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Impact Of The Implementation Of Strategic Cultivars On Traditional Cultivars In The Technical Efficiency Of Farmers And Welfare (The Case Of Strawberry Crop Farming In Serang Village)

Adi Poernomo^{1*}, Lilis Sitibadriah², Diah Setyorini Gunawan², Suharno²

¹ The Faculty of Economics and Business, Wijayakusuma University, Purwokerto, Indonesia.

² The Faculty of Economics and Business, Jenderal Soedirman University, Purwokerto, Indonesia.

Corresponding author: ebotpurnama@gmail.com

Abstract: The implementation of strategic strawberry cultivars in Serang village agriculture has caused some farmers to switch from vegetable farming to strawberry farming, this phenomena is interesting to find out whether the transfer to strawberry cultivar plants is followed by increased production efficiency and farmer welfare. The aim of this study is to analyze the level of technical efficiency of strawberry farming and vegetable farming, and to measure the level of welfare of farmers through the "farmer exchange rate index". The data used in this study are primary data, with the method of "in-depth interviews". Quantitative analysis was carried out to measure the level of technical efficiency of strawberry and vegetable farming using the Data Envelopment Analysis approach. The measurement of technical efficiency of strawberry and vegetable production uses input variables which consist of "land rent, labor, fertilizer, seeds, medicines, irrigation, and agricultural equipment", and the output variable is production. Measurements of the efficiency of strawberry distribution and vegetable farming use variable input number of distributors and shipping costs, and the output variable is the distributor's selling price. To measure the level of welfare of farmers, the farmers' exchange rate index is used, which is a measure of the ability of the exchange rate of products produced and sold by farmers with products consumed by farmers, both those which are household needs and agricultural production costs. The results of the Data Envelopment Analysis show that from the level of efficiency of production and distribution, strawberry farming and vegetable farming on average are already efficient. The results of measuring the level of welfare of farmers indicate that strawberry and vegetable farmers are in prosperous conditions.

Keywords: New Cultivar, Economic Efficiency, Data Envelopment Analysis, Farmer Exchange Rate, Farmer Welfare

1. Introduction

Serang Village Karangreja Subdistrict Purbalingga Regency is a highland area with an altitude of about 650 to 1300 meters above sea level with an average air temperature of 20 degrees Celsius. Very strategic location for vegetable farming. Climate conditions that meet the requirements for farming types of horticultural agriculture, so that the villagers use it to farm vegetables, as a basic farmer for local farming.

In the late 1990s, farmers in Serang Village began to recognize and develop the "Cultivar Oso grande" strawberry plant which has a larger size and sweeter taste [16], this cultivar is also



an introduced cultivar from California United States, with the characteristics of the fruit size is very large, dense, the middle part is textured like foam, and the yield is high[2]. With the inclusion of strawberry crop farming in Serang Village, it is hoped that it can improve the welfare of the community, especially farmers who previously planted vegetables and turned into strawberry farmers (strategic cultivation with high economic value).

The problem of strawberry crop farming in Indonesia is the availability of high-quality and disease-resistant seeds. Provision of seeds has been carried out conventionally by using stolon (modification of stems that grow sideways and in the growth of new plants). The weakness of this method is to have limited multiplication capacity and disease resistance, due to the infection of endogenous pathogens that are transmitted from the parent plant. Seedlings that are exposed to this pathogen infection cause the quality of production to decline after about three periods of planting [42].

In the dry season strawberries planted in open land are capable of maximum production, but in the rainy season, strawberry plants are not able to produce well, because the production of many strawberries is rotten, so special cultivation techniques are needed so that strawberries will continue to produce optimally during the rainy season. Strawberry plants are generally planted in open land such as in beds, or in plastic sacks, but at this time, many strawberries are cultivated in greenhouses by planting in pots or polybags with wooden shelves or multilevel gutters and some are planted in polybag pads [6].

The government's involvement in supporting agricultural activities in Serang Village Karangreja Sub-District, Purbalingga District, is realized by developing road infrastructure to Serang Village, such as widening the road to the village, and "rest area" around strawberry farming in Serang Village, to facilitate the emergence of agrotourism rural area. Consumers who initially came to buy strawberries directly, now they not only buy strawberries, but also can enjoy the beauty of mountain scenery and strawberry farming directly. Responding to these conditions, the farmers, in addition to selling strawberry crops, farmers also develop strawberry-based agro-tourism such as direct strawberry picking, making roadside stands around agro-tourism to sell agricultural products as souvenirs [20,31,37].

