# Feasibility of Potato Farming in Pakis Sub-District, Magelang District

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**Abstract.** Potato crops play an important role in providing food and can generate income, employment opportunities, and livelihoods through potato farming. This study aims to determine the costs, profit receipts and feasibility of potato farming in Pakis District, Magelang Regency. The research location in Pakis sub-district was chosen because it has the largest land area but low production in Magelang district. The number of respondents was 50 farmers who were taken randomly from 113 potato farmers in Pakis sub-district. The analysis technique used descriptive analysis of cost, revenue and profit analysis as well as R/C analysis, capital productivity, labour productivity and land productivity. The results showed that on a land area of 1,830 $m^2$ potato farming requires a total cost of 16,760,225. The revenue obtained was IDR 30,475,380 and the profit was IDR 13,902,877. Based on the results of the R/C value of 1.84, capital productivity of 84%, labour productivity of IDR 261,578/workday, and land productivity of IDR 7,597/$m^2$, potato farming in Pakis District is feasible. Therefore, it is expected that potato farmers can improve and develop potato cultivation in order to generate greater profits.

## 1 Introduction

Agriculture is one of the mainstay sectors for national economic growth, especially in providing food and industrial raw materials, contributing foreign exchange through export activities, and increasing people's income. The contribution of the agricultural sector in national economic growth through export activities is increasing. In 2019, the agricultural sector contributed to the national economy by around 5.29 per cent and in 2020 it increased to 14.02 per cent [1]. Indonesia as a tropical country has considerable potential to develop horticultural commodities [2]. Demand for horticultural commodities is increasing along with changes in human lifestyles that require horticultural commodities to be of higher quality. In managing a farm, farmers strive so that the costs incurred can produce maximum products. So that in the end the farmer's income will increase [3]. Farm management not only includes how to produce maximum products, but more importantly how to increase the profit of a branch of business [4].

Potato (*Solanum tuberosum* L.) is one of the leading horticultural commodities in Indonesia. Potato is an economical food and rich source of energy [5]. In the world potato is considered as one of the fourth most important crops after maize, rice, and wheat [6]. Potatoes

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have the potential to improve the welfare of farmers' livelihoods due to high potato yields in a short growing season of 3-4 months [7]. The appeal of this vegetable lies in its tubers which contain a lot of carbohydrates, vitamin C, minerals, and protein [8]. Potatoes are also widely used by certain groups such as diabetics and supporting the intake of people who are on a diet because the sugar content contained in potatoes is relatively low [9]. Not only that, potatoes have good market prospects and can be stored for a long time [10]. Potatoes are generally used for cooking, in fact it is likely that approximately 50% of potatoes in the world are consumed raw and processed into food products, processed into starch for industry and then reused as seed tubers for reuse in the farming process [11]. Root crops including potatoes play an important role in food provision and can generate income, employment opportunities and livelihoods through potato farming activities [12]. According to FAO potatoes bring more yield per unit of agricultural land in a shorter period of time than any other major crop [13].

Provinces that have a large contribution to national potato production in Indonesia are Central Java, West Java, East Java, Jambi, and North Sulawesi [14]. One of the areas in Central Java Province that is a potato producer is Magelang District, which is considered to have potential for potato crop development. Geographically, the plateau of Magelang Regency—that is, a plateau inside the Mount Sumbing mountain pass in Central Java—is ideal for growing a variety of horticulture crops, particularly potatoes[15]. Pakis sub-district is one of the potato production centres in Magelang district. Pakis sub-district has an area with an altitude of 841m above sea level. According to the data of land area, production, and productivity of potato in Magelang district in 2021, Pakis sub-district has the lowest potato productivity and the third lowest potato production under Ngablak and Kajoran sub-districts. However, it has the highest potato cultivation land area compared to the other four sub-districts that cultivate potato crops.

