Analysis of chili farming in Indonesia

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Abstract. Horticultural crops are one of the most prominent national income supporters in Indonesia. Chili is one of the vegetable commodities that have excellent and promising business opportunities. The need for chili increases every year, in line with the increasing population and the development of industries that require chili as raw material. This study aimed to determine the number of costs, revenues, income, and profits and determine the efficiency of chili farming in Indonesia. The total respondent was 342 from four provinces: West Java, Daerah Istimewa Yogyakarta, Central Java, and East Java. The basic research method used in this research was descriptive and analytical. This study was carried out using survey techniques with a simple random sampling method. The method of analysis used is the analysis of costs, revenues, income, and farming profits. The results showed that the chili farming business obtained IDR 114,510,523.99. The costs incurred are IDR 41,120,740.16 per growing season so that the income is IDR 91,905,415.11 and the profit is IDR 73,389,783.83. The R/C ratio of 2.78 indicates that it is efficient.

1. Introduction
Horticulture consists of 2 types of plants, namely seasonal plants and annual plants. Horticultural crops are the most significant commodity produced in Indonesia. There are various horticultural plant groups: vegetable plants, ornamental plants, biopharmaceutical plants, and fruits. In the first quarter of 2018, agricultural business in horticultural commodities increased by 7.07% due to rainfall which supported the high production of horticultural crops [1,2]. Horticultural crops are one of the essential food crops so that production should increase. Horticultural crops are also the most prominent supporter of national income in Indonesia.

Chili is one of the vegetable commodities that have excellent and promising business opportunities. Big red chili (Capsicum annum L.) is a vegetable commodity that gets a lot of attention because it has a fairly high economic value. The need for chili continues to increase every year, in line with the increasing population and the development of industries that require chili. Farmers assume the use of excessive production factors can produce maximum results and minimize the use of fertilizers. However, the usage of extreme production factors can increase the production costs and reduce farm income if the additional costs incurred are higher than the additional revenue. In agriculture, it is known as The Law of Diminishing Return. Many red chili farming analyses have been carried out, but most of them are at district scale [3,4]. Therefore, this study aims to determine the costs and benefits of red chili farming, analyze the efficiency of chili farming, and determine the risks faced by chili farmers.
2. Methods
The data analysis methods were used to determine the costs, revenues, and profits of chili farming in four provinces of Indonesia: West Java, Daerah Istimewa Yogyakarta, Central Java, and East Java. There were 342 respondents.

2.1. Farming cost
Precise costs were incurred by farmers, including the fees of non-family-labor, seeds, fertilizers, pesticides, and other production facilities, as well as irrigation costs, tax payments, and transportation costs for harvesting crops in one planting season per hectare. Farmers do not incur implicit charges. Still, they are essential to be taken into account, including the use of family labor, depreciation of equipment, rent of own land, and interest on own capital in one planting season [5]

\[ TC = EC + IC \]

Here,

- \( TC \) = Total cost of chili farming (IDR)
- \( EC \) = Explicit cost of chili farming (IDR)
- \( IC \) = Implicit cost of chili farming (IDR)

2.2. Farm revenue
Revenue in farming is defined as the units of IDR for one planting period. Farmers strive in every farming season so that the income obtained exceeds the costs incurred [6,7]. Revenue is the final result between production and the prevailing selling price [8]. Calculation of farm income by multiplying the amount of output per hectare by the selling price per unit kg formulated as follows [9]:

\[ TR = Py \times Y \]

Where,

- \( TR \) = Chili farming revenue (IDR)
- \( Py \) = Price of chili production (IDR/kg)
- \( Y \) = Chili production (kg)

2.3. Farm income
Farm income is the difference between revenue and all costs incurred. Calculation of farm income was by calculating the difference between the explicit income and costs of farming which is defined as follows [9]:

\[ P = TR - TC \]
\[ P = (Py \times Y) - EC \]

Where,

- \( P \) = Chili farming income (IDR)
- \( TR \) = Chili farming revenue (IDR)
- \( TC \) = Total cost of chili farming (IDR)
- \( Py \) = Price of chili production (IDR/kg)
- \( Y \) = Chili production (kg)
- \( EC \) = Explicit Cost of chili farming (IDR)

2.4. Farming profits
Profit in farming is seen as the difference between revenue and total costs incurred. A farm will run continuously if the profit earned is greater than zero (0) or the farm has reached normal profits [10]. Calculation of farming profits by calculating the difference between explicit and implicit farm revenues and costs formulated below [6].
\[ P = TR - TC \]
\[ P = (Py \times Y) - (EC + IC) \]