This study aims to analyze and compare the technical efficiency of production and distribution, "strategic cultivar" (strawberry) farming with "traditional cultivars" (vegetables). To analyze the technical efficiency of farming, the Data Envelopment Analysis model was used, while to find out the level of farmer welfare was measured by the Farmer Exchange Rate index. Measuring the level of welfare of farmers is intended to determine the impact of the implementation of strategic strawberry cultivar farming on traditional vegetable cultivar farming at the level of farmers' welfare.

The difference of this research with other research that has been done is on the analysis and comparison of the level of technical efficiency of strawberry and vegetable farming with a mathematical method using the Data Envelopment Analysis model, which can measure and compare productivity well between comparable units [10]. While other studies in the same case in the Serang village, only analyzed at the level of agricultural productivity strawberries and vegetables partially and not using the same analysis model. In addition to technical efficiency, this study also conducted an analysis of both cultivars distribution efficiency, the above limitations that researchers know, have not been analyzed by other researchers on the case and the same location, so it is a novelty of this study.

2. Literature Review

Implementing strategic (commercial) cultivars to farmers who are used to traditionally carrying out traditional crop farming activities, often carried out by the government in an effort to accelerate rural (traditional) agricultural development, because it is considered to have high economic value, can immediately change traditional cropping patterns to modern, which is accompanied by an increase in the welfare of rural farmers [25], but these efforts require hard work and a long process of adaptation, besides being faced with a high risk of failure, because

strategic cultivars need agricultural knowledge with specific modern technologies while rural farmers are accustomed with cropping patterns and traditional types of plants, so the level of success is often not as expected[3,30].

Transformation of traditional farming patterns into strategic cultivar agriculture if not followed by increased knowledge of farmers [19], also often not followed by increased farm efficiency and farmer welfare [5], another fact explains that strategic cultivars economically it is estimated to be profitable, in fact it faces the reality of instability in output markets [24]. The instability of the strategic cultivar output market often occurs because the product is not a consumer item that is favored by the local market (although it has good benefits and quality) or an uncompetitive export-oriented product in the global market, so the government and private sector need to overcome the problem [23].

The traditional cropping pattern of rural farmers who are considered uneconomical and the cause of prolonged rural farmers' poverty by the government, has proven to be capable of surviving despite having to deal with imported agricultural products, global climate change [11] and the deteriorating quality of rural agricultural environments [38], in other words rural traditional agriculture is actually able to show the form of sustainable agriculture based on local wisdom [41].

Other research results show that rural peasant poverty is not absolutely due to agricultural patterns and traditional types of crops or inefficiencies in production, but it is largely caused by economic instability [27] which is a dynamic of economic activity and economic policy government macro [1,22]. Regional barriers in the form of rural infrastructure are very limited, and the cultural attitudes of rural communities that tend to live in a simple and modest way play a role in creating rural ethical poverty. Rural farmers are also often used as a medium for government political interests in running pro-poor development programs [14, 33] to get public sympathy as a potential constituent[9,29].

3. Method

This research uses primary data, collected by observation, interview, and discussion methods. The observation method is carried out by making direct observations during the research activities in Serang Village to obtain supporting information and data from farmers, extension workers, or government officials. The interview method is done by asking several questions that have been compiled in the concept of the questionnaire.

Purposive sampling method by selecting farmers who deliberately sampled the appropriate criteria in this study. The sample criteria in this study were strawberry farmers and vegetable farmers who had the scale of the area they worked on as relatively wide. The total filtered respondents were 60 farmers consisting of 30 vegetable farmers and 30 strawberry farmers.

Quantitative analysis was carried out to analyze the technical efficiency of vegetable and strawberry farming using the Data Envelopment Analysis (DEA) approach. Data is processed using computers (Microsoft Excel 2013) for each type of agriculture. The results of processing primary data are presented in the form of tables which are then interpreted to explain the true event. DEA is a strong methodology for measuring the efficiency of multiple inputs in several output production units [7]. Therefore, DEA is relatively an efficient measure that accommodates several inputs, several outputs and other factors in one model [15]. Technically, DEA analysis is comparing input and output data from a DMU (Decision Making Units) data organization with other input and output data in a similar DMU. This comparison is done to get an efficiency value [12]. In addition to producing efficiency values for each DMU, DEA also shows units that are references for inefficient units [17,26].

