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Technical Efficiency 0f Onion (*Allium Cepa* L.) Farming in Anggeraja, Indonesia

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ABSTRACT

Background: The agricultural sector has a significant role in the Indonesian economy as a source of revenue for the country, promoting economic growth and employment, as well as providing the raw materials for industry, particularly the food and beverage processing industries. Horticulture (including onions) is included in the food crops subsector, which also contributes to the national GDP. (Abbreviations: DEA: Data Envelopment Analysis; GDP: Gross Domestic Product; NPK: Nitrogen, Phosphorus, Potassium; ZA: Ammonium Sulphate; SP-36: Super Phosphate)
Purpose: This study was aimed to measure the technical efficiency of onion farming in the District of Anggeraja, Enrekang, Indonesia.
Method: The samples consisted of 75 onion farmers who were chosen through random sampling. The model used to analyze technical efficiency was developed by Khumbakar.
Result: The analysis showed that the average value of technical efficiency in onion farming is already quite high.
Conclusion: Improved education, training in more advanced technologies, and improvements in the managerial capabilities of farmers who are associated with farm management are efforts that can increase the productivity of onion farming.

Keywords: Horticulture, models Kumbhakar, onion farming, Technical efficiency

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INTRODUCTION

The agriculture sector has a significant role in the Indonesian economy as a source of revenue for the country, promoting economic growth and providing jobs. In addition, the agricultural sector is also an important provider of the raw materials for industry, particularly the food and beverage processing industries or agro-industries. It is also a major pillar supporting the country's food security because of its contribution to the fulfillment of the consumption needs or the food needs of the majority of the Indonesian people.

Another advantage of the agricultural sector, compared to other sectors in the economy, is that agricultural production is based on domestic resources. In addition, because of the low import content of the raw materials and because the inputs used are generally from within the country, it is relatively more resilient when facing economic turmoil, eg, monetary fluctuations, whether they involve the exchange rate or are fiscal. The strength of the agricultural sector was proven during the monetary crisis, during which it was the largest contributor to foreign exchange. The amount of the agricultural sector's contribution to the national GDP cannot

be separated from that of the food crop, plantation crop, livestock, forestry and fishery subsectors.

Horticulture (vegetables and fruits) is included in the food crop subsector, which also contributes to the national GDP. There are several provinces in Indonesia that produce onions, namely Central Java, East Java, West Java, and West Nusa Tenggara, including South Sulawesi and North Sulawesi. Enrekang is one district that produces onions in the province of South Sulawesi. The production of onions in that district is still relatively low. According to the Agency for Agricultural Research and Development in 2002, the potential production of onions in Indonesia has reached more than 20 tons/ha.

The low production of onions in Enrekang can be seen in how the farmers allocate the production inputs used in farming. Based on a review of the theoretical and secondary data, the low or declining production of onions in Enrekang could be caused by several factors; among others, technical efficiency has not been achieved, and there are technical inefficiencies in the allocation of the production inputs used in farming .

The concept of production efficiency cannot be separated from the basic principles of economics: generating output/production with the optimum use of limited (certain) production factors or minimizing the cost to produce the output/specific production. Thus, production efficiency is a measure of the relative ability of companies in the use of inputs to produce a given output at a certain technological level. If these economic principles are applied by farmers to farming, they are trying to achieve an efficient use of the production factors. If farmers have not allocated their resources efficiently, there is potential that has not been harnessed optimally to increase their farms' income and to create a surplus. Conversely, if farmers have allocated their resources efficiently, then an additional contribution by the agricultural sector can be obtained only through growth-oriented business development. Thus, identify the efficient use of resources is important in determining the existence of a wide range of opportunities in the agricultural sector and is related to its potential contribution to economic growth and to improve in the welfare of farm households [1].

Research regarding the efficiency of onion farming carried out by [2], among others, has shown that, together, the factors of production of land, labor, fertilizer urea, NPK Mutiara, ZA fertilizer and pesticide liquids have significantly affected the production of onions in Brebes. In addition, the results of the study also showed that the combination of the factors of production used in onion farming was not efficient.

Research conducted by [3] regarding the efficiency and profitability of onion farming in Brebes showed that onion farmers are managing their working capital and input (the cost of production) effectively and efficiently. [4] use the Cobb-Douglas frontier production function approach to determine the effect of the production management and technical efficiency on the onion farmers' income in Brebes. The results showed that the land, seeds, pesticides and labor had a significant influence on the production of onions in Brebes. The average value of the technical efficiency achieved by the farmers was 81%. This shows that the technical efficiency that has been achieved by the onion farmers in Brebes is already relatively high.