Here,
- \( P \) = Chili farming income (IDR)
- \( TR \) = Chili farming revenue (IDR)
- \( TC \) = Total cost of chili farming (IDR)
- \( Py \) = Price of chili production (IDR/kg)
- \( Y \) = Chili production (kg)
- \( EC \) = Explicit Cost of chili farming (IDR)
- \( IC \) = Implicit cost of chili farming (IDR)

### 2.5. Farming efficiency

Efficiency is a measurement of success that is judged by the number of resources sacrificed to obtain specific results [11]. Farming efficiency or \( R/C \) (Return Cost Ratio) compares total revenue and total farming costs. The greater the \( R/C \) ratio, the greater the profits. This can be achieved if the use of production factors in farming management is more efficient [9]. The method used to determine the efficiency of chili farming was the \( R/C \) ratio. If the \( R/C \) ratio is > 1, the farming system is said to be efficient. If the \( R/C \) ratio = 1, then the farm experiences BEP (break-even). If the \( R/C \) ratio < 1, then the farming system is inefficient [9].

### 3. Results and discussion

#### 3.1. Farmer characteristics

The characteristic of farmers is an essential factor in a study. Characteristics are useful to show the background of farmers in chili farming. It contains the name, the area of land cultivated, the farmer's age, address, education history, the number of families who are active in farming and inactive, and the experience of farmers in chili farming.

| No | Characteristics                      | Average  |
|----|--------------------------------------|----------|
| 1. | Age (years)                          | 48.55    |
| 2. | Education (years)                    | 9.48     |
| 3. | Household size                       | 4        |
| 4. | Family labor (orang)                 | 2        |
| 5. | Experience in chilli farming (th)    | 11.58    |
| 6. | Land are for chilli farming (Ha)     | 0.32     |

Source: Primary data analysis, 2021

The results of data analysis in Table 1 show that the average age of the respondent farmers was 48.55 that is a productive age. The age of the farmer indicates that the farmer can work well and is still strong enough to practice farming. The length of education of respondent farmers was 9.48 on average which means that most of them finish the study in junior high school (SMP) and high school (SMA). The level of education will affect the knowledge, creativity, and level of farmer adoption of the developing technology for chili farming in increasing crop productivity.

The average number of respondents' family members was four people with two men and two women. In chili farming, farmers mostly do their tasks by themself with the help of their family members. The data analysis in Table 1 shows that the number of members involved in chili farming is two people. From the data, the length of experience of farmers in chili farming had an average of 11.58 years. It shows that farmers have enough expertise in chili farming. The longer the farmer experiences, the easier it is for the farmer to solve problems that arise in chili farming. It is because farmers understand the right way to increase red chili productivity from various experiences. The average land ownership of
chili farmers was 0.32 Ha. The land is an important factor in farming because it is where the farming activities take place. Land area is very influential on the production and income of farmers. Larger land area is more efficient for chili farming activities.

3.2. Production factors in chilli farming

The production factors affect the production results from the quality and the quantity of chili production. Production factors used are land area, labor both inside and outside the family, seeds/seeds, urea fertilizer, Za fertilizer, SP36 fertilizer, Phonska fertilizer, KCL fertilizer, manure, leaf fertilizer, agricultural lime/dolomite, and pesticide. As shown in Table 1, the average land area used by farmers was 0.32 ha, which results in a lack of efficiency and thus prolongs the fulfillment of the demand.

Table 2. Average use of production factors in chili farming

| No | Factor                  | Quantity | Percentage(%) |
|----|-------------------------|----------|---------------|
| 1. | Land (ha)               | 0.32     |               |
| 2. | Labor (HKP)             |          |               |
| a. | Family Labor            | 48.63    | 34.26         |
| b. | Hired labor             | 93.31    | 65.74         |
|    | Total Labor             | 141.94   | 100.00        |
| 3. | Manure (kg)             | 2,030.30 |               |
| 4. | Inorganic fertilizer    |          |               |
| a. | Urea (kg)               | 128.61   | 13.39         |
| b. | Za (kg)                 | 169.39   | 17.63         |
| c. | TSP(kg)                 | 22.91    | 2.38          |
| d. | SP36 (kg)               | 134.04   | 13.95         |
| e. | KCL (kg)                | 216.04   | 22.48         |
| f. | Ponska (kg)             | 108.34   | 11.28         |
|    | NPK (kg)                | 181.50   | 18.89         |
|    | Total Inorganic Fertilizer | 960.83   | 100.00        |
| 5. | Other fertilizers       | 31.80    |               |
|    | Foliar fertilizer (lt)  | 0.84     |               |
|    | Agricultural lime (kg)  | 185.83   |               |
| 6. | Seed                    | 8,319.2  |               |
|    |                         | 6        |               |
| 7. | Pesticide (lt)          | 55.55    |               |

Source: Primary data analysis, 2021. Note: HKP = Working day of labor.