The Banker Charnes Cooper [8] model or Variable Returns to Scale (VRS) used in this study [26], this model assumes that farming does not or does not yet operate at an optimal scale. This model assumes that the comparison that the ratio between the addition of input and output is not the same, namely VRS, which means the addition of inputs x times, can be smaller or even larger. The VRS formula can be mathematically written as follows:

$$\begin{aligned} \max_{\mu_k, v_i} \quad & \Sigma_K^p \mu_k y_{k0} - U_0 \\ \text{s.t.} \quad & \Sigma_{i=1}^m v_i x_{i0} = 1 \\ & \Sigma_K^p \mu_k y_{kj} - \Sigma_{i=1}^m v_i x_{ij} - U_0 \leq 0 \quad j = 1, \dots, n \\ & \mu_k \geq \epsilon, v_i \geq \epsilon \quad k = 1, \dots, p \\ & i = 1, \dots, m \end{aligned}$$

[28]

Where:

Y_{kj} = Number of output r produced by farmer j ,

X_{ij} = Amount of input i used by farmer j ,

μ_k = Weight given to output r , ($r = 1 \dots t$ and t is the number of outputs),

V_i = Weight given to input i , ($i = 1 \dots m$ and m is the number of inputs),

N = Number of farmers,

i_0 = Farmers who are given an assessment

Usually the result of calculation of output and input-oriented DEA, will identify an efficient DMU is exactly same. The efficiency value for the output-oriented model will be the same as the efficiency value of the input-oriented model. The average efficiency value for the VRS model input orientation will generally be greater than the input oriented CRS model [17], [13].

The welfare level of play is measured using the "farmer exchange rate index", which is a comparison between the price index received by farmers and the price index paid by farmers [4]. The price index received by farmers illustrates the price movements of the products produced by farmers, which also reflects the level of income of the agricultural sector. The price index paid by farmers reflects an illustration of the price movements of goods consumed by farmers, including the amount of agricultural production costs incurred, the movement of the index paid by farmers is also a picture of inflation in the rural agricultural sector. Farmer Exchange Rate is a measure of the ability of the exchange rate of products produced and sold by farmers with products consumed by farmers, both those which are household needs and costs of agricultural production. Farmer Exchange Rate also shows the competitiveness of rural farmers' production compared to other products [4,35,36].

The criteria of the Farmer Exchange Rate index are as follows:

- $NTP > 100$, means that farmers experience a surplus or farmers' income is greater than their consumption.
- $NTP = 100$, meaning farmers experience break even if farmer income is the same as consumption.
- $NTP < 100$, means farmers experience a deficit or farmer's income is smaller than their expenditure [4].

4. Result

4.1. Production Technical Efficiency

Technical efficiency of agricultural production of strawberries and vegetables are calculated by comparing the number of inputs and outputs that are used in agricultural production systems strawberry and vegetable farm. The results obtained from these calculations will be presented by the table below.

Tabel 1: Production Technical Efficiency.

	Production Technical Efficiency	
	Strawberry	Vegetables
Mean	1.36	1.48
Median	1.13	1.58
Minimum	0.47	0.08
Maximum	3.64	2.41

Source: Primary data processed

From table 1, it can be seen that from each of the 30 samples of strawberry and vegetable farmers, it is known that both (strawberry and vegetable farming) are efficient in "technical production". The average level of technical efficiency of strawberry farming is 1.36 and vegetables are 1.48. Where is the technical efficiency of agricultural production > 1; it means that the use of inputs on strawberry farming and vegetables is efficient, but when viewed from the level of efficiency of each respondent, then, of the 30 respondents in strawberry farming, farmers who produce efficiently are 18 farmers or around 60 percent, and 12 farmers or around 40 percent, it is not efficient in its production. Whereas in vegetable farming there were 22 farmers or around 73 percent were declared efficient and 8 farmers or around 27 percent were declared inefficient. the explanation above illustrates that Serang village farmers, are still more efficient in producing vegetables, both in terms of their level of efficiency, as well as from the number of farmers who are able to produce efficiently.

The information above also explains, the difference in the level of efficiency of strawberry and vegetable farming is very narrow, this illustrates that the effort to introduce strawberry plants to vegetable farmers requires more effort, because strategic cultivars should get a higher level of efficiency.

4.2. Distribution Efficiency

The results of calculating the technical efficiency level of distribution of strawberry farming and vegetable farming are as follows:

Tabel 2: Distribution Efficiency

	Distribution Efficiency	
	Strawberry	Vegetables
Mean	1.45	1.20
Median	1.44	1.22
Minimum	1.30	1.12
Maximum	1.59	1.27

Source: Primary data processed

From table 2, it is known that the distribution of strawberries and vegetable farming is technically efficient. The distribution of strawberry farming has an average efficiency of 1.45, while vegetable farming has an average value of 1.20, distribution efficiency > 1: shows that the distribution channels of both agricultural products are efficient, the highest average value is obtained by strawberry farmers, who means that the distribution channel of strawberry agriculture is better, this is very likely to occur because of the strategic nature of the product (having high economic value), and local government support in creating strawberry agro-tourism that can boost the price level and the sale of strawberry agricultural products.

