The effects of seasons on chrysanthemum flower (Chrysanthemum indicum) production in Sleman Regency, Yogyakarta, Indonesia

E S Rahayu, N Setyowati* and I Khomah

Faculty of Agriculture, Universitas Sebelas Maret, Jl.Ir.Sutami No. 36.A, Kentingan, Jebres, Surakarta, 57126, Indonesia
*Corresponding author: noenk_setyo@yahoo.com

Abstract. Chrysanthemum is a type of cut-flower that has commercial value and popular in Indonesia. Economically, Chrysanthemum has the potential for the export commodities and expected to increase in the future. One fruitfulness factor of Chrysanthemum cultivation is determined by season. The risk factors of Chrysanthemum production need to be studied, particularly season factor. This research aims to find out the optimum season for Chrysanthemum production and how to anticipate the impacts of climate change or seasonal factors on Chrysanthemum flower production and to discover the main factors of Chrysanthemum production. The research was carried out in Sleman Regency. The analytical method used was the Cobb-Douglas production function model. The results show that seasons affected Chrysanthemum flower production. The highest Chrysanthemum production occurred in the dry season. It is better for the farmer to cultivate Chrysanthemum in the dry season to reduce the risk of production. Protection houses are needed to protect plants from excessive heat intensity and strong winds during the rainy season as the impacts of climate change.

1. Introduction

Chrysanthemum is one of the important and popular decorative plants and one of the new economic growth sources in agricultural development. The Chrysanthemum production is the largest one in Indonesia compared with other cut flower production traded domestic market during 2016-2017 [1]. In addition, Chrysanthemum is considered as a potential export commodity and most widely during 2017, followed by rose and orchid. The export volume of Chrysanthemum in 2017 was 49.52 tons, with Japan and Kuwait being the states importing Chrysanthemum from Indonesia [2]. Chrysanthemum with high economic value is one of the favorite plants to farmers as the economic source of farmers in Indonesia including in Sleman regency, Yogyakarta [3].

Furthermore, one of the areas producing Chrysanthemum is Yogyakarta (Yogyakarta Special Region) (DIY) Province. BPTP (Badan Penelitian Teknologi Pertanian or Agricultural Technology Research Agency) of Yogyakarta’s researchers cooperate have just cooperated with small farmers in Pakem Sub District of Sleman Regency in 2005 to redevelop it as the attempt of improving the income of farmers and the life sustainability of people cultivating Chrysanthemum [4]. The harvest land width is 6.95 Ha during 2015-2017, increasing to 8,963 Ha, but decreasing again to 4,490 Ha in 2017. Its production is 5,140,444 bunches, increasing to 6,318,433 bunches in 2016, but decreasing to 902,926 bunches. The problem resulting from the fluctuating harvest land and production phenomenon is due to some factors and the Chrysanthemum farmers’ profit level is affected by input and output prices, in...
addition to being determined by the production quantity. Chrysanthemum cultivation belongs to Chrysanthemum with a successful rate of Chrysanthemum cultivation ranging between 70% and 80% and needing quite intensive maintenance. In addition, the seasonal factor highly determines the Chrysanthemum productivity [5]. Nowadays, climate change causes extreme season and environmental conditions. This has a negative impact on Chrysanthemum, including temperatures that are too high, strong winds and direct exposure to rainwater. Chrysanthemum plants need adequate water, but cannot withstand rainwater exposure [6]. Departing from this condition, a study should be conducted on the factors affecting Chrysanthemum production and particularly season so the farmer can anticipate the impact of climate change or extreme season because, among various factors, seasonal factor is the one controlled difficulty by the farmers. So this research aims to find out the optimum season for Chrysanthemum production and how to anticipate the impacts of climate change or seasonal factors on Chrysanthemum flower production and to discover the main factors of Chrysanthemum production.

2. Material and method
This research employed descriptive analytical method. The research location was determined purposively recalling that Sleman Regency, particularly Pakem Sub District, is the Chrysanthemum cultivation area with the highest production. The technique of collecting data used was the survey. Farmer sample was selected using the census method due to the limited numbers of farmers and 31 farmers fulfilling the criterion of minimum standard planting width were taken to be the sample. The method of analyzing data used was the Cobb-Douglas production function approach.