Research regarding the efficiency of the use of the factors of production and farm income from onions in the District of Leces Probolinggo was conducted by [5] using the Cobb-Douglas production function and a regression. The study concluded that the factors that significantly affect the production of onions are land and labor, while the effect of fertilizer and seed was not significant. Another conclusion of the study was that the factors of production of land, labor, fertilizer, and seed were still not economically efficient.

Research of [6] results regarding the technical efficiency of onion farming in Bangladesh showed that the average technical efficiency of onion farming was 83%. This showed that there was still an opportunity for a 17% increase in output per hectare through the use of production technology.
Research conducted by [4] regarding the production management and technical efficiency of onion farming in Brebes using the Cobb-Douglas production function frontier showed that the factors that significantly influence the production of onions are acreage, seeds, pesticides and labor. The technical efficiency of farming red onions has an average value of 80%

1. MATERIALS AND METHODS

This study uses the survey method. The experiment was conducted in the District of Anggeraja, which was one of the centers for the production of onions in Enrekang in 2015. The data were obtained through interviews with onion farmers, and as many as 75 people were selected randomly (random sampling). The data

used are primary data and secondary data. Furthermore, the data collected were tabulated and analyzed according to the research objectives.

To analyze the efficiency and the risk behavior of farmers, we used a model developed by [7]. The functional form is as follows:

$$yi = \alpha_0 \Pi_{j=1}^{7} X_{ij}^{\alpha j} + \beta_0 \Pi_{j=1}^{7} X_{ij}^{\beta j}.e^{vi} - \gamma_0 \Pi_{j=1}^{7} X_{ij}^{\gamma j}.e^{ui} \quad (1)$$

Note:

$\alpha_0 \Pi_{j=1}^{7} X_{ij}^{\alpha j}$ is a function of the average

$\beta_0 \Pi_{j=1}^{7} X_{ij}^{\beta j}.e^{vi}$ is a function of the production risk

$\gamma_0 \Pi_{j=1}^{7} X_{ij}^{\gamma j}.e^{ui}$ is a function of technical inefficiency

y_i= the amount of the productivity of onion (kg/ha)
X_1 = the number of seeds used (kg/ha)
X_2 = the amount of labor used in onion farming (HKSP/ha).
X_3 = the amount of urea used in onion farming (kg/ha)
X_4 = the amount of fertilizer used in farming sun onion (kg/ha)
X_5 = the amount of insecticides used in onion farming (ltr/ha)
X_6 = the amount of herbicide used in onoin farming (ltr/ha)
X_7 = the amount of fungicide used in onion farming (kg/ha)
vi = error term which shows the uncertainty of the assumed production i.i.d $(0, \sigma_u)^2$
ui = technical inefficiency by assumed i.i.d $(0, \sigma_u)^2$ and u>0, ui are independent of vi.

2. RESULTS AND DISCUSSION

3.1. Profiles of the Farmer Respondents

The following profiles of the farmer respondents will be discussed: (1) The ages of the farmer respondents, (2) The level of education of the farmer respondents, (3) The experience in farming of the farmer respondents, (4) The number of family members of the farmer respondents, and (5) The area of land cultivated by the farmer respondents.

3.1.1. Age of the Farmer Respondents

Age is one factor that affects a person's ability to work and his productivity. Individuals have an increased ability to work with increasing age, but then, at a certain age, they experience a decreased ability to work. Age has an influence on the maturity of thinking and physical ability involved in the management of business respondents [8]. The distribution of the farmer respondents in the District of Anggeraja by age can be seen in (Table 1).

(Table 1) shows that the ages of the respondent farmers in Sub-Anggeraja mostly fall within the productive age range, that is, 98.67%, and 1.33% are less aged/unproductive. This suggests that the farmer respondents who grow onions are able to engage in optimal attempts to achieve results and higher profits, and are young enough to accept changes.

[Table 1 put it here]

3.1.2. Level of Education

The level of education affects the ability of farmers to accept innovation and information. The higher the farmers' education level, the easier it is for the farmers to understand and accept new innovations that are being delivered to them. Education can also be considered as an investment vehicle that is capable of helping to improve the knowledge, skills and expertise of the workforce as capital that will enable it to work more productively, thereby increasing its income in the future.

In addition to formal education, non-formal education also helps people/farmers in developing their businesses, as it is typically able to enhance the thinking patterns and technical skills of farmers. The distribution of the farmer respondents by level of education can be seen in (Table 2).

[Table 2 put it here]

(Table 2) shows that the education level of the respondent farmers who grow onions is primarily a high school education, which was attained by as many as 38 people (50.67%), while an elementary education was attained by as many as 21 people (28.00%). The level of education also determines whether individuals will easily receive knowledge and adopt new technologies that are beneficial for the improvement of their business activities.

