The Profitability of Sweet Potato Farming in Karanganyar Regency, Central Java

R Anggraeni¹, Kadarso¹, BT Sumbodo¹, WA Munandar¹, and SR Ika²

¹ Faculty of Agriculture, Janabadra University Yogyakarta, Jl. TR Tentara Rakyat Mataram 55-57 Yogyakarta, 55231, Indonesia
² Faculty of Economics and Business, Janabadra University Yogyakarta, Jl. TR Tentara Rakyat Mataram 55-57 Yogyakarta, 55231, Indonesia

E-mail: ri_nies@janabadra.ac.id

Abstract. Sweet potato production in Indonesia is spread across several provinces, including Central Java, with a harvest area of 6,348 hectares (ha), production of 145,068 tonnes, and productivity of 228.51 quintals (Ku)/ha. One of the regencies with the largest harvest area is the Karanganyar Regency, with a harvest area of 868 hectares. This present study aims to analyze the cost, revenue, income, profit, and profitability of sweet potato farming in Karanganyar Regency. Besides, the study also analyses the efficiency of farming. In this study, the analysis of sweet potato farming costs is calculated using explicit costs and implicit costs. Implicit costs include the cost of seeds and labor in the family. The explicit costs include labor outside the family, fertilizer, pesticides, taxes, equipment depreciation, and own capital interest. Forty sweet potato farmers located in Tawangmangu and Ngargoyoso District, Karanganyar, were used as samples. The sample utilizes a simple random sampling method. The data analysis used is the analysis of costs, revenues, income, profits, efficiency, profitability. Data was obtained from an interview and questionnaire to the respondents. Results of descriptive statistics indicate that the revenue received is IDR 99,488,080 per hectare, while the explicit and implicit costs are IDR 8,068,714 per hectare and IDR 26,906,990 per hectare, respectively. The farming generates income IDR 91,419,366 per hectare and obtains a profit of IDR 64,512,376 per hectare. Sweet potato farming is classified as efficient and profitable with an efficiency value of 2.8 per hectare and a profitability value of 1.8.

1. Introduction

Sweet Potatoes (*Ipomoea batatas* L.) or yams are a type of cultivated plant. The part that is used is the roots that form tubers with high levels of nutrients (carbohydrates) [1]. In Africa, sweet potato tubers are an essential staple food source [2], while in Asia, besides being used for the tubers, young sweet potato leaves are also made a vegetable. It is a local food ingredient that is the fourth source of carbohydrates after rice, corn, and cassava[3]. Carbohydrates are needed daily to provide energy for the human body to maintain, grow, work, and replace damaged body tissue [1][4]. Human life is not possible without the availability of nutritional sources [2].

Based on the Food and Agriculture Organization (FAO) data, Nigeria is the largest sweet potato producing country in the world. The FAO noted that throughout 2016 the amount of sweet potato production in Nigeria was 44,109,615 tons and made the country the number one sweet potato producer
globally. [1][5][6]. Indonesia is included in the top 10 sweet potato producer countries. The production of sweet potato in Indonesia each year has increased an average of 6.01%.

According to data of the Ministry of Agriculture, Sweet potato production in Indonesia is spread across several provinces, including Central Java Province, which ranks number thirteen as a producer of sweet potatoes or yams with a harvest area of 6,348 hectares (ha), production of 145,068 tonnes and productivity of 228.51 quintals (Ku)/ha, in 2018. One of the regencies with the largest harvest area is the Karanganyar Regency, with a harvest area of 868 hectares. According to the Central Statistical Bureau, Karanganyar Regency is the area with the most massive production volume in Central Java Province, namely 28,914 tons in 2018, with a harvest area of 720 ha with productivity of 401.36 Ku/ha.

With the increase in a harvested area based on 2017 data, sweet potato production in Karanganyar Regency has increased enormously. This shows that sweet potato is a commodity that is currently in high demand by farmers. Increasing the yield of sweet potato production will increase the profit received by farmers [1][7][8][9]. Hence, it is necessary to analyze sweet potato farming to determine profit, analyze farm profits, and analyze the efficiency of sweet potato farming obtained. Therefore, this study aims to analyze the number of costs, revenue, income, and profit of sweet potato farming; further, this study also attempts to analyze the efficiency of sweet potato farming in the Karanganyar Regency.