Granola potato production is not optimal. One of the main obstacles in potato cultivation in Pakis Sub-district that results in low potato production in Pakis Sub-district is because Granola potatoes grown by farmers are very vulnerable to leaf blight attacks caused by the fungus Phytopthora infestans. Constraints in potato cultivation cause a decrease in productivity, especially during the rainy season because farmers have to spend more money to control pests and diseases that attack potato plants [16]. Potato conditions have an impact on production results that are not optimal both in terms of production quality and quantity of production which will result in revenue, income, and profits received by potato farmers. The action taken by farmers against potato farming constraints is the continuous spraying of pesticides which will have an impact on the high costs incurred in potato cultivation because farmers will increase production costs for the purchase of pesticides. Potato farming in Pakis District of Magelang Regency is a farm where most of the labour is dominated from within the family, in addition to the use of land and capital also comes from own or private property so it is necessary to see the feasibility of labour, land, and capital used by potato farmers in Pakis District of Magelang Regency. This study aims to a) determine the cost and profit of potato farming in Pakis District, Magelang Regency, b) determine the feasibility of potato farming in Pakis District, Magelang Regency.

## 2 Research Method

This research was conducted in Pakis sub-district of Magelang district with the consideration that Pakis sub-district is a potato producer with the largest land area but low production. The respondents were 50 farmers out of 131 potato farmers spread across 4 villages, namely Kaponan Village, Kenalan Village, Ketundan Village, and Kragilan Village. The data taken is data from the last harvest season, October 2022-February 2023. The analytical technique used is descriptive analysis of the amount of costs, profits, and feasibility of potato farming seen from R/C, capital productivity, land productivity, and labour productivity.

### 2.1 Total Cost

$$TC = TFC + TVC \tag{1}$$

Where, *TC* was total cost; *TFC* was total fixed cost; and *TVC* was total variable cost

### 2.2 Revenue

$$TR = Q \times P \tag{2}$$

where, *TR* was total revenue; *Q* was quantity; and *P* was price

### 2.3 Profit

$$\Pi = TR - TC \tag{3}$$

where, *Π* was profit; *TR* was total revenue; and *TC* was total cost

### 2.4 Feasibility Analysis

#### *2.4.1 Revenue Cost Ratio (R/C)*

$$R/C = \frac{TR}{TC} \tag{4}$$

where, *TR* was revenue and *TC* was total cost

#### *2.4.2 Capital Productivity*

$$Capital\ Productivity = \frac{Revenue}{Total\ Cost} \times 100\% \tag{5}$$

#### *2.4.3 Labor Productivity*

$$Labour\ Productivity = \frac{Revenue}{Total\ Labour} \tag{6}$$

#### *2.4.4 Land Productivity*

$$Land\ Productivity = \frac{Revenue}{Land\ Area} \tag{7}$$

## 3 Research Result and Discussion

### 3.1 Respondent Identity

The age of potato farmers in Pakis Sub-district is between 24 and 45 years old (Table 1). Potato farming in Pakis Sub-district is mostly done by potato farmers who are of productive age, aged between 15 and 64 years. Farmers who are classified as productive by age have good physical abilities, healthy body conditions, are able to absorb new innovations and are able to do business properly and optimally. Farming done by farmers who are still productive will get better results.

**Table 1.** Profile of Potato Farmers in Pakis District, Magelang Regency

| Category | Number (People) | Percentage (%) |
|---|---|---|
| **Age (years)** | | |
| 24-29 | 5 | 10 |
| 30-35 | 9 | 18 |
| 36-41 | 19 | 38 |
| >41 | 17 | 34 |
| Total | 50 | 100 |
| **Education Level** | | |
| SD | 19 | 38 |
| SMP | 18 | 36 |
| SMA | 12 | 24 |
| PT | 1 | 2 |
| Total | 50 | 100 |
| **Farming Experience (years)** | | |
| 1-8 | 13 | 26 |
| 9-16 | 28 | 56 |
| >16 | 9 | 18 |
| Total | 50 | 100 |
| **Land Area ($m^2$)** | | |
| 500-1500 | 22 | 44 |
| 1501-2500 | 24 | 48 |
| 2501-3500 | 1 | 2 |
| 3501-4000 | 3 | 6 |
| **Total** | **50** | **100** |

The education level of potato farmers in Pakis Sub-district is mostly at the elementary level as much as 38%. This shows that potato farmers in Pakis Sub-district do not have a high awareness of education. There are quite a lot of farmers who do not continue their education to the junior or senior high school level due to economic factors that force some farmers not to continue their education.

