonal time series data usually differs significantly from zero in only the first few lags (k<5). It can occur with a variety of different correlogram patterns.

First, the correlogram with the autocorrelation coefficient for all lags is zero. It shows that the data has no trend and the residual component is random. Second, the correlogram with the autocorrelation coefficient is cut off after the first few lags. It means that the autocorrelation coefficient for lag 1, lag 2, and or lag 3 is quite large and significant. In most cases, ACF will cut off after lag one or two. Third, a correlogram with an autocorrelation coefficient that does not cut off but decreases to near zero in a fast pattern is referred to as a rapidly dying down pattern. ACF shows several dying patterns, namely a decreasing exponential pattern, a sine wave pattern, and a combination of the two patterns. After analyzing the ACF and PACF patterns' behavior, the Box Jenkins tentative model can be determined (Gaspersz, 1998).

If the ACF is cut off after lag 1 or 2, the seasonal lag is insignificant, and PACF is slowly dying down, then a non-seasonal MA model (q = 1 or 2) is obtained.

a. If ACF is cut off after seasonal lag L, non-seasonal lag is insignificant, and PACF is dying down, we get the seasonal MA model (Q = 1).
b. If the ACF is cut after the seasonal lag L, the non-seasonal lag is cut off after lag 1 and 2; we get a non-seasonal - seasonal MA model (q = 1 or 2; Q = 1).
c. If ACF is dying down and PACF cut off after lag 1 or 2; The seasonal lag is not significant, so we get a non-seasonal AR model (p = 1 or 2).

3. Parameter Estimation Stage from the Interim Model

The diagnostic checking stage is carried out after the parameter estimators are obtained so that the model is ready to be used for forecasting. This stage is carried out to check or test whether the model has been specified correctly or whether the correct p, d, and q have been selected. This stage can be passed in many ways:

a. Residual non-autocorrelation test

The correlogram can be used to find out the autocorrelation of the residuals. If the correlogram shows a significant ACF or PACF plot in the initial lags, the residuals have autocorrelation. Otherwise, the residual does not have autocorrelation.

b. Residual homoscedasticity test

The test finds out whether the residuals variance is homogeneous or cannot be seen from the correlogram of residual squared. If the correlogram shows a significant ACF or PACF plot in the initial lags, the residual variance is not constant. Otherwise, the residual variance is constant.

c. Residual normality test

The residual normality test was conducted to see the normality of the residuals. The model is good if the residuals are normally distributed if the residual histogram forms a bell shape.

4. Model Evaluation

After estimating the model parameters using computer software, then evaluating the model that has been obtained.

5. Forecasting Phase

This stage is the final stage of the Box-Jenkins method. At this stage, the model obtained is used to predict the existing time-series data so that forecasts can be carried out for some time to come.

6. Time Series Forecasting Method Selection

The criteria for selecting the most frequently used method or the main criterion is the mean square error (MSE). The method chosen is the method that has the lowest MSE value. It implies that the lower the forecast's MSE value, the closer to the actual value (more substantial forecasting power). The second criterion has the simplest form and requires the least amount of time in the processing process. The formulas that can be used to calculate MSE are:

$$MSE = \frac{1}{n} \sum_{i=1}^{n} (Yt - \check{Y}t) \qquad (3)$$

in which:

Yt = actual value

Ŷt = predicted value

Yt - Ŷt = forecast error

n = number of sample

RESULTS AND DISCUSSION

Development of Tobacco Area, Production, and Productivity in Temanggung Regency

1. Tobacco Area

The area of tobacco in the Temanggung Regency in 30 years (1987-2016) tended to decrease by 2% on average. The total area of tobacco in the Temanggung district for 30 years (1987-2016) was 488,965.31 hectares. The land for growing tobacco in the Temanggung Regency is dry. That area depends on rainwater irrigation, planted with seasonal or annual plants, and separated from the house's environment. The moorland is rugged for irrigation because of the uneven surface. During the dry season, the land becomes more solid, making it challenging to grow farming crops (Murdiyati, 1991).