2. Literature review and hypotheses development
Agricultural science is the study of how a person cultivates and coordinates production factors in land and natural surroundings as capital to provide the best possible benefit. The farming analysis is intended to determine the level of net income or profit in farming. Net income or profit earned is highly dependent on the total revenue and costs incurred to produce production [10]. Explicit cost is the cost that is the actual incurred in obtaining a factor of production. Implicit cost is the estimated cost of production factors owned by farmers and used in the production process. Income has a close relationship with the production level achieved. If production increases, income will also increase. Income is the difference between the revenue earned and the total costs incurred by a farmer. Profit is the difference from the farmer's income minus family wages and interest on his capital. Farming is said to be efficient if the use of resources produces output that exceeds the input. Profitability is the company's ability to generate profits. Profit itself is the amount left after considering all non-operating income and expenses, such as interest income or dividend receipts and interest expenses.

Several studies have been done to conduct investigations related to sweet potato farming income. In Indonesia, for example, [6] focuses on production. At the same time, these subsequent studies examine the income level of sweet potato farming [11][12] observes the efficiency of sweet potato farming, while[13] added value of purple sweet potato processing. There have also been several studies abroad, for example [14] in Benin, [2] in Nigeria, [15] in India, [16] in Pakistan, [17] in the Philippines. The difference between this present study and previous literature is that the research above has not calculated farm profitability. The profitability analysis would give a new source of references related to sweet potato farming. This study predicts that the sweet potato farming in the sample is profitable and efficient. The hypotheses are stated as follows.

H1: Sweet potato farming in Karanganyar Regency is efficient
H2: Sweet potato farming in Karanganyar regency has a profitability of more than 0 (is profitable).

3. Research method
3.1. Data and sample
The present study uses descriptive statistics to analyze the data [18] gathered from a survey [19]. The research was conducted in Karanganyar Regency, one of the potato producing areas in Central Java. Sampling is done by purposive. Purposive is a technique of determining the location of research intentionally based on specific considerations. The districts of Tawangmangu and Ngargoyoso were chosen with respect to the production area, the highest average production and yield of sweet potatoes
The population of farmers who cultivate sweet potatoes is 499 farmers. The number of samples was 40 farmers, taken by a simple random sampling technique, namely random sampling [10]. The data in this study came from primary and secondary data. Primary data is data obtained directly from direct sources. Secondary data is data obtained from indirect sources covering matters related to this study's research question, such as production, productivity, and a land area of sweet potatoes.

3.2. Variable definition

Farming cost analysis is the value of all production factors used, both in the form of objects and services during the production process. The production costs consist of land rent, capital interest, cost of production facilities for seeds, fertilizers, medicines, and labour. Analysis of sweet potato farming costs is calculated using explicit costs and implicit costs. Implicit costs include the cost of seeds, the cost of labour in the family. The explicit costs include the cost of labour outside the family, the cost of fertilizer, the cost of pesticides, taxes of renting one's own land, equipment depreciation, and own capital interest.

Farming revenue is the amount of total production value; that is, all output produced from a farm is multiplied by the price per unit of output. Revenue can be calculated from the sale, exchange, or re-appraisal. Income is the difference between revenue and costs incurred. The farmer's income can be calculated by the cost of external equipment and with outside capital. The net income can be calculated by reducing the gross income with the operating expenses. The cost of cultivating is the cost of external equipment plus the wages of the family's labour, calculated based on the salaries paid to outside workers [12]. The profit is the difference between farm revenue minus the total cost of farming [10].

Farming is said to be efficient if the use of resources produces output that exceeds the input. Efficiency includes three definitions, namely technical efficiency, allocative efficiency (price), and economic efficiency. Profitability is the company's ability to generate profits. Profit itself is the amount left after taking into account all non-operating income and expenses, such as interest income or dividend receipts and interest expenses.

The analysis of sweet potato farming costs is stated in the following equation[10].

Farming cost analysis

\[ TC = EC + IC \]  (1)

Where:
- \( TC \): Total Cost (Rp or IDR)
- \( EC \): Explicit Cost (Rp or IDR)
- \( IC \): Implicit Cost (Rp or IDR)

The revenue of sweet potato farming is the money obtained from the sale of goods or products, stated in the following equation[10].

\[ TR = Q \times P \]  (2)

Where:
- \( TR \): Total Revenue (Rp or IDR)
- \( Q \): Production (Ku) / (Quintal)
- \( P \): Price (Rp or IDR)

The Income of sweet potato farming is stated in the following equation

\[ I = TR - EC \]  (3)
Where:
- $I$: Income Farm (Rp or IDR)
- $TR$: Total Revenue (Rp or IDR)
- $EC$: Explicit Cost (Rp or IDR)