The length of time farmers has been doing potato farming activities is mostly in the range of 9-16 years at 56%. This shows that many farmers already have enough experience to manage and develop potato farms. The more experience farmers have, the better they can manage and develop their farms. The low experience of farmers in farming cannot be a benchmark for the success of farming activities. The longer the farming experience, the wider the knowledge in managing and handling problems during farming activities.

Land area for potato farming in Pakis Sub-district 92% of farmers have a land area below 2500$m^2$. The average land area for potato farming in Pakis Sub-district is 1,830 $m^2$ and it is known that most of the land used is owned land.

## 3.2 Potato Farming Analysis

Farming analysis is carried out to determine the amount of revenue, income, and profit. Potato farming takes 100-120 days for one growing season. So that potato farming can be done for 2 growing seasons in one year.

### 3.3 Potato Farming Cost

Inputs in potato farming consist of seeds, fertilizers, pesticides, and labor (Table 2). Variable costs in this study consist of seed costs, fertilizer costs, pesticide costs, labor costs. While fixed costs consist of land rent, tool depreciation costs and other costs.

**Table 2.** Potato Farming Cost per Growing Season in Pakis Subdistrict

| Type | Amount | Cost (IDR) |
|---|---|---|
| **Seedlings** | 254.47 | 5,511,820 |
| **Fertilizer** | | |
| 1. Manure (kg) | 6996.28 | 1,224,350 |
| 2. Prostal fertilizer (kg) | 736.18 | 22,085 |
| 3. NPK fertilizer (kg) | 91.12 | 667,416 |
| 4. SP 36 fertilizer (kg) | 69.97 | 419,815 |
| Total | | 2,333,666 |
| **Pesticide** | | |
| 1. Solid fungicide (kg) | 19.88 | 2,231,599 |
| 2.Insecticide (l) | 0.31 | 79,689 |
| 3. Liquid fungicide (l) | 0.04 | 9,837 |
| Total | | 2,321,125 |
| **Labor (man day)** | | |
| 1. Land Processing | 14.42 | 985,302 |
| 2. Planting | 2.34 | 150,166 |
| 3. Fertilization | 3.79 | 270,311 |
| 4. Pest Control plant | 16.20 | 1.331,688 |
| 5. Maintenance | 13.28 | 948,605 |
| 6. Harvesting | 2.90 | 236,926 |
| Total Labor | 53.15 | 3,933,013 |
| **Tool Depreciation** | | 389,946 |
| **Other Costs** | | 252,915 |
| **Land Rent** | | 1,380,000 |
| **Total Cost** | | **16,572,503** |

The cost of seeds for potato farming per 1,830m$^2$ per growing season in Pakis Sub-district is IDR 5,654,578 with the price of potato seeds at IDR 22,221 per kg. Potato farmers in Pakis Sub-district get Granola variety potato seeds from different places such as Wonosobo, Temanggung and Bandung, so the price of seeds obtained by farmers also varies. Potato growers can use harvesting technology, seed management, and seed propagation to reduce seed expenses [17]. seed potato source, variety wise seed use rate, seed replacement rate, seed size, variety wise potato yield and adoption and impact of seed potato quality on farmers' profitability.