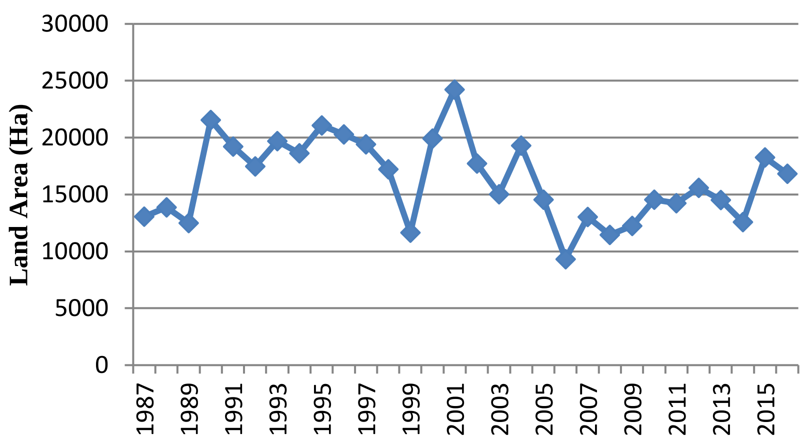

Figure 1. The Land Area of Tobacco in the Temanggung Regency 1987-2016
Source: Center Bureau of Statistic, 2017

Based on Figure 1, the total area of tobacco in the Temanggung Regency from 1987 to 2016 is seen from the graph fluctuating every year. From 1989 to 1990, the area increased by 9,054.2 hectares, but in 1991 it decreased again. The highest area was in 2001, which was 24,239.3 hectares, and the lowest was in 2006 with an area of 9,326 hectares. Meanwhile, the average area from 1987 to 2016 was 16,298.8 hectares.

The acreage of tobacco in the Temanggung Regency has fluctuated and decreased drastically since, during these years, many farmers experienced a lack of capital to cultivate tobacco plants and a shortage of labor. Besides, many farmers can also not rent agricultural land because of the lack of capital, which causes tobacco production to decline.

2. Tobacco Production

Tobacco production in the Temanggung district has fluctuated every year for 30 years. Based on Figure 2, Temanggung tobacco production has fluctuated from 1987 to 2016. From 1989 to 1990, there was a decline in 5.080.3 tonnes production and was the lowest production with a production size of only 1,062.2 tonnes; then in 1991, it increased by 6,580.8 tonnes. From 1998 to 2001, there was a significant increase in production, and the most massive production occurred in 2001, which resulted in the tobacco production of 14,260.05 tons. In 1999, there was a significant decrease in tobacco areas, but from 1998 to 2001, there was a significant increase in tobacco production. The increase in production in 2001 was supported by the area that has increased. Then from 2002 to 2016, the average production experienced fluctuation. The climate influences increased production and decreased production of Temanggung tobacco. The size of Temanggung tobacco production from 2000 to 2015 compared to the national production of only 4.4% of Indonesia's tobacco production.

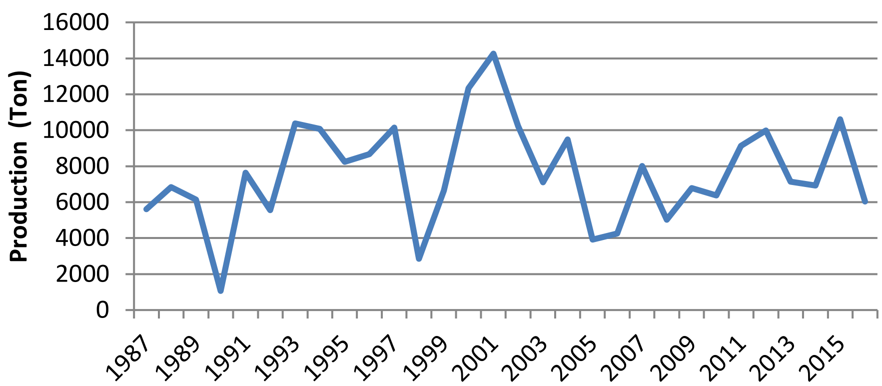

Figure 2. Tobacco Production in Temanggung Regency 1987-2016
Source: Center Bureau of Statistics, 2017.

3. Temanggung Tobacco Productivity Rate

According to Bangun (2007), the productivity factor explains the relationship between productivity factors and productivity results. The productivity factor is known as the input, while the yield of productivity is called output, where one of the inputs is the area of land. In this case, the output referred to tobacco production. The input is land, namely the size of the area. Temanggung tobacco productivity has tended to increase in the past 30 years. For more details, see Figure 3 below.