3.1.3. Experience in Farming Red Onions

Experience in onion farming is represented by the length of time that the respondent farmers have engaged in onion farming, expressed in years. Experience is one of the determining factors in the success of farming. Generally, the longer a farmer manages a farm, the farmer is increasingly likely to know about or acquire

knowledge about how farming is done, and is also likely to adopt the technology used in farming. The distribution of the farmer respondents by farming experience is presented in (Table 3).

[Table 3 put it here]

(Table 3) shows that the experience of the farmer respondents who grow onions is mostly above 5 years, i.e., as much as 94.67%. This indicates that the respondent farmers have long-term experience in farming onions. Sufficient experience makes it easier to accept and choose innovations or technologies that are suitable and appropriate for use in farming.

3.1.4. Number of Family Members

The number of family members in a household indicates the magnitude of the burden borne by the head of the family. In addition, the number of family members can have a beneficial effect on the family economy because the family members can participate in a variety of activities, such as onion farming. The distribution of the respondents by the number of family members is presented in (Table 4).

(Table 4) shows that the number of farmer respondents who have 4-6 family members was as many as 57 people (76.00%). This reveals that the farmer respondents have no constraints regarding the availability of labor for farming.

[Table 4 put it here]

3.1.5. Area of Farming Land

Land is one of the main factors of production in managing a farm. The farming land area is the area of land occupied by the respondent farmers. The average size of the land owned by the farmer respondents is 0.74 ha. These results indicate that the area of land occupied by the farmers is somewhat cramped, and thus, it may be an obstacle in improving their agricultural production capacity. The distribution of the farmer respondents by the area of land occupied by farming is presented in (Table 5).

[Table 5 put it here]

3.2. Description of Shallot Farming at the Location of the Research

Red onions (Allium ascalonicum) are a seasonal horticultural crop that has high economic value. At certain times, there is often an excess supply in onion production, which can cause the price to plummet. This is worsened by the import policy applied by the government, which often exacerbates the decrease in the market price of onions. Onions thrive in dry climates with temperatures that are somewhat hot and in which they receive sunlight for more than 12 hours. Shallots grow well in lowlands and highlands (0-900 masl) with rainfall of 300-2500 mm/yr and temperatures of 25°C to 32°C. The types of soil that are optimal for the cultivation of onions are regosol, grumosol, latosol, and alluvial, with a pH of 5.5 7 [9].

In Enrekang Regency, certain areas produce onions, including the District of Anggeraja. Shallots are grown at an altitude of 400-850 meters above sea level. Generally, farmers plant onions between two to three times a year. The cultivation techniques performed by onion farmers in the District of Anggeraja are as follows.

3.3 Land Preparation and Planting

Before onions are planted in the land, the farmers engage in land preparation using a cultivator or a hand tractor, as well as hoes. Land management is carried out for two to three days, depending on the area of the land to be planted. In addition, in processing the area, they will also perform weeding. If the land has previously been planted with red onions, little time is required to remove the weeds. However, if the land is a newly cultivated, considerable time is required for weeding activities. The conditions in the location of the field study showed that the land planted with red onions had been planted previously.

The labor used for the preparation/processing of the land is that of the family members, as well as labor from outside of the family. If non-family labor is used, the wages for the land treatment are adapted to the number of seeds planted.

After processing, mounded beds are made in the land through the labor of the family members, although this task sometimes supported by non-family labor through mutual cooperation. The tools used to construct the raised bed/ridge are small spades or hoes. Furthermore, the basic NPK fertilizer, SP-36 and Ponska are spread in accordance with the land area that is cultivated. After completing the preparation of the beds, the land is left fallow for approximately one week before planting.

The planting is done by hand and is generally performed by workers outside of the family and female workers. The spacing used by the respondents varies from 20 cm x 20 cm, to 20 cm x 18 cm and 20 cm x 15 cm. Some farmers use seed selections resulting from the production of

the previous growing season and some buy them from traders. The varieties grown by the farmers are varieties from Bima, Surabaya and Maja Cipanas.

The seedlings will be planted, and the top ends will be cut at about 5-7 cm to accelerate the growth of the plants. If the seeds are planted during a dormancy period, then the tips of the seedlings are not cut too long, but if the seed's dormancy period is not long, the ends of the seedlings are cut longer.

3.3.1. Fertilization

Fertilization is performed three times: 10 days after planting with NPK fertilizer and ZA, 20 days after planting and 35 days after planting using Urea, NPK, ZA, Fertilizer Sun and several other kinds of fertilizers, such as pertipos and fertilizer c-organic.