The distribution efficiency of vegetable farming is lower than strawberry farming because, distribution channels, vegetable products, still use traditional distribution channels,

which are only channeled through local collectors, to meet the needs of the local market and sell directly to consumers.

4.3. Farmer Welfare

The results of the calculation of the level of farmers' welfare are measured using the farmer exchange rate index

Tabel 3: Welfare Level of Strawberry Farmers

	Welfare Level of Strawberry Farmers	
	< 100	> 100
Mean	72.82	158.45
Median	80.15	129.30
Minimum	46.79	102.42
Maximum	99.66	323.60
Number of Farmers	12	18

Source: Primary data processed

From table 3, it is known that strawberry farmers who have a farmers' exchange rate index <100 are 12 people or around 40 percent, with an average index value of 72.82, which means that 40 percent of farmers are not yet prosperous. While 18 other farmers or around 60 percent obtained a farmer exchange rate index > 100, with an average value of 158.45, which means 60 percent of farmers prospered, in general these differences were quite moderate, but what was very worrying was that there were farmers who got the lowest index, with a value of 46.79, which can be declared a poor farmer, on the other hand there are farmers who get the highest index, with a value of 323.60, which can be declared by rich farmers. This very high gap in the level of welfare of farmers is a serious problem related to the social and economic problems of farmers, this problem requires a separate study to solve it.

Tabel 4: Welfare Level of Vegetables Farmers

	Welfare Level of Vegetables Farmers	
	< 100	> 100
Mean	52.69	144.32
Median	55.74	140.53
Minimum	6.47	100.16
Maximum	98.81	238.29
Number of Farmers	8	22

Source: Primary data processed

From table 4, it is known that vegetable farmers who have a farmers' exchange rate index <100 are 8 farmers or around 20 percent, with an average index value of 52.69, which means that 20 percent of farmers are not yet prosperous. While 22 other farmers or around 80 percent obtained a farmer exchange rate index of > 100, with an average value of 144.32, which means that 80 percent of farmers prospered, this indicates that vegetable farmers generally are in a prosperous state. The same problem is also faced by vegetable farmers, where, it is found that farmers get the lowest index, with a value of 6.47, which can be stated as very poor farmers, on the other hand there are farmers who get the highest index, with a value of 238.29, who can say as farmers rich. So that when viewed from the level of farmers' welfare, the two agricultural models are still faced with the classic problem of income inequality among farmers.

5. Conclusion

The empirical facts explain that, the implementation of strategic cultivars (strawberries) on traditional cultivar agriculture (vegetables) actually cannot be fully adopted by rural farmers. If the measure of success comes from technical efficiency, it turns out there are still 40 percent of farmers who adopt strawberry cultivars, are not efficient in production, while for vegetable farmers only around 27 percent, this explains that the failure rate of strawberry cultivar production is still higher than vegetables. It should be a strategic cultivar with the adoption of more modern agricultural technology, has a high competitive value and more economical, able to create a high level of technical efficiency. In this problem the effort to implement strategic cultivars in rural traditional farming needs to be carefully planned by all parties concerned to introduce strategic cultivars to rural farmers, so that rural farmers are no longer faced with the uncertainty of farming certain crops, but instead have confidence strong to keep on producing cultivars that really have good production techniques.

From the results of analysis efficiency and distribution of agricultural products show the facts that all parties in the distribution channel have a high level of efficiency. For strawberry products the average has an efficiency level of 1.45, for vegetables an average of 1.20, the highest average value of distribution efficiency is in strawberry products, which means that the distribution channels for strawberry farming are better, this is very likely because the nature of the product is strategic (has high economic value), and local government support in creating strawberry agro-tourism that can boost price levels, accelerate distribution, which ultimately increases the value of selling strawberry agricultural products. For vegetable products, they still survive using traditional distribution channels that run from generation to generation, without definite conditions. If the vegetable distribution channel gets the same touch, maybe you can talk differently.

From the results of analysis of farmer exchange rates, the average welfare level of farmers for both cultivars can be said to be prosperous. But in strawberry farming there are still 12 (40 percent) respondents of farmers who are not prosperous, and in vegetable farming there are only 8 (27 percent) farmers who are not prosperous. This fact also proves the implementation of strategic cultivars, does not directly improve the welfare of farmers evenly or still faces the classic problem of sustainable income inequality of rural farmers. The very high problem of income inequality in the level of welfare of farmers is a serious problem related to the social and economic problems of farmers, this problem requires a separate study to solve it.

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