

# Feasibility and production of soybean cultivation in Banyumas Regency, Central Java

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**Abstract.** The demand for soybeans always rises in line with population growth. Domestic soybean productivity has not increased in tandem with rising demand. Soybean productivity in Banyumas Regency has reached only 80 percent of Indonesia's soybean productivity. The research objectives were to analyze: 1) the feasibility of soybean cultivation, 2) factors affecting soybean production, and 3) the degree of efficiency in using soybean production factors. The research method used is survey. The research was conducted in Banyumas Regency from August to October 2022. The sampling technique used simple cluster sampling and selected 80 out of 1050 farmers. The data used is soybean production data for the 2021 planting season. The data analysis method used is the relationship between costs and revenues, the Cobb Douglas production function, and the Cobb Douglas economy. The findings revealed that: 1) agriculture is feasible because it has a positive profit value and more than one R/C; 2) land area, seeds, fertiliser, and labour have a significant impact on soybean production, whereas pesticides have no significant impact; and 3) the use of land, seeds, fertiliser, and labour inputs in soybean cultivation is inefficient when the BKM-NPM ratio is more significant than one.

## 1 Introduction

The agriculture industry has made a substantial contribution to economic growth in Indonesia, which is known as an agricultural nation. The agricultural industry is crucial to the national economy since it provides food ingredients. The agricultural sector is, of course, supported by aspects such as plantations, livestock, fisheries, food crops, and forestry [1]. Apart from being an agricultural country, Indonesia is also known for its large population. The large population must also be balanced with the increasing domestic food needs. The increasing yearly population will affect people's purchasing power to consume food. One of the food commodities is soybeans. This plant is a strategic food commodity with low prices and high protein sources. People's favorite foods in Indonesia are processed soybeans such as tofu, tempe, oncom, milk, and tauco [2].

Soybean demand is projected to increase from year to year. However, a gap has occurred between soybean production and demand in Indonesia for several years. On this basis, it causes Indonesia to import—in the last ten years, soybean imports increased sharply. Imports

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recorded in 2022 reached 171.62 million kilograms. Soybean production is unstable and tends to fluctuate, causing imports to occur besides high soybean consumption. Several countries also import, but some are used to manufacture animal feed [3]. Therefore, production has become important, especially for sufficient domestic consumption [4]. It is necessary to know strategies that study and developed to increase domestic soybean production, which can reduce import levels [5].

The importance of considering the financial aspects, in this case, profits, the feasibility of investment, and the level of risk to keep the business able to survive [6]. Determination of financial aspects that are worth using to provide an overview of business capability that has been running then can be evaluated to assist in making decisions for the future [7]. Financial feasibility is divided into several aspects, such as the use of input, financial reports, profit, and feasibility analysis, and the last part is the determinant analysis result of whether the business is feasible to continue or not based on the three previous aspects [8]. However, the current challenges many entrepreneurs face are management weaknesses and the absence of financial records, which impact entrepreneurs' ignorance of financial performance and lead to difficulties in obtaining capital [9].

Banyumas Regency is one of Central Java Province, Indonesia's regions with soybean-based industrial centers. Soybean production capability in Banyumas is still a problem in domestic soybean supply, so there is a gap between supply and demand. Efforts to optimize resource potential for soybean production continue to be carried out in various ways, such as land use, labor, capital, and other aspects. Given that farming practises are still basic and farmers have little access to information and innovation, the usage of appropriate production variables will also boost productivity in terms of efficiency. The description that has been provided informs the three goals of this study. The initial goal is to determine whether soybean farming is feasible in the Banyumas region. The second goal is to identify the elements that affect soybean output, and the third is to assess the efficiency of the Banyumas regency's soy production factors.

## 2 Method

This study is descriptive-analytic in nature. In Banyumas Regency, the study was carried out between August and October of 2022. Because Banyumas Regency is the hub of the soybean business in Central Java, Indonesia, the area was specifically chosen. The sample for this study was 80 soybean farmers in Banyumas Regency through cluster sampling from 1050 existing farmers. The research method used is a survey. Three districts were selected as research locations that contributed the most to soybean production in Banyumas Regency, namely Kebasen, Wangon, and Banyumas. 80 farmers were chosen from 1050 using the simple cluster sample sampling approach. In order to meet the first objective, it is necessary to first conduct an income study to ascertain how much money Banyumas Regency's soybean farmers make [10].

$$\pi = TR - TC \quad (1)$$

Information:

$\pi$  = Profit (IDR)

TR = Total Revenue (IDR)