The function of production is defined as a technical relationship between input and output, indicating output as the function of input and is considered as important in some productive economic discussions [7] Production function can find out the relationship between variable explained (Q) and variable explaining (X). The function of production can be written as follows:

\[ \text{Output} = f (\text{input}) \]

\[ Q = f (X_1, X_2, X_3, ..., X_i) \]

where: \( Q \) = output \( X_i \) = input used in production process; \( i = 1,2,3, \ldots, n \). The input used in the production process includes, among other capital, labor, dummy, and etc. In economics, the output is denoted with \( Q \) while input (production factor) used usually consists of capital (K) and labor (L).

Thus:

\[ Q = f (K, L) \]

This Cobb-Douglas production function is often called exponential production function. This production function is different from another, dependent on the characteristics of data existing and used, but it is generally written as follows:

\[ Y = a X^b \]

Mathematically, Cobb-Douglas production function used in this study on Chrysanthemum production can be written as follows:

\[ Y = \alpha X_1^{b_1} + X_2^{b_2} + X_3^{b_3} + X_4^{b_4} + X_5^{b_5} + X_6^{b_6} + D_m \]

where : \( Y \) = Chrysanthemum flower production,
\( X_1 = \) number of seed,
\( X_2 = \) number of labor,
\( X_3 = \) manure use,
\( X_4 = \) NPK fertilizer quantity,
\( X_5 = \) leaf fertilizer quantity,
\[ X_6 = \text{planting area width} \]
\[ D_m = \text{seasonal dummy}, \]
\[ b_1, b_2, b_3, b_4, b_5, b_6, b_7 = \text{parameter estimated for its value}. \]

Then the estimation of the equation above can be accomplished by changing multiple linear forms into logarithm, so that the following equation is obtained:

\[ \log Y = \log \alpha + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + b_7 D_m + e \ldots \ldots \] (5)

3. Results and discussion
The effect of seasonal factor on Chrysanthemum production is analyzed using the production function approach; to see the need for Chrysanthemum production other factors such as seed number, labor number, manure quantity, NPK fertilizer quantity, leaf fertilizer quantity, and land width are included, in addition to the season. The effect of those factors on Chrysanthemum production is analyzed using a multiple linear regression method. The instrument of analyzing data used was SPSS software.

3.1 Result of classical assumption test

3.1.1 Normality test. Data normality test in the regression model is used to find out whether or not the confound or residual variable has a normal distribution in the regression model. The normality test, can be conducted using the Kolmogorov-Smirnov (KS) test [8]. The result of the normality test using Kolmogorov-Smirnov is presented in Table 1.

| Normal Parameters | Unstandardized Residual |
|-------------------|-------------------------|
| N                 | 30                      |
| Mean              | 0.00000000              |
| Std. Deviation    | 0.07895391              |
| Absolute          | 0.127                   |
| Positive          | 0.063                   |
| Negative          | -0.127                  |
| 0.698             |
| Kolmogorov-SmirnovZ | 0.715               |
| Asymp Sig (2-tailed) |                        |

Source: Primary Data Analysis, 2019

From Table 1, it can be found sig. (2-tailed) of 0.715 higher than alpha (\( \alpha = 0.05 \)); thus it is insignificant. It indicates that H is supported. The residual value resulting from regression analysis is distributed normally. Then, t- and F-tests assume that residual value follows a normal distribution; if this assumption is broken, the statistic test is invalid for the small size of the sample.

3.1.2 Heteroscedasticity test. Heteroscedasticity Test aims to examine whether or not there is a variance difference between one observation’s residual and another’s in a regression model. The result of the heteroscedasticity test can be in the output of scatterplots in Figure 1.
Figure 1 shows that the pattern of dots does not create a certain pattern. The dots spread randomly and are distributed both above and under 0 (zero) number on Y-axis. It can be concluded that no heteroscedasticity occurs in the regression model, so that the regression model is feasible to use to make a prediction.

