International Journal of Management, Accounting and Economics
Vol. 7, No. 12, December, 2020
ISSN 2383-2126 (Online)

www.ijmae.com

Original Research

Potential of Increasing Vegetable Production During Covid-19 Pandemic in Sumberejo Village, Batu City, Indonesia

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Abstract

Farmers in Sumberejo Village cultivate vegetables simultaneously during certain seasons on their land. This study aims to analyze potential for increased production vegetables during Covid-19 pandemic. Data collected from 45 randomly selected farmers were analyzed using Cobb Douglas production function. The analysis showed that land area had a very significant effect and positive on the production of celery, mustard greens and red chilies. Seeds did not have a significant effect on celery and mustard greens production, but had a significant effect on red chilies. Fertilizers did not have a significant effect on the vegetables yields. Labor had a significant effect in different directions on celery production (positive) and pakcoy (negative), but does not have a significant effect on red chili. Pesticides only had a significant effect and positive on celery, while the mustard greens and red chilies have no significant effect. During a pandemic, the expansion of production vegetables included in category increasing return to scale, because sum of input coefficients was greater than one. These results can be a signal for farmers to increase their production. Government should regulate distribution of these commodities and the prices stability because people must keep their distance.

Keywords: Covid-19, expansion, vegetables, production

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Introduction

Import performance of vegetable commodities in East Java in January 2020 decreased to US $ 67.88 million (BPS, 2020). This condition cannot be ascertained whether it is due to obstruction of export-import activities from Indonesia to China due to the Covid-19 pandemic or due to changes in other variables for example: decreased production or increased consumption. Trade restrictions to China as a result of the pandemic only started in February, but the decline in imports already occurred in January. This is important to analyze because according to Pudjiastuti et al. (2013); Pudjiastuti (2014); Pudjiastuti & Kembauw (2018), dependence on imports can have a negative impact on the national economy performance.

Economic crisis due to Covid-19 shows a lack of food security in Indonesia due to high food imports. One of the most imported food commodities is vegetables. The imports have reached 770 million dollars in 2019. If converted to rupiahs, the import value will reach around IDR. 11.55 trillion, assuming an exchange rate of IDR. 15,000 per US dollar. Most of these are imported from China and tend to increase (BPS, 2020). It will not cause a problem if agricultural trade balance is still positive. Agricultural trade balance with China in 2019 shows exports were US$ 3.89 billion and imports were US$ 2.02 billion. Thus, Indonesia had a surplus of US$ 1.87 billion from this country. Meanwhile, in January-March 2020, Indonesia had a surplus of US$ 164 million. Especially for the horticulture sector, balance sheet grew positively by up to 8.25 percent. It is the impact of strengthening domestic production and opening up export market access by government.

Domestic production of agricultural and fresh vegetables in 2016 was still very sufficient to meet the population needs. Several types of fresh leaf vegetables such as lettuce, spinach, kale, cabbage, carrots can even be exported. Farmers have difficulty selling it because production is abundant (BPS et al., 2017). Increasing import of vegetables in 2019 was dominated by industrial garlic and potatoes. They are included in various vegetables group. Import volume of garlic reached 38.62 percent of total import value of vegetables, followed by industrial processed potatoes, onions and dried chilies. Imports are needed because domestic supplies are not sufficient for people's needs. So imports are carried out for vegetables whose production is still low.

Research on the potential for developing vegetable farming has been carried out, but in different criteria. Celery has a prospect to be developed in Jati Bali Village because R/C = 3.16 (Sari & Gafaruddin, 2018). However, celery production obtained by farmers in Zed Village, Mendo Barat Subdistrict, Bangka Regency was not optimal, because farmers' production yields were still lower than production optimal. Maximum profit per planting season will be IDR. 13,639,672.04 if the celery price is IDR. 21,514 and optimal production is 1111,154 kg (Jannah et al., 2019), while celery production in Saring Sei Binjai Village is 6,980.00 kg/ha (Bahrun, 2015). Information about celery is still very limited.