The profit of sweet potato farming is stated in the following equation \[10\][16]

\[
\pi = TR - TC
\]
\[4\]
\[
TC = EC + IC
\]
\[5\]

Where:
- $\pi$: Profit (Rp or IDR)
- $TR$: Total Revenue (Rp or IDR)
- $TC$: Total Cost (Rp or IDR)
- $EC$: Explicit Cost (Rp or IDR)
- $IC$: Implicit Cost (Rp or IDR)

The efficiency analysis is calculated by the Return Cost Ratio using the following equation \[10\].

\[
R/C \text{ Ratio} = \frac{R}{C}
\]
\[6\]

Where:
- $R$: Revenue (Rp or IDR)
- $C$: Cost (Rp or IDR)

Criteria:
- $R/C \text{ Ratio} < 1$: sweet potato farming is not efficient (loss) means that the hypothesis is rejected
- $R/C \text{ Ratio} = 1$: sweet potato farming (break even point)
- $R/C \text{ Ratio} > 1$: efficient (profitable) sweet potato farming means that the hypothesis is accepted

Analysis of the profitability of sweet potato farming using the following equation \[10\]

\[
\text{Profitability} = \frac{\pi}{TC}
\]
\[7\]

Where:
- $\Pi$: Benefits of sweet potato farming (Rp or IDR)
- $TC$: The total cost of sweet potato farming (Rp or IDR)

Criteria:
- Profitability $> 0$, means that sweet potato farming is profitable, meaning that the hypothesis is failed to reject.
- Profitability $= 0$, it means that sweet potato farming has BEP
- Profitability $< 0$, means that sweet potato farming is not profitable, meaning that the hypothesis is rejected.
4. Results and discussion

4.1. Characteristics of farmer

The characteristics of farmer describe the condition of farmers in general and farmer backgrounds which may influence farmers in running their business. The characteristics of the sample farmers are illustrated in Table 1.

**Table 1. Characteristics of sweet potato sample farmers in Karanganyar regency**

| Description                                                        | Sweet Potato |
|----------------------------------------------------------------------|--------------|
| Number of farmer (people)                                           | 40.00        |
| The average age of farmers (years)                                  | 57.00        |
| The average farmer education (years)                                | 7.00         |
| The average number of farmer family members (people)                | 4.00         |
| The average number of active family members in UT sweet potato (person) | 1.00        |
| The average area of land under cultivation (Ha)                     | 0.25         |
| Average farming experience (years)                                  | 31.00        |

Source: Primary data analysis.

Based on Table 1, the average age of sweet potato farmers is 57 years. The age is included in the productive age. The average education for farmers is seven years, equivalent to graduating from elementary school. The average population is four people with 1 person active in farming. The average land area is 0.25 ha. The average experience of farmers in cassava farming is quite a long time, which is about 31 years.

4.2. Analysis of sweet potato farming in Karanganyar Regency

This section provides an analysis of the cost, revenue, and income of sweet potato farming. First, we present the production facilities used in farming, consisting of seeds, fertilizers, chemical drugs, and labour. It is provided in Table 2.

**Table 2. The average usage of production facilities and labour in sweet potato farming in Karanganyar Regency in 2020**

| Type Input                        | Sweet Potatoes | Ha   |
|-----------------------------------|----------------|------|
| Means of Production               |                |      |
| a. Seedlings (kg)                 | 50.68          | 202.72 |
| b. Fertilizer (kg)                |                |      |
| - Cages                           | 324.06         | 1,296.24 |
| - Phonska                         | 58.89          | 235.56  |
| - SP-36                           | 38.27          | 153.08  |
| - KCl                             | 12.9           | 51.60   |
| c. Chemical medicine (ml)         |                |      |
| - Rat drops                       | 61.37          | 245.50  |
| Labor                             |                |      |
| a. Outside Labor (HKP)            | 17.95          | 71.8   |
| b. Family Labor (HKP)             | 7.56           | 30.26  |

Source: Primary data analysis.
Based on Table 2, the average use of sweet potato seeds is 50.68 kg/farm or 202.72 kg/ha. The average use of manure in sweet potato farming is 324.06/farm or 1,296.24 kg/ha.[20]. Farmers can rarely provide manure up to 5-10 tonnes/ha, so farmers choose to use chemical fertilizers compared to organic fertilizers. The highest use of chemical fertilizers is Phonska fertilizer, which is 235.56 kg/ha or 58.89 kg/farm on average. The average use of SP-36 fertilizer in sweet potato farming is 153.08 kg/ha or 38.27 kg/ha.