TC = Total Cost (IDR)

R/C ratio analysis is used to assess the viability of soybean growing in Banyumas Regency and is based on the following formula [11]:

$$R/C \text{ ratio} = \frac{TR}{TC} \quad (2)$$

Criteria :

- R/C ratio > 1, it means farming is feasible to be developed
- R/C ratio = 1 means even farming
- R/C ratio < 1, it means farming is not feasible to be developed

To determine the factors influencing soybean production in Banyumas Regency, the Cobb-Douglas production function model was used with Ordinary Least Square (OLS) Method. The SPSS 22 software is the tool used to process the data. The causal relationship between the independent factors and the dependent variable is predicted using regression analysis. Regression analysis not only reveals the direction of the link between the independent and dependent variables, but also measures the degree of the association. Regression analysis is also employed since different farmers manage their soybean farms differently in terms of how much land area, fertiliser, and labour are used as inputs.

Furthermore, regression analysis can be used to form a production function model. The Cobb-Douglas production function model is used with the OLS (Ordinary Least Square) method to determine the factors that affect the level of soybean production. The basic model of the Cobb-Douglas production theory, namely equation [12]:

$$Y = A K^{\alpha} L^{\beta} \quad (3)$$

By breaking down the K and L variables in a more specific form, namely the independent variables used in this study, the production function becomes [12] :

$$Y = f(X_1, X_2, X_3, X_4, X_5) \quad (4)$$

By including all the independent variables of this study, the Cobb-Douglas function explains that the Cobb-Douglas production function is formulated as follows [12]:

$$Y = A X_1^{\beta_1} X_2^{\beta_2} X_3^{\beta_3} X_4^{\beta_4} X_5^{\beta_5} \quad (5)$$

The variables that were used to create the research model were also transformed. The common logarithm is the transformation employed. To examine how the independent factors affect the production of soybeans. The following are the requirements for this research model [12] :

$$\ln Y = \ln A + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + e \quad (6)$$

Information :

- Y = Soybean production (Kg)
- X1 = Land area (Ha)
- X2 = Amount of Seed Use (Kg)
- X3 = amount of fertilizer used (kg)
- X4 = Total use of pesticides (L)
- X5 = Total use of labor (HOK)
- A = Constant
- $\beta_1 - \beta_5$  = Regression coefficient
- e = Error

The level of efficiency in the utilisation of production elements in soybean farming is evaluated using a marginal approach. When the ratio of the production and marginal productivity values (NPMx) matches the input cost (Px), efficiency has been attained. It can be expressed mathematically as follows [13]:

$$bi. Y. Py = Px_i X_i \quad (7)$$

$$NMPx = Px \text{ or } \frac{NPMx}{Px} = 1 \quad (8)$$

$$\frac{bYPx}{x} = Px \text{ or } \frac{bYPx}{x.Px} \quad (9)$$

Information :

b = production elasticity

Y = production

Py = Y production price

X = number of factors of production X

Px = The price of the factor of production X

Criteria:

If  $\frac{NPMxi}{BKMXi} > 1$  indicates an inefficient use of production factors (adding more production factors is required).

If  $\frac{NPMxi}{BKMXi} = 1$ , it indicates optimal utilisation of production factors; and

If  $\frac{NPMxi}{BKMXi} < 1$  indicates to a need for fewer production factors since the utilisation of production factors is inefficient.

## 3 Result and Discussion

### 3.1 Cost, Revenue, Income Analysis, and R/C Ratio

A farmer's high revenue is by no means a guarantee that farming is financially feasible if production expenses are still high. This necessitates the use of the R/C ratio value to assess the viability of the soybean farming system created by farmers in Banyumas Regency as one of the primary food commodities. The examination of the profitability and viability of soybean growing in Banyumas Regency is based on a number of factors, including production costs, which are the sum of all fixed and variable costs borne by farmers. Input expenses utilised in soybean cultivation by farmers include fixed costs whose amount is unaffected by production volume and depreciation costs for agricultural equipment employed by farmers. Farmers, on the other hand, utilise variable costs in one production step. Several consumable factors, including the price of labour, labour costs, pesticides, fertilisers, and soybean milling, have an impact on this cost.