Pakcoy is planted by farmers in Bannae Village because of its short harvest life, and can grow in dry season so that planting intensity is high, but the income is relatively low (Hane & Kune, 2018). Most (65%) of production cost is related to input (i.e. seeds, fertilizers, pesticides). The productivity is recorded at 1,500.35 kg/ha (Suratman, 2018); 4,150 kg per season (Lestari et al., 2019); and 5,714 kg/ha (Halim & Suherman, 2019). Productivity in some locations is low. However, its farming is still considered feasible because R/C > 1 (Normansyah et al., 2014; Damayanti, 2016; Opat & Hutapea, 2017; and Azzura et al., 2017). Inputs (land area, seeds, fertilizers, pesticides, labor) is used in this farming are still allocatively inefficient (Rakhmawati et al., 2011; Lama & Kune, 2016; Xaba & Masuku, 2013; Silitonga et al., 2017; Halim & Suherman, 2019; Hukom et al., 2019; Lestari et al., 2020; and Hermawan et al., 2020). This is a signal for farmers to change combination of production factors which cost less.

Quantity of red chilies in Bangladesh offered is price responsive (Hossen, 2015). In Indonesia, this is indicated by fluctuating price of red chili (Khasanah et al., 2020). Fertilizers, pesticides, and labor have an effect on red chili production, but land and seeds have no significant effect (Andayani, 2016). Otherwise, addition of land area, fungicides, and suitability of recommended use of seeds will increase red chilies production in Central Bangka Regency, but the increase of P fertilizer will actually reduce production (Purwasih et al., 2020).

Studies on efficiency of celery, mustard greens and red chilies is limited, then a research-based literature review was conducted on farm income and efficiency using the Cobb Douglas production function, but the commodities were different. Results of a study on water spinach (Lamusa, 2005); spinach (Kamisi, 2013); cabbage (Masithoh et al., 2013); (Mufriantie & Feriady, 2014); green beans (Kalauw et al., 2015); tomatoes (Sita & Hadi, 2016); (Amane et al., 2019); carrots (Wahyuningsih et al., 2020), found that this vegetable crop was generally profitable but the production is not analyzed so it cannot be known whether it is lower or higher than the standard. Farmers' income varies according to the type of vegetables and the use of input is not yet efficient. Damayanti et al. (2019) stated that the growth and production of vegetables also very much depends on the media and fertilizers used.

Horticulture such as various types of vegetables dominates agriculture in Batu City. Several commodities are usually planted by farmers simultaneously in a certain planting season on a certain land. In Sumberejo Village, most of the farmers planted celery, mustard greens, and red chilies in one planting season since February 2020 when the pandemic began to emerge. This study aims to analyze the potential for developing this vegetable production during Covid-19 pandemic.

Research Method

This research was conducted at the vegetable center of Batu City, namely Sumberejo Village in 2020. Population in this study were vegetable farmers who planted celery, mustard greens and red chilies during one growing season and the number was 350 people. Sample is determined by simple random sampling in consideration that land area cultivated by farmers is homogeneous. Number of samples is determined by Slovin formula:

$$n = \frac{N}{1+Ne^2} \quad (1)$$

where, n is the number of samples, N is the population and e is the level of accuracy desired (15%). Based on this formula, the number of samples is:

$$n = \frac{350}{1 + 350(0,15)^2} = \frac{350}{1 + 7,875} = \frac{350}{8,875} = 40 \text{ farmers.}$$

Primary data were collected through interviews with farmers who were selected as respondents with a questionnaire as a research instrument. Number of respondents was 45 farmers. The number that exceeds minimum sample limit is intended as a precaution if a farmer is unwilling to conduct an interview. In addition, data crosschecks were carried out through observations in order to obtain valid data. Secondary data were collected using documentation methods i.e. research articles, documents from Central Bureau of Statistics (BPS) and Ministry of Agriculture.

Data that has been collected are edited in the field first, so that the information obtained is appropriate and complete. After all questionnaires have been filled in completely and the data is declared valid, the data is tabulated and compiled for analysis.