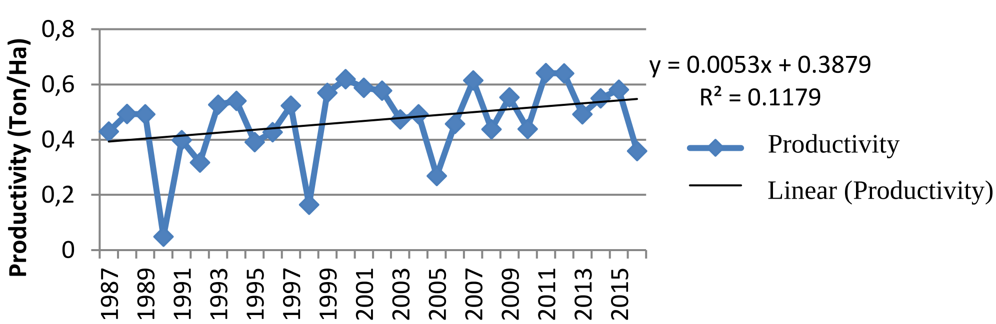

Figure 3. Tobacco Productivity Rate in theTemanggung Regency 1987-2016
Source: Center Bureau of Statistic, 2017

Based on Figure 3, the productivity rate of Temanggung tobacco has the equation Y = 0.005315x + 0.387869, which means that every one year increase will increase the productivity of Temanggung tobacco by 0.0053 tonnes/ha/year. Then obtained R^2 of 0.1179 means variables, namely, years can explain that 11.7% of Temanggung tobacco productivity variables, then 88.3%, are explained by variables outside the model. In Table 1, the T-Trend test results of Temanggung tobacco productivity obtained a probability of 0.063 greater than alpha 1%. It shows that the time variable (years) has no significant effect on Temanggung tobacco's productivity during 30 years. Temanggung tobacco productivity has tended to increase from time to time so that it has a positive trend.

Temanggung tobacco productivity, when compared to national tobacco production, does not have a significant effect. Temanggung tobacco's productivity from 2000 to 2015 affects national productivity of only 11%, and the average magnitude of the effect on national productivity is 2.55 tonnes/ha/year.

Table 1. The Result of Tobacco Productivity T-Trend Test in Temanggung Regency 1987-2016

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.387869	0.048784	7.950783	0.0000
Year	0.005315	0.002748	1.934129	0.0633

Source: Secondary Data Analyzed in 2018

Fluctuations in Temanggung tobacco productivity are caused by several things such as land degradation, elevation, slope direction, and land slope. Tobacco productivity in Temanggung is caused by land degradation as a result of intensive tobacco cultivation. The decrease in land productivity is due to, among others, land degradation due to erosion and endemic diseases (Rochman and Yulaikah, 2007). According to Mastur et al. (2002), tobacco productivity is affected jointly by elevation, slope direction, and land slope. Slope splay and slope length are two factors for erosion because these factors determine the magnitude of the water velocity of slope runoff. The large runoff water velocity is generally determined by the continuous and long slope of the slope.

Moreover, it concentrated in narrow channels that have great potential for erosion (Asdak, 1995). Therefore, the slope of the slope can decrease productivity. Besides, some things make Temanggung tobacco productivity fluctuate, one of which is the lack of sufficient information to farmers on how to use fertilizers on time and the right dose to make tobacco productivity less volatile.

4. Government Policy on Tobacco

Government policies are the way to increase productivity, quality, and income of Temanggung tobacco farmers, so since 1980 the people's tobacco intensification program (ITR) has been implemented. The ITR program is developing the rice intensification program's success, increasing farmers' productivity and income, and the rice intensification program. The participating farmer ITR program receives a permanent capital credit facility (KMKP) in money and production facilities and guidance from extension workers. The supervisor of the ITR program is a branch of the Regional Plantation Office of Temanggung Regency. In this case, the project implementing unit (UPP) is the executor but does not act as a manager (buyer). In other words, UPP, as the supervisor of the ITR, does not provide market guarantees for the tobacco products of the participants. Based on Mukani and Isdijoso's (1990) research, the ITR program was unable to increase the productivity, quality, and income of Temanggung tobacco farmers. This phenomenon confirms that market assurance is a critical factor in increasing productivity and quality and farmers' income.