According to Table 2, the average cultivated land area was 0.32 Ha. Respondents' labor consisted of 48.63 HKP from family labor and 93.32 HKP from hired labor. The use of family labor was smaller than hired labor which was 65.74%. Another production factor is the utilization of manure, which amounted to 2,030.30 kg. The function of manure is to improve the physical properties of the soil. The use of inorganic fertilizers such as urea was 128.61 kg (13.39%), TSP was 22.91 kg (2.38%), SP36 was 134.04 kg (13.95%), and KCL was 216.04 kg (22.48%). Those four fertilizers are single fertilizers that fulfill the nutrients for chili plants optimally. The use of this fertilizer is also to stimulate flower and fruit growth. The usage of Za fertilizer was about 169.39 kg (17.63%). It plays a role in the formation of roots, stems, and green leaves for photosynthesis. The usage of phonska was 108.34 kg (11.28%) and NPK was 181.50 kg (18.89%). The usage of seeds was 8,319.26 seeds. The application of dolomite was 185.83 kg. It is used on acidic plants because it increases soil pH. Microorganisms in plants can grow if the pH is neutral, ranging from pH 6.5-7. The organic/manure fertilizers are generally in the form of livestock manure such as cattle which has a nutrient content of about 2.33% N, 0.61% P, 1.58% K, and other micro-nutrients. The use of this fertilizer is to meet the nutrients needed by chili plants. Fertilizers used in general contain elements of nitrogen (N), phosphorus (P), potassium (K), and other elements.
According to Cahyono [12], the artificial commonly used nitrogen fertilizer is urea which has a nitrogen content of 46%. Fertilizers with phosphorus or phosphate component that farmers generally use are TSP-containing P material between 40-47% and fertilizers containing potassium (K) namely KCL fertilizers containing 48-60% potassium. Based on standard fertilizer requirements per hectare, the requirement of urea fertilizer is 335 kg/hectare, greater than SP 36 fertilizer at 170 kg/hectare and KCL 185 kg/hectare, but the farmers only used urea 128.61 kg/hectare, SP 36 134.04 kg/hectare, KCL 216.04 kg/hectare.

Table 3. Chili farming costs in Indonesia

| No | Explicit Cost | Quantity | Price/Unit | Price (IDR) | % |
|----|---------------|----------|------------|-------------|---|
| 1. | Hired labor (HKSP) | 93.31 | 88,000.00 | 8,211,280.00 | 36.32 |
| 2. | Seed (stem) | 8,319.26 | 349.40 | 2,906,749.44 | 12.86 |
| 3. | Manure (kg) | 2,030.30 | 949.03 | 1,926,815.61 | 8.52 |
| | Inorganic Fertilizer: | | | | |
| | Urea (kg) | 128.61 | 2,504.87 | 322,151.33 | 1.42 |
| | Za (kg) | 169.39 | 2,063.51 | 349,537.96 | 1.55 |
| | SP 36 (kg) | 22.91 | 2,963.19 | 67,886.68 | 0.30 |
| | KCL (kg) | 134.04 | 4,686.15 | 628,131.55 | 2.78 |
| | TSP | 216.04 | 2,687.72 | 580,655.03 | 2.57 |
| | NPK (kg) | 108.34 | 3,717.63 | 537,027.30 | 2.38 |
| | Phonska (kg) | 181.50 | 3,717.63 | 674,749.85 | 2.98 |
| | Total | 960.83 | 23,579.94 | 3,160,139.70 | |
| | Other fertilizers (kg) | 31.80 | 5,910.20 | 187,944.36 | 0.83 |
| | Total fertilizer | 3,022.93 | 30,439.17 | 5,910.20 | 30,439.17 |
| 4. | Pesticide (liter) | 55.55 | 32,083.57 | 1,782,242.20 | 7.88 |
| 5. | Foliar fertilizer (lt) | 0.84 | 74,115.28 | 62,256.84 | 0.28 |
| 6. | Agricultural lime | 185.83 | 3,816.73 | 709,262.94 | 3.14 |
| 7. | Irrigation | 1,189,306.44 | 5.26 |
| 8. | Selamatan | 330,480.98 | 1.46 |
| 9. | Land tax | 563,627.97 | 2.49 |
| 10. | Transportation | 342,041.60 | 1.51 |
| 11. | Interest | 331,993.50 | 1.47 |
| 12. | Mulch | 681,942.74 | 3.02 |
| 13. | Other | 219,024.46 | 0.97 |
| Total | 22,605,108.88 | 100.00 |

| No | Implicit Cost | Quantity | Price/Unit | Price (IDR) | % |
|----|---------------|----------|------------|-------------|---|
| 1. | Family labor | 48.63 | 88,000.00 | 4,279,440.00 | 23.11 |
| 2. | Depreciation | | | 557,974.72 | 3.01 |
| 3. | Owned land rent | 0.32 | 3,022.93 | 4,154,899.63 | 70.30 |
| 4. | Interest | 662,100.42 | 3.58 |
| Total | 18,515,631.28 | 100.00 |
| Total Cost | 41,120,740.16 | |