To achieve research objectives, multiple regression analysis is used with Cobb-Douglas production function approach which is mathematically written:

$$Y_i = b_0 X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} X_7^{b_7} X_8^{b_8} \quad (2)$$

where:

Y_i = vegetable yields (kg) i = 1, 2, 3
b_0 = constanta
b_i = regression coefficient of input i = 1, 2, ……,8
X_1 = land area (ha)
X_2 = seed (gr)
X_3 = manure (kg)
X_4 = NPK fertilizer (kg)
X_5 = Urea fertilizer (kg)
X_6 = TSP fertilizer (kg)
X_7 = labor (HOK)
X_8 = pesticide (liter)

Cobb Douglas production function is used in this study because the regression coefficients can indicate potential expansion of the vegetable business. After classical assumption test, identification about goodness of fit the model is carried out based on determination coefficient (R^2). If this parameter is close to 1, the Cobb Douglas production function can be used as an analysis model. Furthermore, F test and t test were conducted to obtain information about which production factors influence vegetable production. Potential development of vegetables (celery, mustard greens and red chilies) is based on 1) production factors that have a significant effect and 2) the number of production function regression coefficients that indicate the position of expanding vegetable farming (constant return to scale, increasing return to scale or decreasing return to scale).

Results and Discussion

ISSN 2383-2126 (Online)

Characteristics of Vegetable Farmers

Sumberejo Village, which is geographically and administratively located in Batu Municipality and Batu District, has 89 ha of rice fields. Most (94%) of this agricultural land has technical water and the rest is semi-technical. Apart from rice fields, this region also has 117.90 ha of dry land. Since 2018, this paddy field has not been planted with paddy, but various other types, especially vegetables. There are 22 types of vegetables cultivated in rice fields (BPS, 2019).

Vegetable farmers have characteristics that can determine their farming successfully, including age, gender, education, number of family members that must be covered, land area, land status (see Table 1). Vegetable farmers generally (89%) had a productive age. At this age, farmers will find it easier to adopt new things and dare to take risks. As is well known, business in agricultural sector faces various obstacles such as not harvest because of climatic conditions, fluctuating commodity prices as a result of low bargaining power of farmers, limited capital ownership due to relatively small land area controlled by, and other factors. Most (87%) of vegetable farming is carried out by male farmers, most (98%) of whom have only had 9 years of basic education. This indicates that vegetable farming does not require high education. In other words, this sector is wide open for anyone to earn income. However, the area of cultivated land is not too large, that is less than 0.6 ha. Most (64%) of arable land status is lease rights. This fact shows that vegetable farming is profitable. In addition, almost all (91%) farmers have a sizeable dependency, namely 3-6 family members. So farmers believe this business can be relied on to meet the needs of their families.

Table 1. Characteristics of Vegetable Farmers in Sumberejo Village

No	Characteristics	Category	Quantity (farmers)	Percentage (%)
1	Age (year)	31-40 41-50 51-60 >60	6 21 13 5	13,33 46,67 28,89 11,11
2	Gender	Male Female	39 6	86,67 18,33
3	Education	Primary School Junior High school Senior High School Diploma	15 12 17 1	33,33 26,67 37,78 2,22
4	Land Area (ha)	≤ 0,20 0,21 – 0,40 0,41 – 0,60	25 12 8	55,55 26,67 17,78
5	Family Members (person)	1-2 3-4 5-6	4 20 21	8,89 44,44 46,67
6	Land Status	Ownership Right Lease Right	16 29	35,56 64,44

Vegetable Production Function in Sumberejo Village

As explained in the research method, the relationship between the means of production and the production of vegetables (celery, mustard greens and red chilies) was estimated using the Cobb Douglas production function. Production factors that are thought to affect production are land area, seeds, manure, TSP fertilizer, NPK fertilizer, urea fertilizer, labor and pesticides. The production function is Best, Linear, Unbiased Estimator (BLUE) because classical assumption test show that data is normally distributed, no multicollinearity and heteroscedasticity (Table 2).