Fertilizer costs for potato crops in Pakis Sub-district amounted to IDR 2,333,666 per 1,830 m2 per growing season. The highest use of fertilizer is in the use of manure amounting to 6,996.28 kg at a cost of IDR 1,224,350. Organic fertilizers used by farmers are chicken manure and prostal fertilizer. The types of inorganic fertilizers that are often used by farmers are NPK fertilizer and SP 36 fertilizer. In general, manure is used by farmers as a basic fertilizer in tillage because it can help increase land productivity and can increase agricultural production. The use of organic fertilizer from dry leaves is an alternative fertilizer that is environmentally friendly and more economical than chemical fertilizer to increase potato productivity and quality [18]. Inorganic fertilizers are used by farmers to help increase agricultural production. NPK fertilizer is used to increase the weight of potato tubers. While SP36 fertilizer is used to stimulate root growth and accelerate seed formation.

The amount of fungicide solid pesticide used was 19.88 kg, at a cost of IDR 2,231,559. This cost is the largest cost in the use of pesticides. Solid pesticide types of pesticides used by potato farmers in Pakis District include *mankozeb, besconil, cadilac, besromil, nativo*, *prima-zeb*, and chlorothalonil. The insecticide liquid pesticides used are *abacel* and *curacron*. The fungicide liquid pesticide used is z*ampro*.

The total cost of labor use was IDR 3,933,013 with a total labor of 53.15 workday. The highest labor cost is the cost incurred for the maintenance of integrated pest management. In addition to the cost of integrated pest management, the cost of land cultivation and maintenance also requires high labor costs. Farmers use outside family labor in the initial land cultivation process and farmers who have a large enough land area so that they need the help of outside family labor so that land cultivation activities do not take a long time. Some farmers also use non-family labor during the harvesting process because the more people there are, the faster the harvesting process will be, and the potatoes can be immediately sold to middlemen.

Fixed costs on tool depreciation costs in potato farming per one growing season in Pakis District amounted to IDR 389,946. The highest tool depreciation costs on the use of sprayers amounted to IDR 135,653. While the smallest tool depreciation costs in the use of rakes amounted to IDR 1,455. Rakes have a relatively cheap purchase price, and not all farmers use them.

Other costs in potato farming in Pakis Subdistrict per 1,830 $m^2$ per one growing season are IDR 252,915. Transportation costs of IDR 42,862 in Pakis subdistrict are usually used to transport harvested potatoes to the sorting or storage area. Potato farmers in Pakis Sub-district do not all use transportation to transport harvested potatoes because some are directly transported or taken by middlemen. The use of plastic mulch is high with an average use of IDR 210,053. Plastic mulch can be used about 4 times during the potato planting period. Potato farmers in Pakis Sub-district buy plastic mulch at IDR 700,000 per roll.

Own Land Rental Cost. The prevailing land rental price in Pakis Sub-district is around IDR 30,000,000/ha/year, so the cost of own land rental is IDR 1,830,000/$m^2$ for one potato growing season. The total cost of potato farming in Pakis Sub-district is IDR 16,572,503 per 1,830 $m^2$ in one growing season.

## 3.4 Potato Farm Revenue and Profit

Revenue can be interpreted as the value received from the sale of agricultural products which is the multiplication of the selling price with the production obtained [19]. The revenue obtained by farmers can be a measure of the success of potato farming activities.

**Table 3.** Cost and Income Analysis of Potato Farming (1,830 $m^2$) in Pakis District

| **Description** | **Total/Value** |
|---|---|
| Production Quantity (Kg) | 2,670 |
| Selling Price (IDR) | 11,414 |
| **Revenue (IDR)** | 30,475,380 |
| Total Cost (IDR) | 16,572,503 |
| **Profit (IDR)** | 13,902,877 |

The revenue earned from the 2,670 kg of production is IDR 30,475,380. Potato prices are not always fixed but can be volatile and erratic. The price of potatoes when the research was conducted was a good potato price, so the *resancakavenue* obtained by farmers was large. The profit from potato farming obtained by farmers during one growing season with a land area of 1,830 $m^2$ amounted to IDR 13,902,877 (Table 3).