5. Tar and Nicotine Content Regulatory Policy

The content of tar and nicotine must be immediately regulated and then added to the existing policy. These substances can cause various diseases, including cancer, heart disease, impotence, and pregnancy disorders. The data states that smoking activities cause 25 percent of people with heart disease, not only that many smoking-related diseases have implications for the exhaustion of the budget allocated for Jamkesmas or now called BPJS Kesehatan. The data shows that as much as Rp 2.11 trillion of the total Rp 7.4 trillion of BPJS health funds has been spent on financing the treatment of diseases caused by smoking. The issue of tar and nicotine restriction is a very sensitive one. It is because it directly threatens the existence of cigarettes. Various incidents appear to have been deliberately carried out, eliminating the article nicotine as an addictive substance in Law No. 36 years 2009.

6. Prediction of Temanggung Tobacco Production

Table 2 shows the regression output that ARIMA (0,1,1) AR (0) or autoregressive one means that the current production data does not affect the previous data. I (1) means Integrated one that the data is stationary at the first differentiation, which is notated as d = 1. MA (1) or Moving Average one is the current production affected by the fluctuation of production in the previous period. ARIMA (0.1,1) MA (1) has a value of -0.975215 that for every 1 unit increase in tobacco production (other factors are considered constant), the fluctuation in tobacco production will decrease by 0.975215. This result may be because tobacco farmers experienced a decrease in production caused by the extreme climate in Temanggung Regency with high rainfall. Besides, it may also be because farmers managing land and tobacco plants are less precise and efficient, resulting in decreased production.

Table 2. The Result of ARIMA Regression (0,1,1)

Variable	Coefficient	Std. Error	t-Stat	Prob
MA(1)	-0.975215	0.063258	-1.541637	0.0000

Source: Secondary Data Analyzed in 2018

7. Prediction Results

Table 3 shows that tobacco production from 2017-2021 has decreased every year. If it is pulled a few years back, namely in 2015, tobacco production reached 10,611.78 tons. Then tobacco production decreased significantly in 2016, namely 6,041 tons. In the forecast results in 2017, tobacco production has increased by 696.64 tons, then decreased tobacco production in 2018 by 18.19 tons, in 2019 it increased by 148.71 tons, in 2020 tobacco production increased by 29.48 tons, and the end of the forecast in 2021, tobacco production also has an increase of 5.5 tons.

The increase in tobacco production in Temanggung Regency from 2017 to 2021 is not too large. Tobacco production increases or decreases can also be due to climatic conditions in Temanggung Regency. In Temanggung, when the intensity of rainfall is high in a year, it will result in a lack of production and vice versa. If the rainfall is low in one year, then average production. Besides, the management of tobacco plant management also affects the number of tobacco products in Temanggung Regency.

Table 3. Forecast Results of Tobacco Production in Temanggung Regency 2017–2021

No	Year	Production (tonnes)
1	2017	6,737.64
2	2018	6,719.45
3	2019	6,868.16
4	2020	6,897.64
5	2021	6,903.14

Source: Secondary Data Analyzed in 2018

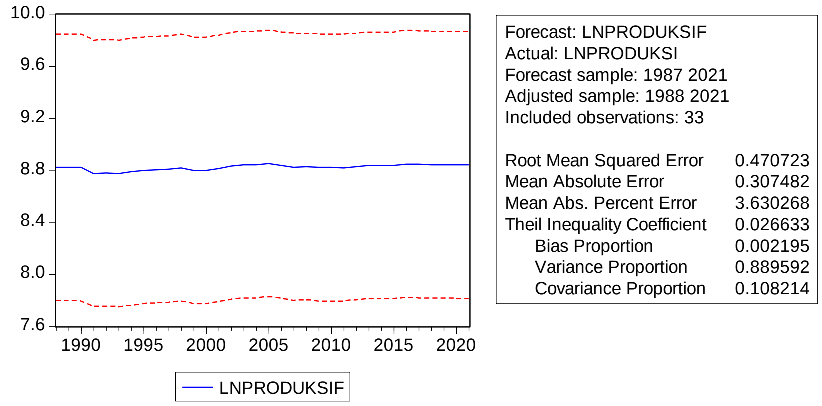

Figure 4. Forecast Results of Tobacco Production 1987-2021
Source: Secondary Data Analyzed, 2018

Based on Figure 4, it is known that the Mean Absolute Percentage Error (MAPE) value is 3.630268, which means 3.63 % of the average forecast data deviates from the actual data. The MAPE value is the average value of the overall percentage error (difference) between the actual data and the forecast data. The accuracy measure is matched with the time-series data and is expressed as a percentage. The smaller the MAPE value, the smaller the forecast results' error, and the better it is to be applied a forecast model. The MAPE value shows how much the forecast's average absolute error is compared to the actual value. MAPE is calculated using the absolute error for each period divided by the actual observed value for that period, then averaging the absolute percentage errors. The MAPE function is to measure the reliability of the forecasting method in forecasting the data being tested. So that the smaller the MAPE value, the better the forecast results obtained.