The result of production and the product's selling price, in this case soybeans, is the farmer's income. The whole value of produce obtained by farmers before deducting their production expenses is referred to as total revenue or gross income. In this project, farmers who grow soybeans earn income that is determined over the course of one soybean growing season. The amount of production that farmers acquire has a direct impact on their revenue from farming. Farmers' great productivity reflects the significant money they also earn. Perished revenue, which is the difference between soybean sales (production time price) and the total production costs incurred by farmers in Banyumas Regency, is the source of income used in this study. Farmers in Banyumas Regency generally earn varying amounts of money since everyone cultivates a different amount of land, which affects the inputs they utilise. The costs, revenues, and income that soybean growers in Banyumas Regency received are detailed in Table 1 below.

Table 1 shows how much the costs incurred by farmers when cultivating soybeans in one planting period. Some soybean farmers spend the highest costs, namely 3,368,657 rupiah per season, while some spend only 570,533 rupiahs per planting season. The average expenditure

of soybean farmers in Banyumas Regency reaches 1,566,697 rupiah per season. Differences in spending between farmers are, of course, due to differences in input use. The average variable cost of soybean farmers in Banyumas Regency is 1,452,942 rupiah per season. Naturally, the inputs provided by farmers with the highest costs—such as the quantity of seeds and labour they employ—will correspond to the high production facilities. Of course, the amount of input used depends on the land area. Farmers who incur low costs usually rely on the number of already available seeds and the use of labor in large families. Of course, the area of land owned by the farmer with the lowest cost will be different from the farmer who incurs the highest cost. Limited capital ownership also affects farmers' expenses, so farmers usually reduce input costs. The average expenditure of soybean farming is still quite reasonable; the availability of production facilities around the farmers also influences this. Discussing costs cannot be separated from fixed costs originating from several components such as land and equipment depreciation costs. The average depreciation cost of tools used by farmers is around 46,472 rupiah per season, while land costs have an average expenditure of 67,283 rupiah per season.

**Table 1.** Farmers' cost, revenue, and income of soybean farming in Banyumas District

No	Description	Cost (IDR/Season)	Revenue (IDR/Season)	Income (IDR/Season)
1	Highest	3,368,657	11,000,000	7,834,367
2	Average	1.566.697	3,728,925	2,162,228
3	Lowest	570,533	855,000	82,476

Table 2 also shows how big farmers in Banyumas Regency own the revenue of soybean farming. The highest income belonging to farmers reaches 11,000,000 rupiah per season, while the lowest revenue reaches 855,000 rupiah per season. The average revenue of soybean farmers reaches 3,728,925 rupiah per season. Of course, soybean farmers' revenue level is determined by how much production the farmers have and the price of soybeans when they sell them. The average soybean production owned by farmers reached 421, while the selling price of soybean farmers reached 8.912 rupiah per kilogram. Table 2 also provides information on the income received by farmers. The highest income earned by farmers reached 7,834,367 rupiah, while the lowest income earned was 82,476 rupiah. The average income of soybean farmers in Banyumas Regency reaches 82.476 rupiah. Of course, the greater the farmer's income, the greater the farmer's soybean production. This is in line with research by Osondu et al. (2014), which states that the amount of production is positively correlated with income [14]. The production amount is important in increasing farming because it is closely related to profits. Price, of course, also has an effect because it will be a return on investment that has been made [15].

**Table 2.** R/C Coefficients Ratio in Soybean Farming in Banyumas District

No	Description	R/C Ratio (Farmer)
1	R/C Ratio > 1	80
2	Average (R/C Ratio = 1)	0
3	Lowest (R/C Ratio < 1)	0
<b>Highest</b>		4.27
<b>Average</b>		2.26
<b>Lowest</b>		1.10

The R/C ratio coefficient is determined by contrasting the revenue generated by soy cultivation with the expenses incurred by soy farmers. This ratio is used to see whether the soybean cultivated by farmers is feasible. The R/C ratio is also used as an indicator later in

determining the direction of the development of agricultural products, especially food commodities such as soybeans in certain areas. The feasibility measure referred to also determines whether the soybean farming carried out is good to continue. If it is feasible, it can be said that the farmers are getting benefits. Still, if it is not feasible, it is necessary to know what problems are causing the farmers not to experience profits, whether the costs incurred are too large or the soybean production belonging to the farmers has decreased due to certain factors. The outcome of the soybean growing R/C ratio in Banyumas Regency is as follows.