Table 2. Results of Classical Assumption Test

No	Variable	Celery			Mustard Green			Red Chilli		
		Collinearity Statistics		Glesjer Test	Collinearity Statistics		Glesjer Test	Collinearity Statistics		Glesjer Test
		Tole-rance	VIF	Sig.	Tole-rance	VIF	Sig.	Tole-rance	VIF	Sig.
1.	Land Area (X_1)	.173	5.787	.169	.152	6.599	.638	.105	9.538	.501
2.	Seed (X_2)	.540	1.853	.812	.116	8.632	.319	.259	3.859	.821
3.	Manure (X_3)	.374	2.671	.112	.464	2.157	.429	.351	2.849	.652
4.	TSP Fertilizer (X_4)	.290	3.443	.525	.297	3.363	.775	.614	1.628	.934
5.	NPK Fertilizer (X_5)	.384	2.602	.410	.219	4.574	.353	.441	2.269	.198
6.	Urea Fertilizer (X_6)	.346	2.893	.538	.315	3.174	.181	.764	1.309	.381
7.	Labor (X_7)	.268	3.729	.474	.432	2.313	.125	.222	4.500	.634
8.	Pesticide (X_8)	.624	1.603	.835	.669	1.494	.061	.763	1.311	.431
	Kolmogorov-Smirnov Z			.770			.910			.778
	Asymp. Sig. (2-tailed)			.594			.562			.580

Data to estimate production function of celery, mustard greens and red chilies are stated to be normally distributed because its significance value (Asymp. Sig.) > 0.05. Meanwhile, to detect the presence of multicollinearity is based on tolerance and variance inflation factor (VIF) with criteria alpha/tolerance > 10% and VIF <10. VIF is calculated from all production factors <10 and all tolerance factors for vegetable production are above 10%, so it can be concluded that there is no multicollinearity among the production factors. To determine the presence of heteroscedasticity, Glesjer test is used. The results in Table 2 show that all vegetable production factors meet the assumption that heteroscedasticity does not occur because each input has a sig. > 0.05. Because there is no violation of classical assumptions, the next step is to identify affect input to vegetable yield. Vegetable production function as a result of multiple regression analysis is presented in Table 3.

Coefficient of determination (R^2) shows successively that it is 93.3%; 78.9%; and 89.7% of variations in production of celery, mustard greens and red chilies were explained by production factors used. Thus, Cobb Douglas production function for each vegetable can be expressed as a relevant model (goodness of fit model). Mathematically, production function of vegetables can be written as:

Celery : $$Y = -1,171X_1^{0,985}X_2^{0,052}X_3^{0,046}X_4^{0,097}X_5^{-0,079}X_6^{0,092}X_7^{0,055}X_8^{0,040} \quad (3)$$

Mustard Green : $$Y = 0,699X_1^{0,970}X_2^{-0,171}X_3^{0,006}X_4^{-0,163}X_5^{0,359}X_6^{0,087}X_7^{-0,368}X_8^{0,364} \quad (4)$$

Red Chilli: $$Y = -0,3604X_1^{0,842}X_2^{0,430}X_3^{0,040}X_4^{-0,137}X_5^{-0,125}X_6^{0,21}X_7^{-0,63}X_8^{-0,131} \quad (5)$$

Table 3. Vegetable Production Functions

Variabel	Celery		Mustard Green		Red Chilli	
	Regression Coefficient (b)	Sig.	Regression Coefficient (b)	Sig.	Regression Coefficient (b)	Sig.
Constanta	-1,171	.918	0,699	.656	-0,3604	.024
Land Area (X_1)	.985**	.000	1.014**	.000	.842**	.000
Seed (X_2)	.052	.471	-.195	.495	.430**	.001
Manure (X_3)	.046	.413	.021	.836	.040	.735
TSP Fertilizer (X_4)	.097	.241	.048	.768	-.137	.300
NPK Fertilizer (X_5)	-.079	.324	.184	.359	-.125	.239
Urea Fertilizer (X_6)	.092	.314	.111	.526	.021	.790
Labor (X_7)	.055*	.617	-.413*	.057	.063	.692
Pesticide (X_8)	.040*	.521	.251	.142	-.131	.270
R^2	.933		.789		.897	
F hit.	77.944		21.540		52.359	
Sig. F	0,000		0,000		0,000	

Analysis results showed that simultaneously, land area, seeds, manure, TSP fertilizer, NPK fertilizer, urea fertilizer, labor and pesticides had a significant effect on vegetable production. However, partially, input that affects production varies by type, except for land area.