The ARIMA model chosen can cause differences in the production forecasting results where the actual tobacco production data is between the predicted tobacco production data (Anggraeni, 2005). So that might cause Temanggung tobacco production to increase from year to year, which is supported by supervision in managing and maintaining Temanggung tobacco so that production can be endeavored to increase. Therefore, cooperation between the government and tobacco farmers is needed in increasing tobacco production so that production increases for the next five years (2017-2021).

CONCLUSIONS

The conclusion obtained from this research is that tobacco products in the Temanggung Regency in 1987-2016 have increased. The t-trend test results show that the time variable (years) does not affect Temanggung tobacco's productivity for 30 years. The best prediction model for predicting tobacco production in Temanggung Regency is the ARIMA model (0,1,1). Predictions of tobacco production in the Temanggung Regency for 2017-2021 will experience an increase in production from year to year.

The forecast results for tobacco production in the Temanggung Regency can consider decision-making for both the government and farmers in the area. Decision making can take the form of determining planting and harvesting times.

REFERENCES

Anggraeni, Adhita Dyah. 2005. Pemrakiraan Produksi Pucuk Teh Dengan Model ARIMA di PT. Pagilaran Yogyakarta. Tesis. Pascasarjana Magister Manajemen Agribisnis. Universitas Gadjah Mada. Yogyakarta.

Asdak, C. 1995. Hidrologi dan Pengelolaan Daerah Aliran Sungai.Gadjah Mada University Press. Yogyakarta

Assauri.1984. Teknik dan Metode Pemrakiraan. Fakultas Ekonomi UI. Jakarta

Bangun, Wilson. 2007. Teori Ekonomi Mikro. Bandung.

Center Bureau of Statistics, 2017. Tobacco Production in Indonesia. Directorate General of Plantation, Center Berau Statistic of Indonesia.

Dutch Tobacco Growers. 1951. Report on tobacco –

cultivation in Indonesia. World Tobacco Congres. Amsterdam. 1951.78p
Gaspersz, Vincent. 1996. Ekonomi Manajerial, Penerapan Konsep-Konsep Ekonomi Dalam Manajemen Bisnis Total. Gramedia Pustaka Utama, Jakarta.
Gaspersz, Vincent. 1998.Statistical Process Control. Gramedia.Pustaka Utama, Jakarta
Mastur, G. Dalmadiyo, Suwarso,A.S. Murdiyati, Djajati, M dan Mukani. 2002. Pengkajian Teknik Konservasi Lahan Tembakau Temanggung. Laporan Akhir Proyek Pengkajian Teknologi dan Serat. Malang, 19 hlm.
Mukani dan S.H. Isdijoso. 1990. Peranan program ITR terhadap peningkatan produksi, mutu, dan pendapatan petani pada usaha tani tembakau Temanggung. Prosiding Simposium I Hasil Penelitian dan Pengenbangan Tanaman Industri. Pusat Penelitian dan Pengebangan Tanaman Industri, Bogor IV.178P.
Mulyono. 1999. Pemrakiraan Bisnis dan Ekonometrika Edisi Pertama. BPFE. Yogyakarta.
Murdiyati, Dalmadiyo, Mukani, Suwarsi, S.H. Isdijoso, A. Rachman, dan Bagus .H.A. 1991.Observasi lahan lincat di daerah Temanggung.Balai Penelitian Tembakau dan Tanaman Serat, Malang. 31 p.
Padmo,S dan Djatmiko, E.1991.Tembakau: Kajian Sosial Ekonomi. Aditya Media,Yogyakarta
Rochman, F dan Yulaikah. 2007. Varietas Unggul Tembakau Temanggung. Prosiding Lokakarya Nasional Agribisnis Tembakau. Badan Litpang Pertanian.
Soejoeti, Zanzawi. (1987). Analisis Runtun Waktu. Karunika Jakarta, Jakarta.
Widarjono, A. 2007. Ekonometrika: Teori dan Aplikasi untuk Ekonomi dan Bisnis. Ekonisia Fakultas Ekonomi. Universitas Islam Indonesia, Yogyakarta.