International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 04 April 2023
DOI: 10.47191/ijcsrr/V6-i4-44, Impact Factor: 6.789
IJCSRR @ 2023
www.ijcsrr.org

Organic Fertilizer and Technical Efficiency in Melon Cultivation in Wonogiri, Central Java

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ABSTRACT: Melon (Cucumis melo L.) is a potential seasonal fruit crop. In melon cultivation, farmers combine various inputs. Combined inputs such as land, seeds, organic fertilizers, inorganic fertilizers, pesticides, labor. Organic fertilizer is now a promising method for sustainable agriculture where it is most affordable compared to synthetic fertilizers. The objectives of this study were (1) to determine the technical efficiency (ET) of melon farming, (2) to determine the effect of manure on melon production. (3) To determine the effect of age, formal education and farmer experience on the use of manure. Giriwoyo sub-district was chosen as the research location because it has the largest area of harvested land and the highest amount of melon farming production in Wonogiri Regency. Selection of farmer samples using accidental sampling technique. The number of respondents was 60 farmers. The conclusion from the results of the study that (1) the average technical efficiency of melon farmers is 96.7% classified as high criteria, (2) manure has a positive effect on melon production, thus the use of manure can increase melon production which will further increase technical efficiency. (3) Age, education and experience have a positive effect on the use of manure. The suggestions given are (1) to increase technical efficiency can be done by adding manure and (2) increasing the use of manure can be done by increasing age, education and experience. Increasing age as a proxy for information, namely by adding information, increasing knowledge with training and increasing experience can be improved by apprenticeship activities with other parties. Experience is a key factor to increase the use of manure.

KEYWORDS: Agriculture, Manure, Organic Fertilizer, Sustainable, Technical Efficiency.

INTRODUCTION

Melon (Cucumis melo L.) is one of the potential seasonal fruit crops to be cultivated [21]. Melon fruit is usually consumed as a dessert fruit for dessert [7]. Melon fruit contains a lot of water, important nutrients needed by the body, and a fairly high nutritional content such as vitamins A, C, potassium, niacin, fiber and folic acid. Melon also contains adenosine which functions as an anticoagulant that can prevent blood clots [13]. In addition, the nutritional content of melons can help increase body power and prevent various other diseases, so some people favor melons as one of the fruit choices for consumption, either directly or in processed form.

Good melon farming requires efficiency. The concept of efficiency is grouped into 3 namely technical efficiency, price efficiency and economic efficiency. This research focuses on technical efficiency. [19] stated that technical efficiency is the production function itself that describes the conditions of technical knowledge and ownership of certain inputs. Differences in efficiency are related to variations in several inputs, such as managerial or quality inputs, prices, and capital, as well as dynamic elements of producer behavior. Such gaps are either a form of delayed adjustment to changing conditions or are caused by the costs of making changes and uncertainty.

To produce melons, farmers combine various inputs. The combined inputs include land, seeds, organic fertilizers, inorganic fertilizers, pesticides, and labor. [14] stated that the use of agrochemacalia (inorganic fertilizers or inorganic pesticides) to increase productivity will lead to a decrease in soil quality and have an impact on human health and the environment. In melon cultivation, inorganic fertilizers are applied side by side with organic fertilizers. [18] stated that most farmers traditionally use inorganic inputs in agriculture due to availability in the market. Organic fertilizer is now a promising method for sustainable agriculture where it is most affordable compared to synthetic fertilizers. Organic fertilizers are produced from animal manure, crop residues, organic waste through earthworms and other agricultural by-products. It improves the physical, chemical and microbial status of the soil.