The R/C values of soy growers in Banyumas Regency are shown in Table 2. All farmers have an R/C ratio value greater than 1, according to the R/C ratio calculation results. As a result of this claim, all soybean producers in Banyumas Regency are qualified to expand their operations. The lowest R/C ratio for farmers in Banyumas Regency is 1.1, while the highest is 4.27, according to Table 2. The R/C ratio of soybean growers in Banyumas Regency is 2.26 on average. According to the indication of the value obtained, farmers who invest one rupiah in soybean growing will at least receive a yield of 2.26 rupiah. The value of this R/C ratio also shows that Banyumas Regency soybean producers already make an average income that exceeds their expenses. Overall, Banyumas Regency could benefit from developing soybean growing. This is consistent with Nikoyan's research (2020), which claims that the extremely low utilisation of farmer input expenses [6] also makes a high R/C ratio attainable.

### 3.2 Factors Affecting Farmer Soybean Production in Banyumas Regency

The Douglas Cobb function was used to identify the factors affecting the production of soybeans owned by soybean farmers in Banyumas Regency. Classical assumptions are made first, then the normalcy test is examined. The normality test and classic assumptions used are the heteroscedasticity test and the multicollinearity test. The three tests have been carried out and passed all existing assumptions so that they can be continued in the analysis of factors affecting production, as shown in the table below.

**Table 3.** Results of Multiple Linear Regression Analysis of Factors Affecting Soybean Production in Banyumas Regency

Variable	Coefficient	t-statistic	Sig.
Constant	3.974***	10.372	0.000
Land Area	0.038**	2.138	0.036
Seeds	0.387**	3.610	0.001
Fertilizer	0.136**	2.119	0.037
Pesticide	0.025 <sup>ns</sup>	1.312	0.194
Labor	0.379***	5.057	0.000
R <sup>2</sup>			0.959
Adjusted R <sup>2</sup>			0.920
F			0.000

Information :

\*\*\* = significance at the 99% confidence level ( $\alpha = 0.001$ )

\*\* = significance at 95% confidence level ( $\alpha = 0.05$ )

\* = significance at 90% confidence level ( $\alpha = 0.1$ )

ns = not significant

The amount by which the independent variable may account for the proportion of the dependent variable is known as the coefficient of determination. Adjusted R<sup>2</sup> is an alternative to the coefficient of determination. The more the dependent variable is explained by the independent variable, the better the regression model utilised as indicated by a higher adjusted R<sup>2</sup> value. Based on Table 3, it can be observed that the adjusted R<sup>2</sup> value is 0.920,

or 92%, meaning that the variables of land area, number of seeds, fertilisers, pesticides, and labour can explain 92% of the variables related to soybean output, while other variables outside the model can explain the remaining 8%.

The F test seeks to determine whether all of the regression's independent variables concurrently have a substantial impact on the dependent variable. The significance level (F value, sig.) is contrasted with the value of 0.05. The independent factors significantly affect the dependent variable when the value of F sig. is less than 0.05. It is evident from Table 3 that the F sig is 0.000. Since this number is much lower than 0.05, it can be inferred that the factors land area, seed quantity, fertiliser application, pesticide application, and labour all have a sizable impact on the production of soybeans in Banyumas.

The t-test is a limited test designed to examine how a certain independent variable affects the dependent variable. The t-sig values are compared to perform this test. (importance) on each contributing factor's mistake rate. It can be inferred that the independent variables have a significant impact on the dependent variable if the t-sig. used is smaller than the. At the 99% confidence level, it is evident from Table 3 that the labour surplus has a large impact on soybean production. Additionally, soybean productivity is highly impacted by land area, seeds, and fertilisers, with a 95% confidence level.

The land area is smaller than 0.05 with a coefficient of 0.038 and a significance value of 0.036. This demonstrates that the amount of land has a big impact on soybean productivity. The link between the area of land used for soybean cultivation and the coefficient is positive. Soybean production will grow by 0.038% for every 1% increase in land area. With a coefficient of 0.387 and a significance level of 0.001, the number of seeds is less than 0.05. This demonstrates that the amount of land has a big impact on soybean productivity. The coefficient has a positive value, indicating a positive link between the amount of seed used in soybean production and yield. The production of soybeans will rise by 0.387% for every 1% increase in the use of sources. Therefore, more soybean plants can be planted to boost soybean yield the more seeds are used. This is consistent with research based on Moses' research (2017) on the technical efficiency of soybean production in Nigeria's Adamawa State, which found that labour, seed quantity, and cultivated land area have a significant impact on soybean production [16].

One of the inputs used in soybean production is fertiliser. The application of fertiliser has a regression coefficient of 0.136 and a significance value of 0.037, which indicates that it is less than 0.5. This demonstrates that the application of fertilisers significantly affects the output of soybeans in Banyumas Regency. The coefficient is positive, indicating a positive association between fertiliser use and soybean yield. Soybean production will rise by 0.037% if fertiliser is applied differently by 1%.