Recommendations for sweet potato fertilization from the agriculture department for every 1 ha are 100 kg urea fertilizer, 100 kg phonska fertilizer, 75 kg SP-36 fertilizer, and 1250 kg organic fertilizer. The use of phonska and SP-36 fertilizers is higher than the Agriculture Office's recommendation; this is because farmers feel that their production is still not optimal and then add their own fertilizer doses. Meanwhile, urea fertilizer is not given because farmers think that using urea can reduce the productivity of sweet potatoes.

In sweet potato farming in Karanganyar Regency, farmers do not spray pesticides. Instead, using a mouse drops an average of 245.50 ml/ha or 61.37 ml/farm. The use of labour is calculated in HKP (Men's Working Days) 7 hours/day. The average use of labour in sweet potato farming is 71.8 people/ha outside labor or 17.95 people/farm, and 30.26 people/ha or 7.56 people farming.

Table 3 shows the explicit costs, costs that are the actual incurred during the farming process. Based on table 3, the average explicit cost of sweet potato is IDR 8,068,714/ha or IDR 2,144,678.5 per farm. The highest cost is labour costs, which is IDR 4,695,000/ha or IDR 1,173,750/farm or 58.2% of the total cost of farming. The average cost of production facilities is IDR 2,968,714/ha or IDR 742,178,714/farm or 36.8%, and the rest is other costs including land tax and salvation, which is IDR 405,000/ha or IDR 228,750/farm or 5%. The amount of money spent on salvation between small and large areas is the same. Besides, not all farmers carry out salvation activities. The amount of land tax depends on the agricultural land condition; if it is flat and easily accessible, the tax value is higher.

### Table 3. Average explicit costs of sweet potato Farming in Karanganyar Regency in 2020

| Cost Type               | Sweet Potatoes |   |   |
|-------------------------|----------------|---|---|
|                         | (0.25Ha)( IDR) | Ha ( IDR) | %  |
| Production Costs        | 742,178.5      | 2,968,714 | 36.8|
| a. Fertilizer           |                |   |   |
| - Cages                 | 162,031.50     | 648,126.00 | 7.67 |
| - Phonska               | 204,312.50     | 817,250.00 | 7.86 |
| - SP-36                 | 113,625.00     | 454,500.00 | 5.38 |
| - KCl                   | 96,750.00      | 387,000.00 | 6.67 |
| b. Chemical drugs       |                |   |   |
| - Rat Drops             | 165,459.50     | 661,838.00 | 9.47 |
| Outside Labor Costs     | 1,173,750.00   | 4,695,000.00 | 58.2|
| Other Costs             | 228,750.00     | 405,000.00 | 5.00 |
| a. Salvation            | 170,000.00     | 170,000.00 | 1.87 |
| b. Land tax             | 58,750.00      | 235,000.00 | 2.70 |
| Total                   | 2,144,678.5    | 8,068,714.00 | 100.00|

Source: Primary data analysis.

Table 4 shows implicit costs, costs that are not actually incurred during the farming process.
Table 4. Average implicit costs of sweet potato farming in Karanganyar Regency in 2020

| Cost Type             | Sweet Potatoes (0,25 Ha)(IDR) | Ha (IDR) | %  |
|-----------------------|-------------------------------|----------|----|
| Family Labor Cost     | 567,187.50                    | 2,268,750.00 | 8.43 |
| Depreciation Cost     | 136,658.00                    | 546,632.00 | 2.03 |
| Seed Costs            | 101,375.00                    | 405,500.00 | 1.51 |
| Own land rent         | 5,681,250.00                  | 22,725,000.00 | 84.45 |
| Own Capital Interest Cost | 240,277.00                  | 961,108.00 | 3.58 |
| Total                 | 6,726,747.50                  | 26,906,990.00 | 100.00 |

Source: Primary data analysis

Based on table 4, the highest implicit cost if incurred is the cost of renting the land itself, which is IDR 22,725,000/ha or IDR 5,681,250/farm or 84.45% for family labor costs in sweet potato farming of IDR 2,268,750/ha or IDR 567,187.5/farm or 8.43% and depreciation cost of IDR 546,632/ha IDR 136,658/farm or 2.03%. Depreciation costs are obtained from the depreciation of the equipment used to cultivate sweet potatoes, such as hoes, sickles. The value of seeds is obtained from the number of sweet potatoes used multiplied by the prevailing price. The cost of capital interest itself is obtained from the investment issued multiplied by the Central Java bank interest rate, which is 7%. The average implicit cost of sweet potato farming is IDR 26,906,990/ha or IDR 6,726,747.5/farm.