Land area has a very significant effect (α = 1%) in a positive direction on production of celery, mustard greens and red chilies. As mentioned in the farmer profile, most of land for vegetable cultivation is rented land. Therefore, farmers make every effort so that they manage it can produce maximum production in order to obtain maximum profits. These results are consistent with the research of Rakhmawati et al. (2011); Xaba & Masuku (2013); Silitonga et al. (2017); Halim and Suherman (2019); and Purwasih et al. (2020), but different from Andayani (2016).

Seeds did not have a significant effect on celery and mustard greens production, but had a significant effect (α = 5%) on production of red chilies. Andayani (2016) states that seeds have no real effect on production this commodity, but Purwasih et al. (2020) stated that the input will increase production if it is used as recommended.

All types of fertilizers used by farmers, including manure, TSP, Urea and NPK fertilizers, did not have a significant effect on production of the vegetables. Research by Andayani (2016) and Purwasih et al. (2020) concluded that fertilizers contributed significantly to the production of red chilies, albeit in different directions.

Labor has a significant effect in different directions on production of celery (positive) and mustard greens (negative), but does not have a significant effect on red chili. Andayani (2016) found that labor had a real effect on this commodity.

Pesticides only has a significant effect in a positive direction on celery production, while for mustard and red chilies it has no significant effect. According to Andayani (2016) and Purwasih et al. (2020), this production factor has a significant effect on production of red chili.

Potential for Increase Vegetable Production during Covid-19 Pandemic

This research was conducted at the beginning of Covid-19 pandemic, that is February 2020. At that time, no policy was made to handle it, including Large-Scale Social Restrictions (PSBB = Pembatasan Sosial Berskala Besar) so that farming was still going on as usual. However, at harvest time, several policies have been implemented to deal with the spread of the virus that causes Covid-19. Before discussing the potential for developing vegetable production, the return to scale for each type of vegetable will be presented first (Table 4).

Table 4. Potential Expantion Path in Vegetable

No.	Type of Vegetable	Sum of Regression Coefficient	Return to Scale
1	Celery	1,367	Increasing return to scale
2	Mustard Green	1,786	Increasing return to scale
3	Red Chilli	1,522	Increasing return to scale

During the pandemic, expansion of all types of vegetables production has an increasing return to scale, because the sum of regression coefficients is greater than one. Production function of those vegetables has total coefficient sequentially of 1.367; 1,786; and 1,522. The implication is that farmers can increase celery production by 1.367 times, mustard greens 1.786 times; and red chilies 1.522 times when increasing input by 1 time.

Conclusion

Analysis of potential for improvement in vegetable production (celery, mustard greens and red chilies) during Covid-19 pandemic in Sumberejo Village using the Cobb Douglas production function model yields the following conclusions. Land area has a very significant effect in a positive direction on the vegetable production. Seeds did not have a significant effect on celery and mustard greens production, but had a significant effect on red chilies. All types of fertilizers, including manure, TSP, Urea and NPK fertilizers, did not have a significant effect on the vegetable production. Labor has a significant effect in different directions on production of celery (positive) and mustard greens (negative), but does not have a significant effect on red chili. Pesticides only has a significant effect in a positive direction on celery production, while for mustard and red chilies it has no significant effect.

During the pandemic, development of vegetables production has an increasing return to scale, because sum of production factor coefficients is greater than one. Returns to scale (RTS) of celery, mustard greens, and red chilies were 1.367; 1,786; and 1,522. The implication, farmers can increase celery production by RTS if all inputs are added 1 time. These results can be a signal for farmers to continue to develop their businesses during Covid-19 pandemic. Government needs to intervene in the distribution process of this commodity and price stability because the people must keep their distance.

Acknowledgment

Thank you to the farmers who are still willing to take the time to interview in the Covid-19 pandemic situation, where large-scale social distancing protocols are being implemented.

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HOW TO CITE THIS ARTICLE

Pudjiastuti, A. Q. (2020). Potential of Increasing Vegetable Production During Covid-19 Pandemic in Sumberejo Village, Batu City, Indonesia. *International Journal of Management, Accounting and Economics*, 7(12), 683-694.

DOI: 10.5281/zenodo.4482717

URL: http://www.ijmae.com/article_124742.html