Source: Primary data analysis, 2021

In this study, farmers did not use fertilizer according to the standard requirements as they have their formulations that are accustomed to reduce cost. The use of this pesticide serves to eradicate pests, weeds, and diseases that attack chili plants. While the use of agricultural lime is to increase soil pH, improve soil structure, and encourage microorganism activity in the process of nitrification and decomposition of soil organic matter (humus).
Table 3 shows that the highest cost incurred by chili farmers to run chili farming was for hired labor (8,211,280) which was higher than the cost of family labor (4,279,440). It is in line with the research of Suratiyah [7] which states that the cost of hired labor is greater than that of family labor. This outpouring of hired labor is used in land management activities, irrigation, nurseries, planting, fertilizing, weeding, controlling pests and diseases, and harvesting. This outpouring of hired labor is the most expensive during the land processing and making beds which are generally carried out on a wholesale basis and using supporting tools such as tractors, hoes, tugals, crowbars, and so on. The second-largest cost was the cost of fertilizer, which was IDR 5,274,899.66. Other costs incurred by farmers for irrigation, security, land taxes, transportation costs, and financing of foreign capital interest. Usually, the 'selamatan' activity is carried out as a hope for increasing the yield of harvests by holding tumpeng, earth alms, and kulupan, which are usually carried out before harvest. In addition, there are other costs for purchasing mulch and making stakes. The use of plastic mulch can reduce the cost of weeding or eradicating weeds and the use of insecticides. Meanwhile, the commonly used stakes were made of bamboo, which supports the stems of chili plants so that they do not collapse.

3.3. Production and profit

Production is an activity of combining inputs in the form of goods or services to produce products with high values. The production in this study is chili produced during the growing season in 2021, expressed in kilograms.

Farming revenue is influenced by several factors, such as the size of the farm, the use of inputs in production activities, and the price of the cultivated farming commodity. The average price of chili per kilogram is IDR 23,986.99, with an average production of 4,773.86 kg. The cost of chili in this market was very fluctuating depending on market forces so that an average revenue of IDR 114,510,523.99.

| No. | Description | Amount       |
|-----|-------------|--------------|
| 1.  | Revenue     | IDR 114,510,523.99 |
| 2.  | Cost        | IDR 41,120,740.16  |
| 3.  | Income      | IDR 91,905,415.11   |
| 4.  | Profit      | IDR 73,389,783.83   |
| 5.  | R/C ratio   | 2.78  |

Source: Data Primer Analysis, 2021

The results in Table 4 show that the average revenue was IDR 114,510,523.99, the cost was IDR 41,120,740.16, so that the income was IDR 91,905,415.11, and a profit of IDR 73,389,783.83. The common economic measurement for agribusiness' performance and commodity is the R/C ratio (revenue and cost ratio). It indicates the comparison between farm revenues and costs [13]. The revenue and costs incurred by farmers can be used to calculate the amount of the R/C ratio which projects the efficiency of chili farming. The results of data analysis in Table 4 show that the R/C ratio of chili in Indonesia was 2.78. It means that every IDR 1 of expenses incurred will generate revenue of IDR 2.78. The value of the R/C ratio that is greater than one provides information that the farming carried out by chili farmers in Indonesia is efficient. This study is linear with the previous research [14] which shows the revenue from cayenne pepper farming by farmers in Paccing Village is greater than the farming costs incurred with R/C higher than 1. The value of R/C for the expenses incurred is 5.40, which means that for every IDR 1.00, the costs incurred will receive an income of IDR 5.40. The current R/C value can also indicate that the cayenne pepper farming carried out by farmers in Paccing Village has been profitable.

4. Conclusion

The revenue earned was IDR 114,510,523.99. The costs incurred were IDR 41,120,740.16 per season, so that the income was IDR 91,905,415.11 and a profit of IDR 73,389,783.83. The R/C ratio of 2.78 indicates that chili farming has been efficient. Efforts need to continue increasing chili production, with
intensive care, selection of superior seeds, and the right combination of inputs to reduce costs and produce more optimal profits.

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