Table 3 shows potato production of 2,670kg/1,830 or 14,590kg/ha. This potato productivity is higher than potato productivity in Magelang district, namely 111.14 kg/ha

[20]. It is hoped that the selling price of potatoes can get a high price so that it can increase the income and profits of potato farming. To maintain potato productivity and increase profits, government intervention is needed to create strong market relationships between producers and buyers and provide appropriate training to agricultural extension agents [7]. To increase the profitability of potato farmers, detailed information is needed about the source of potato seeds, the level of seed use by variety, the rate of seed replacement, seed size, yield and adoption of potatoes by variety [21].

### 3.5 Feasibility Analysis of Potato Farming

Feasibility analysis is one measure of the success of a farm. The feasibility analysis of potato farming consists of R/C, capital productivity, labor productivity and land productivity. The results of the analysis are listed in the following table.

**Table 4.** Feasibility Analysis of Potato Farming in Pakis District

| Description | Value |
|---|---|
| 1. Cost (IDR) | 16,572,503 |
| 2. Revenue (IDR) | 30,475,380 |
| 3. Profit (IDR) | 13,902,877 |
| 4. Land Area ($m^2$) | 1.830 |
| 5. Total Labor (workday) | 53.15 |
| **R/C (2/1)** | 1.84 |
| **Capital Productivity (%) (3/1 x 100%)** | 84 |
| **Labor Productivity (IDR/Workday) (3/5)** | 261,578 |
| **Land Productivity (IDR/$m^2$) (3/4)** | 7,597 |

*Revenue Cost Ratio* (R/C) The R/C value is the ratio between the potato farm income obtained by the farmer and the total costs incurred by the farmer. Potato farming will be said to be feasible if the R / C value is equal to one or more, if it is less than one then the farm is said to be unfit for cultivation, and if it is equal to one then the potato farm is not profitable and not detrimental. The Revenue Cost Ratio (R/C) analysis of potato farming in Pakis Sub-district for one growing season amounted to 1.84 (Table 4). The R/C value of 1.83 > 1 indicates that potato farming in Pakis Subdistrict can be said to be feasible, which means that for every IDR 100 spent on potato farming activities, farmers will receive IDR 183. There is significant potential to lower costs, increase yield and enhance overall profitability by using the existing better processes. By addressing the issues faced by small farmers their profits can be potentially doubled [22].

The capital productivity of potato farming in Pakis Sub-district in one growing season is 84%. The capital productivity value is greater than the bank loan interest rate of 6% per year or 3% in one growing season. The 84% value shows that potato farming in Pakis Sub-district is feasible because the capital productivity value is greater than the bank loan interest rate so that money is better used for potato farming than saved.

The value of labor productivity is IDR 261,578/workday, which indicates that potato farming in Pakis Sub-district is feasible. The value of labor productivity generated from potato farming of IDR 261,578/workday is greater than the prevailing labor wage of IDR 65,000 per person in one day. In other words, labor is better used to do potato farming than being a laborer.

The land productivity value for one growing season of potato farming with an average land area of 1,830 $m^2$ is IDR 7,597/$m^2$, indicating that potato farming in Pakis Sub-district is feasible because it has a land productivity value greater than the seasonal land rental cost of IDR 1,000/$m^2$ so that land is better used for potato farming than rented.

## 4 Conclusion and Suggestions

### 4.1 Conclusions

Potato farming in Pakis District, Magelang Regency with a land area of 1,830 $m^2$ requires a cost of 30,475,380. Potato production amounted to 2,670kg, revenue amounted to IDR 30,475,380, and profit amounted to IDR 13,888,705. Potato farming in Pakis Sub-district, Magelang Regency is feasible because it has an R/C value of 1.84, capital productivity of 84%, labor productivity of IDR 261,578, and land productivity of IDR 7,597 per $m^2$.

### 4.2 Suggestions

Potato farmers need to pay more attention to potatoes if symptoms of disease begin to appear during the potato cultivation process to reduce the use of pesticides that are too excessive. It would also be better if the early symptoms of potato growth began to be treated and not wait until the potato is already affected by the new disease given by pesticides so that the costs incurred for the purchase of pesticides are not too large. In addition, based on the feasibility analysis of potato farming, it is expected that potato farmers can improve and develop potato cultivation to generate greater profits.

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