**Table 2. Result of heteroscedasticity using Glejser Test**

| Model                        | Unstandardized Coefficients | Sig. |
|------------------------------|-----------------------------|------|
| (Constant)                   | 0.076                       | 0.279| .783 |
| Number of Seed (LnX₁)        | 0.006                       | 0.189| .852 |
| Number of Labor (LnX₂)       | 0.018                       | 0.525| .605 |
| Manure quantity (LnX₃)       | -0.008                      | 0.303| .765 |
| NPK fertilizer quantity (LnX₄)| -0.011                      | 0.308| .761 |
| Leaf fertilizer quantity (LnX₅)| 0.011                       | 0.368| .717 |
| Land width (LnX₆)            | 0.028                       | 0.730| .473 |
| Season Dummy (D₁)            | 0.031                       | 1.156| .260 |

Source: Primary Data Analysis, 2019

Table 2 shows that there is variance similarity between one observation’s residual and another’s in a regression model or the variance between one observation’s residual and another’s is constant (homoscedasticity), so that it can be concluded that there is no heteroscedasticity and the regression model is feasible to use to make the prediction.

### 3.1.3 Multicollinearity test

Multicollinearity Test is aimed at examining whether or not the correlation between independent variables is found in the regression model [9]. The method used to detect whether or not there is multicollinearity is Tolerance Value (TV) and the opposite, Variance Inflation Factors (VIF), using SPSS. VIF margin is 10 and TV is 0.1. If tolerance value ≥ 0.1 and VIF ≤ 10, no multicollinearity will occur in the regression model.
Table 3. Result of multicolinearity test

| Model                        | Collinearity Statistic |
|------------------------------|------------------------|
|                             | Tolerance  | VIF   |
| (Constant)                  |            |      |
| Number of Seed (LnX₁)       | 0.136      | 7.364 |
| Number of Labor (LnX₂)      | 0.541      | 1.848 |
| Manure quantity (LnX₃)      | 0.420      | 2.379 |
| NPK fertilizer quantity (LnX₄) | 0.297    | 3.362 |
| Leaf fertilizer quantity (LnX₅) | 0.188    | 5.327 |
| Land width (LnX₆)           | 0.112      | 8.924 |
| Season Dummy (D₁)           | 0.395      | 2.530 |

Source: Primary Data Analysis, 2019

Table 3 shows that the Tolerance value of individual independent variables is more than 0.1 and the VIF value of individual independent variables is less than 10; it can be concluded that there is no correlation between independent variables. All prerequisites are fulfilled, meaning that the estimator model becomes BLUES (best linear unbiased estimator) or the model can be used for further estimation.

3.2 Result of statistic test

3.2.1 Coefficient of determinacy (R²) test. The coefficient of Determinacy (R²) is used to measure the extent to which a model can explain independent variables including seed number, labor number, manure quantity, NPK fertilizer quantity, leaf fertilizer quantity, land width, and seasonal dummy.

Table 4. Coefficient of determinacy (R²) of seasonal factor on Chrysanthemum production

| Model Summary | R Square | Adjusted R Square | Std. Error of the Estimate |
|---------------|----------|-------------------|----------------------------|
|               | 0.983a   | 0.966             | 0.956                      | 0.09065                    |

Source: Primary Data Analysis, 2019

Table 4 shows the R square of 0.966. R square close to one (1) means that independent variables provide nearly all information needed to predict the dependent variables [8]. Thus, considering the R square known, the variation of independent variables can explain 96.6% of the dependent variable (Chrysanthemum production) variation. Meanwhile, the rest of 3.4% is affected by other variables excluded from this model such as pesticide use, market demand, and governmental policy.

3.2.2 F test. F Test is used to examine whether or not independent variables simultaneously affect the dependent one (Chrysanthemum production) simultaneously. The result of F test can be seen in the Anova output below.

Table 5. The result of F-test

| Model       | Sum of Squares | Mean Square | F     | Sig.   |
|-------------|----------------|-------------|-------|--------|
| Regression  | 5.183          | 0.740       | 0.111 | 0.000a |
| Residual    | 0.181          | 0.008       |       |        |
| Total       | 5.364          |             |       |        |

Source: Primary Data Analysis, 2019
Table 5 shows that the probability value is 0.000, less than (α = 0.05), meaning that independent variables used in this study affect significantly the dependent variable (Chrysanthemum production) simultaneously.