4.3. Analysis of sweet potato farming revenue in Karanganyar regency

This section provides an analysis of sweet potato farming revenue that is illustrated in Table 5. Based on table 5, the average sweet potato production is 23,408.96 kg/ha or 5,852.24/farm with a selling price of IDR 4,250.00 / kg, the income is IDR 99,488,080/ha or IDR 24,872,020/farm.

Table 5. Average production, price, and revenue of sweet potatoes farming in Karanganyar Regency in 2020

| Description         | Sweet Potatoes (0.25 Ha) | Ha |
|---------------------|--------------------------|----|
| Production (Kg)     | 5,852.24                 | 23,408.96 |
| Price (IDR/Kg)      | 4,250.00                 | 4,250.00 |
| Revenue (IDR)       | 24,872,020.00            | 99,488,080.00 |

Source: Primary data analysis

4.4. Analysis of sweet potato farming income in Karanganyar regency

Table 6 provides the average income, profit, efficiency, and profitability of sweet potato farming in Karanganyar Regency in 2020. Based on table 6, the average income of sweet potato farming is IDR 91,419,366 /ha or IDR 22,727,341.5/ farm.

Table 6. Average revenue, income, profit, efficiency, and profitability of sweet potato farming in Karanganyar regency in 2020

| Description         | Sweet Potatoes (0.25 Ha) | Ha |
|---------------------|--------------------------|----|
| Revenue (IDR)       | 24,872,020.00            | 99,488,080.00 |
| Explicit Costs (IDR)| 2,144.50                 | 8,068.14 |
| Implicit Costs (IDR)| 6,726,747.50             | 26,906,990.00 |
| Income (1-2)        | 22,727,341.50            | 91,419,366.00 |
### 4.5. Profit analysis of sweet potato farming in Karanganyar regency

Based on table 6, it can be shown that the amount of profit obtained by sweet potato farming is IDR 64,512,376 /ha or IDR 16,001,000/farm. The amount of profit earned by sweet potato farming is IDR 64,512,376 /ha or IDR 16,001,000/ farm.

| Profits (1-2-3) | 16,001,000.00 | 64,512,376.00 |
|----------------|---------------|---------------|
| Efficiency [1/(2+3)] | 2.80          |
| Profitability [5/(2+3)] | 1.80          |

Source: Primary data analysis

### 4.6. Analysis of the efficiency of sweet potatoes in Karanganyar Regency

Table 6 shows that the efficiency value of 1.32 (ha) or 2.80 (farming) means that sweet potato farming is efficient because the R/C value is more than 1. These results are in line with research with an efficiency value of 2.1 and profitability of 1.8 shows that sweet potato farming is feasible to be cultivated[21].

### 4.7. The profitability analysis of sweet potato farming in Karanganyar regency

From table 6, it can be shown that the value of the profitability of sweet potato farming shows a result that is more than zero, namely 0.8 (ha) or 1.80 (farming), which means that sweet potato farming has reached a profit with a profitability value of more than zero. This result is in line with research [22] that sweet potato farming in Tawangmangu District is feasible to be cultivated with an R/C ratio of 2.79. Likewise, the research [12] obtained an R/C ratio of 2.1. Also results of the research showed that the average total cost of sweet potato farming per hectare was IDR 22,052,029.49 with an average total farm revenue of IDR. 63,444,198.78, so that the farm income reached IDR 41,392,169.29. Sweet potato farming is efficient, with an R/C value of 2.15[11].

### 5. Conclusion and limitation

The objective of this study is to analyze the cost, revenue, income, profit, efficiency as well as the profitability of sweet potato farming in Karanganyar Regency. Based on the study results, it was documented that the average sweet potato farming revenue was IDR 99,488,080 / ha or IDR 24,872,020 /farm with an explicit cost of IDR 8,068,714 / Ha or IDR 2,144,678.5 / farm and an implicit cost of IDR 26,906/Ha or IDR 6,726,747.5 / farm. The income is IDR 91,419,366 / ha or IDR 22,727,341.5/farm with a profit of IDR 64,512,376 / ha or IDR 16,001,000/farm. Sweet potato farming is classified as efficient and profitable with an efficiency value of 1.32 (farming) or 2.8 (ha) and a profitability value of 0.80 (farming) or 1.8 (ha).

This study's results may not be generalized to other locations even if it is similar farming as many factors may influence the profitability of sweet potato farming.

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