With a significance value of 0.000, or less than 0.001, the regression coefficient of labour use is 0.379, which is less than 0.001. This demonstrates how labour usage has a big impact on soybean production. The coefficient is positive, indicating a positive association between labour utilisation and soybean production. Production of soybeans will rise as more labour is employed. In other words, if 1% more people are employed, soybean production will rise by 0.379%. This is because soy farming requires a lot of labour, particularly during planting and harvest. This is consistent with the study by Siagian et al. (2022), which found that labour output and fertiliser both had an impact on soybean production [17].

### **3.3 Efficiency Analysis of Soybean Farming in Banyumas Regency**

Efficiency is the ratio between the input and output produced in the production process. Allocative efficiency measures the extent to which a business uses the optimal proportion of information to achieve maximum profit. Allocative efficiency is achieved when the addition of input can maximize profits. This can be shown by the Marginal Product Value (NPM), the

same as the input value ( $P_{xi}$ ). Allocative efficiency testing was conducted on factors significantly influencing soybean production in Banyumas Regency. These factors include land area, seed, fertilizer, and labor. The following table shows the findings of the allocative efficiency analysis of soybean farming

**Table 4.** Analysis of Allocative Efficiency of Soybean Farming in Banyumas Regency

Production Factors	bi	Py	Px	Y	X	NPMxi	NPMx	Information
							Px	
Land Area	0.380	8,912.50	250,000	431	0.2691	5,424,338	21.70	Not Efficient
Seeds	0.387	8,912.50	15,000	431	12.5187	118,749	7.92	Not Efficient
Fertilizer	0.136	8,912.50	5,000	431	10.125	51,597	10.32	Not Efficient
Labor	0.379	8,912.50	70,000	431	15.6437	93,063	1.33	Not Efficient

Based on Table 4, it is clear that farmers have not used key production parameters for soybean yield effectively. The comparison between the marginal product value and the factor price of production still yields values that are greater than one. Land area, seeds, fertilisers, and labour are all production factors with  $k$  values greater than 1. To ascertain whether there is a significant difference between the acquired  $k$  value and the value of one as a control, the  $k$  value is next examined using the  $t$ -test. Since production is deemed efficient if the value of  $k = 1$ , the value of one is utilised as a control.

The area of land used by farmers has a  $k$  value of more than one, which is 21.70. This condition indicates that the area of land farmers use for soybean farming is still not allocative efficient. This means that farmers can still increase the area of land so that production increases. Only 0.27 hectares of land are typically under cultivation by farmers in the field. Farmers only possess a small amount of land since much of the land they use has been handed down from one generation to the next. Rarely do farmers who rent land even buy land to expand the land used for soybean farming. The number of seeds farmers use has a  $k$  value of more than one, namely 7.92. This condition indicates that the amount farmers use for soybean farming is still inefficient. In order to produce the most soybeans possible, it is required to use seeds as efficiently as possible in accordance with guidelines. This is consistent with Shalma's (2015) research, which found that a number of factors, including land acreage and seed use in accordance with guidelines, need to be more tightly regulated in order to increase soybean yield. According to Purnamasari et al., (2017) in an effort to be efficient, it is necessary to apply GAP (Good Agriculture Practices).

Banyumas Regency soybean producers continue to utilise fertiliser inefficiently. The difference of 10.32 between the price of ZA fertiliser and the marginal product value is larger than one. This is due to the sufficient availability of fertilizer which is still lacking in the research location. In addition, there are some farmers who have not used fertilizer according to the recommendations from field extension officers. Farmers utilise a lot of labour, but it is not always allocated efficiently. This is demonstrated by the comparison value, which equals 1.33 and indicates more than 1, between the marginal product value and the average labour pay. The average outpouring of labor used by farmers in the field is 15.64 HKO during one season. The limitation to increase the outpouring of labor is due to the lack of farmer capital to provide wages to farm workers. Farmers should be able to increase the outpouring of labor in their farming so that it is more efficient allocatively. This is in accordance with research by Siagian et al. (2022), which found that because inefficient production variables can enhance the usage of labour and fertilisers, it is important to do so [17].

## 4 Conclusion

The results showed that farming is viable because it has a positive profit value and more than one R/C. Soybean production is significantly influenced by the production factors of land



area, seeds, fertiliser, and labour, but is not significantly impacted by pesticides. From an economic point of view, the use of land, seeds, fertilizer and labor inputs in soybean cultivation is not efficient when the BKM-NPM ratio is greater than one.

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