The organic fertilizer used by melon farmers is manure. Manure is a fertilizer made from animal manure. The function of fertilizer from animal manure is on agricultural land as an additional provider of nutrients for plants, simultaneously improving soil fertility

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and structure. The use of manure is an effort to create an organic farming system that produces healthier agricultural products. [18] stated that the industrial revolution followed by the green revolution led to increased yield per unit area in crop production, but they also increased the use of synthetic fertilizers in agriculture. The intensive use of inorganic fertilizers in agriculture causes so many health problems and irreversible environmental pollution. To reduce and eliminate the adverse effects of synthetic fertilizers on human health and the environment, new agricultural practices have been developed which are all called organic farming. Organic fertilizers include peat, animal manure, plant waste from farming, and treated sewage sludge while inorganic fertilizers include chemicals such as ammonium nitrate, potassium chloride urea, NPK etc.

Farmers, in melon farming, act as owners, workers and managers. As a manager, the farmer decides the amount and type of production inputs used and when they are applied. What is decided will affect the success or failure in melon farming. Farmers' decisions to use manure are influenced by the knowledge of farmers. [6] concluded that age, education level, and length of farming affect the level of knowledge of farmers. The more age, the more information obtained will be more extensive, the impact is that the knowledge is getting better. The longer the education, the more knowledge will be obtained. The more experience the more knowledge will be obtained. [15] state that farmers who are longer involved in farming activities will be more selective and precise in choosing the type of innovation to be applied, and more careful in the decision-making process. in carrying out their farming activities, but on the other hand, farmers who are less experienced will usually make decisions more quickly so that they will bear more risks. [8] understanding factors affecting farmers' use of fertilizers is crucial to develop strategies to improve its efficient use and to minimize its negative impacts.

The problem is whether there is still a possibility to increase production and technical efficiency that is more environmentally friendly. Of the various inputs used, organic fertilizer which in this case is manure is an environmentally friendly type of input. To reduce the environmental damage associated with high-input agriculture, farmers are increasingly required to maintain productivity while reducing synthetic fertilizer inputs [1]. The question is, could manure be an alternative? The objectives of this study were (1) to determine the technical efficiency (ET) of melon farming, (2) to determine the effect of manure on melon production. (3) To know the effect of age, formal education, and experience on the use of manure.

LITERATURE REVIEW

In stochastic frontier analysis, the farm is constrained to produce at or below the deterministic production frontier [5]. Stochastic frontier production function can be expressed as:

$Yi = (\ , \beta) + \varepsilon i = exp\ (Xi\beta + \varepsilon i\ )$

where i= 1, 2..., n, Yi = output level of the ith sample farm $f\ (\chi i\ ,\ _{\beta})$ = a suitable function such as Cobb-Douglas production functions χi = vector of inputs $_{\beta}$ = vector of unknown parameter to be estimated $^{\varepsilon}$i = the double component error term ($\varepsilon i = Vi - Ui$), vi is assumed to account for random effects on production associated with factors such as measurement errors in production and other factors in which the farmer does not have control over and Vi is a non-negative random term associated with farm-specific factors, which leads to the i th farm not attaining maximum efficiency of production. Thus, Ui measures the technical inefficiency effects variables which are under the discretion of the decision-making unit. The stochastic frontier approach specifies the technical efficiency of an individual farm as the ratio of the observed output to the corresponding frontier output given the level of inputs and technology used by the farm. The Technical Efficiency (TE) of the ith farm, defined relative to the estimated frontier output of an efficient farm using the same set of inputs [5]. [11] stated that technical efficiency is the difference between the observed product and the highest possible output from a group of input usage. The formulation is:

$TEi=Yi/f(Xi)e^{vi}=e^{-ui}$

TEi is technical efficiency; Yi is output ; Xi is input (; Vi is statistical error; ui is inefficiency.

METHODOLOGY

Giriwoyo sub-district was chosen as the research location because it has the highest harvested land area and production of melon farms in Wonogiri District. Location of Giriwoyo Subdistrict and Wonogiri Regency (Figure 1). Selection of farmer samples using accidental sampling technique. The number of respondents was 60 farmers. The data used were primary and secondary data.