The fertilization of the plants is performed 10 days after planting. In general, the farmers use urea, NPK, ZA, pertipos and Sun, with an average dose of 180 kg per hectare of urea, 40 kg ZA, NPK 55 kg, 196.3 kg of Fertilizer Sun. On average, fertilization is done three times before the harvest. Planting occurs two to three times a year. For the lowland areas, such as Mataran and Lakawan, planting occurs up to three times a year, and there is no crop rotation. This causes the level of pests and diseases to be very high, and they are known as areas/red zones. As for the plateau regions, such as Stone Noni, planting occurs twice a year, and the farmers do engage in crop rotation. Therefore, this area is known as a green zone. The levels of pests and diseases are not high.

3.3.2. Maintenance

The maintenance activities consist of grass weeding, spraying and irrigation. Weeding is done to remove the grass that grows around the onion crop so that its growth is not disturbed. The weeding is performed manually using hoes. At the time of the weeding, the weeded grass is not immediately removed from the land because it is useful as compost. The weeding occurs 20 to 25 days after planting.

Spraying is performed after the plants are 10 days old. For areas classified as red zones, the spraying is done at intervals of three to four days. This is done because the levels of pests and diseases in the red zones are very high. For areas classified as green zones, spraying takes place once a week. The pests and diseases that often attack the onion crops in the location of the research are phytopthora and fusarium wilt. The fusarium wilt disease is caused by a fungus. The symptoms are yellowing and twisted leaves. The bases of the stems rot. To handle the disease, the plants that die are pulled out and burned. Generally, farmers in Sub-Anggeraja spray using a fungicide to combat the plant diseases affecting red onions.

Irrigation activities are conducted three days, or they are adapted to the rainfall. If the level of rainfall is good, then watering is done once a week using sprinkler, and if the level of rainfall is less optimal, then watering is done twice a week. The sources of water used by the farmers are the mountains and rivers, so when rainfall is less optimal, or there is a dry season, the farmers often experience water scarcity, and vice versa during the rainy seasons, when they have excess water.

3.3.3. Harvest

Red onions can be harvested approximately 60 days after planting. The characteristics of onion plants that are ready to harvest are that 60-70% of their leaves have fallen, the leaves have a yellow color, and a tuber has already emerged. The onion harvest is performed manually, as the plants are pulled by hand. Generally, the harvesting of the plants is conducted through the labor of male and female workers. The harvesting is done according to a wage system of IDR 50,000 per day per person.

The red onions that are harvested are then collected under a hood for drying. If the weather is good, then the drying takes approximately 10 days, and if the weather is not optimal, the drying takes longer. Once the onions are dry, binding occurs. The labor involved in the binding process is performed by women. Usually, this work is done in bulk at a cost per tent between IDR 150,000 - IDR 200,000. After the binding, the onions are put in sacks. On average, each bag contains 50 kg of onions (the roots are not removed, and the leaves are dried).

Furthermore, the onions that have been tied are transported back to the farm using motorcycle taxi transportation. The labor involved in this activity is performed by men. The freight costs are between IDR 15,000 – IDR 20,000 for transportation.

3.4. Technical Efficiency in Red Onion Farming

A technical efficiency analysis aims to determine the level of technical efficiency of a farm. [10]and [8] found a high level of efficiency, which reflects that the farmers' managerial skills are sufficiently high. The mastery of information and decision-

making in managing the factors of production will affect the productivity of a farm. In addition, a high level of technical efficiency can also reflect that the opportunities to improve productivity are quite small, because the gap between the level of productivity that has been achieved and the maximum level of productivity that can be achieved with the best management system (the best practice) is quite narrow. This means that in order to increase the productivity of a real farm, the innovations that are needed will require more advanced technological breakthroughs from research activities.

Based on the results of the technical efficiency analysis, the average value of the technical efficiency of onion farming in the district that has been classified as Anggeraja Enrekang is 0.98. The onion farmers' mastery of the cultivation technology is already at a satisfactory level. The efficiency value indicates that the opportunity for increased productivity through increased technical efficiency based on the available technology is very limited, at only about 2%. A policy of increasing productivity through technical efficiency can be implemented based on an individual farm's performance through the education of farmers and through agricultural extension.

The results of research conducted by [11] showed that onion farming in the villages of Sukasari Kaler, the Districts of Argapura and Majalengka, and West Java Province have a technical efficiency value of 72%, which indicates that there are still opportunities for farmers to increase their production in onion farming in order to achieve maximum production. Further, the results of the research conducted by [12], which were based on the analysis of the relative efficiency of onion farming in Bantul using the Data Envelopment Analysis (DEA) approach, concluded that the majority of onion farms in Bantul were not efficient.

3. CONCLUSIONS

Based on the results of studies using quantitative descriptive analysis, it can be concluded that the levels of technical efficiency achieved in onion farming in the District of Anggeraja and the Enrekang Regency are already quite high. Therefore, to increase the farmers' income, there is a need to use more advanced technology and crop rotation to reduce attacks by pests on the onion crops.

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