3.2.3 Result of t-test. The T-statistic test is used to find out the extent to which independent variables explain the variation of the dependent variable partially. The result of t-test can be seen from the output of coefficient table 6

Table 6. Result of analysis on seasonal factor and other factors on Chrysanthemum production

| Model | Unstandardized Coefficients | Sig. |
|-------|-----------------------------|------|
|       | B                           |      |
| (Constant) | 5.365 | .860 | 0.000 |
| Number of Seed (X1) | 0.176 ** | .720 | 0.013 |
| Number of Labor (X2) | 0.294 *** | .233 | 0.000 |
| Manure quantity (X3) | -0.010 ns | 0.182 | 0.858 |
| NPK fertilizer quantity (X4) | 0.004 ns | 0.060 | 0.953 |
| Leaf fertilizer quantity (X5) | -0.048 ns | 0.823 | 0.419 |
| Land width (X6) | 0.403 *** | .243 | 0.000 |
| Season Dummy (D0) | 0.113** | .139 | 0.044 |

Source: Primary Data Analysis, 2019
Note: ***) : significant at confidence interval of 99%
     **): significant at confidence interval of 95%
      ns): non-significant/insignificant

Table 6 shows that seasonal factor significantly affects Chrysanthemum production. The coefficient of regression obtained with positive sign means that dry season affects the production of Chrysanthemum better than the rainy season does. This phenomenon is due to dry season sufficiently affects the productivity of Chrysanthemum blossoming, as air humidity rate is consistent with the Chrysanthemum’s growing need, about 70-80%. During the rainy season usually occurs at the end of the year (October-December), air humidity is very high (up to 95%), and big wind often occurs and it often becomes a constraint to the farmers. The windy weather damages the shelter impacting the damaged plant. The damage will decrease the production of Chrysanthemum cut flower and even the farmers will experience harvest failure. The response of Chrysanthemum changed according to planting time showing an important effect for seasonal changes [10]. Chrysanthemum branches will appear faster if the light intensity is higher [11]. Mostly, ornamental plants are sensitive to temperature and require specific temperatures for production and optimum quality [12].

The Chrysanthemum cut-flower farmers in the Pakem sub-district will anticipate the months at the end of the year, October-December when the big wind likely comes by means of repairing the shelter. The climate factor during the rainy season also results in the increased number of adverse pest and disease attacking Chrysanthemum, so that the farmers control them using pesticide before pest and disease attack.

The seed number factor is significant partially affects the production of Chrysanthemum significantly. The seed is the main input needed for cultivating Chrysanthemum. The more the number of seed used, the higher is the production of Chrysanthemum.

Other significant factors are labor and land width, meaning that the number of labor partially affects the production of Chrysanthemum. This is in line with the previous study that the addition of labor will be able to increase the production of Chrysanthemum flowers. Labor’s knowledge and ability play an important role in the agricultural sector, particularly in flower cultivation as it will improve the productivity of labor. The land width factor partially affects the production of
Chrysanthemum. The more extensive the land will be able to increase Chrysanthemum production [13]. There are 3 insignificant factors: manure, NPK fertilizer, and leaf fertilizer quantities. Chemical fertilizer has no effect on the production of Chrysanthemum flowers. Similarly, leaf fertilizer quantity does not affect the production of Chrysanthemum [14]. The use of manure is intended to repair the nutrient condition existing in the soil, NPK fertilizer tends to grow the Chrysanthemum plant well impacting on blossoming; similarly, leaf fertilizer also serves as a growth-stimulating factor, so that the three fertilizers do not increase the production of Chrysanthemum directly.

4. Conclusion
The seasonal factor affects positively the production of Chrysanthemum. The dry season is the one with the best effect on the production of Chrysanthemum compared with the rainy season is because air humidity in this season is corresponding to the growth of Chrysanthemum so that it is appropriate to produce Chrysanthemum. Protection houses are needed to protect plants from excessive heat intensity and strong winds during the rainy season. In addition to the season factor, the number of seed, number of labor, and land width also affects Chrysanthemum production.

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