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Figure 1. Map of Giriwoyo Subdistrict and Wonogiri Regency
Source: https://id.images.search.yahoo.com/search/images?p=peta+wonogiri

[11] stated that technical efficiency is the difference between the observed product and the highest possible output from a group of input usage. The formulation is:

$TEi=Yi/f(Xi)e^{vi}=e^{-ui}$

TEi is technical efficiency; Yi is melon output (kg); Xi is input (land area, seed, labor, manure, phonska, ZA, TSP, pearl, mutazeb); Vi is statistical error; ui is inefficiency. This measure of technical efficiency has a value ranging between zero and one ($0 \leq TEi \leq 1$). TEi measures the actual output of the i-th farm relative to the output that could have been produced fully efficiently using the same set of inputs. [4] stated that TE for the ith, ranging from 0 to 1, where 1 indicates that the farm is borderline and efficient. Furthermore, the technical efficiency category based . [17] can be divided into three levels. The three levels are low technical efficiency ($ET<0.65$), medium technical efficiency ($0.65 \leq ET \leq 0.91$), and high technical efficiency ($ET>0.91$). The mathematical formulation of the effect of inputs on outputs is approached by the Cobb-Douglas model, the formulation is

$Y=\alpha X_1^{\beta 1} X_2^{\beta 2} X_3^{\beta 3} X_4^{\beta 4} X_5^{\beta 5} X_6^{\beta 6} X_7^{\beta 7} X_8^{\beta 8} X_9^{\beta 9} e^{(v-u)}$

To determine ET and the effect of manure on melon production, Frontier 4.1 analysis tool was used. Furthermore, to determine the effect of age, education and experience on the use of manure, regression analysis was used.. The mathematical formulation is:

$PK=\alpha+\beta Xi + u$

Description PK is manure (kg); Xi is i = 1 is age (years); i = 2 is education (years). I = 3 is experience (years) and u is an error

RESULTS AND DISCUSSION

Technical Efficiency and Effect of Manure on Melon Production

The analysis shows that all farmers have applied their production inputs efficiently. Overall, the average ET was 96.7%. This can already be classified as high. However, it has not yet reached the frontier. None of the 60 respondents have reached 100% technical efficiency. To reach 100% it needs to be increased by 3.7%. Thus it is still possible to increase technical efficiency

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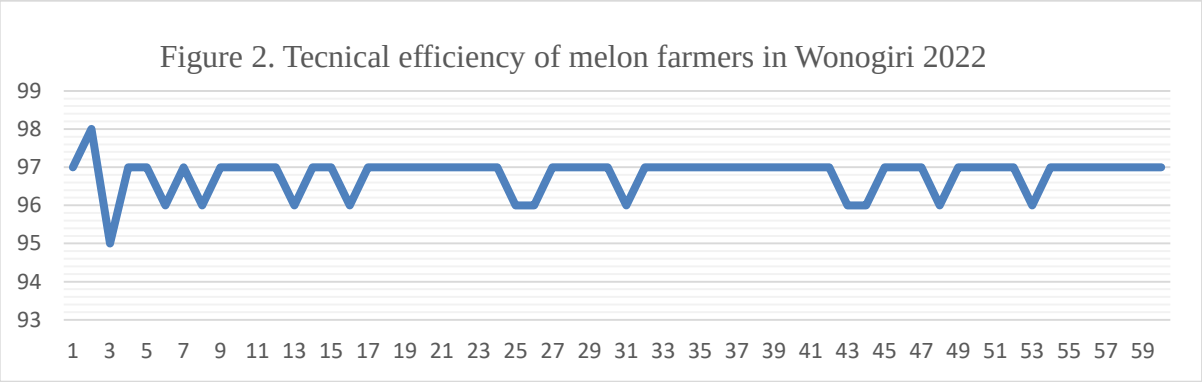

In melon farming, many types of production inputs are applied by farmers. Statistically, manure has a positive effect on melon production. Thus, increasing the use of manure can increase melon production. Furthermore, it can increase technical efficiency. With an elasticity of 0.42, it shows that a 10% increase in manure will increase melon production by 4.2%. This result is different from [8] which states that melon growth and yield are not affected by the type and dose of manure. The application of manure failed to improve soil fertility in the ultisol type. [1] stated that it has been widely recognized that the application of organic fertilizers in monoculture and continuous planting can change the microbial community and increase forage biomass on the Qinghai-Tibet Plateau. Thus, the preference for organic fertilizer is also high. [20] stated that organic fertilizer is a good source of nutrients for soil. It improves physical, chemical and biological characteristics. [12] organic fertilizers have been reported to increase the yield and quality of crops as well as soil properties. Production of organic based fertilizers help to convert wastes which would otherwise become a nuisance to the environment to environmentally friendly and agriculturally useful materials. [3] showed research results that revealed that land certification increased the likelihood of farmers using organic fertilizer by about 15%. Certification is proof of land ownership. In Wonogiri 100% of melon farmer respondents were tenant owners. The cheap price of manure is an incentive for farmers to increase the use of manure, In 2022 the price of manure in Wonogiri was relatively cheap at IDR 500/kg. As a comparison, the price of urea fertilizer is Rp 5,000/kg, the price of pearl fertilizer is IDR 19,000/kg.

Effect of age, education and experience on the use of manure

Regression analysis was used to determine the effect of age, education and experience on melon production. The results of the analysis showed that age, education and experience influenced the use of manure as shown in Table 2

Table 2. Results of regression analysis of the effect of age, education and experience on the use of manure in Wonogiri in 2022

Variabel	B	Std. Error	Beta	t	sig
(Constant)	-872.555	340.515		-2.562	.013
Age	13.601	5.070	.285	2.683	.010
Education	45.232	16.989	.280	2.662	.010
Experience	41.197	8.125	.515	5.070	.000
F	15.359				.000
R^2	.451				

Table 2 shows R^2 of 0.451, this model is able to explain the variation in manure use by 45.1% and 54.9% is explained by variables outside the model. Age, education and experience variables jointly affect the use of manure and partially the three variables affect the use of manure. All variables have positive coefficients. Age is a significant variable with a coefficient of 13.601 meaning that if age increases by 1 year it will increase the use of manure by 13.601 kg. Education has an effect with a regression coefficient of 45.232. If education increases by 1 year, it will increase the use of manure by 45.232 kg. Experience has an effect with a coefficient of 41,197kg. if experience increases by 1 year it will increase the use of manure by 41,197kg. Experience is the most important variable. this is indicated by the largest beta coefficient of 0.515. in connection with that to increase melon production experience

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is a key variable. [8] educational programs highlighting measures to improving nutrient-use-efficiency and reducing the negative externalities of N fertilizer over-use are proposed to address these problems. [10] show the result of logit model indicates that status of education, steep slope land, access of extension service, availability of composting material, fertility of farmland, sex and health status of household head influenced use of organic fertilizers.

CONCLUSIONS AND RECOMMENDATIONS

(1) The average technical efficiency of melon farmers that has been achieved at 96.7% is classified as high criteria, with a range of 96-97%. (2) Manure has a positive effect on melon production, thus increasing the use of manure can increase melon production which will further increase technical efficiency. (3) Age, education and experience have a positive effect on the use of manure. Suggestions (1) To increase technical efficiency can be done by adding manure and (2) Increasing the use of manure can be done by increasing age, education and experience. Age is related to information, therefore increasing information provided to farmers is a policy that can be done, education with training and experience with apprenticeship activities with other parties. Experience is a key factor to increase the use of manure.

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International Journal of Current Science Research and Review
ISSN: 2581-8341
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Cite this Article: Agustono, Evi Irawan, Isnarosan Suci Andriani (2023). Organic Fertilizer and Technical Efficiency in Melon Cultivation in Wonogiri, Central Java. International Journal of Current Science Research and Review, 6(4), 2643-2648