Financial Analysis of Cayenne Pepper and Kenyan Chickpea Intercropping Farming at Gapoktan Wargi Panggupay, Suntenjaya Village, Lembang

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Abstract - Intercropping is a mixture of cropping systems, where two types or more crops are grown on a plot of land at the same time. Planting intercropping patterns can be used as one of the efforts to improve productivity and increase farmers' income. This research aims to analyze the cultivation process and financial feasibility of Intercropping chili and kenya beans at Gapoktan Wargi Panggupay, which has been practiced since 2000. The research was conducted at Wargi Panggupay Farmers Group in Kampung Gandok, Suntenjaya village, Cibodas, Lembang from January to March 2024. Data collection employed purposive sampling techniques through primary sources (interviews with farmers regarding cultivation processes, costs, and revenues) and secondary sources (data from relevant institutions like the Ministry of Agriculture and Central Statistics Agency). The results explain intercropping cultivation of chili and kenya beans strarting from land preparation, seeding, planting, maintenance and harvesting. The financial indicator shows that the NPV is IDR 850,542,171, IRR is 31%, Net B/C is 1.74, and Pay Back Periode is 2 years and 11 month. These financial analysis indicators demonstrate that intercropping farming of chili and kenya beans is financially feasible to implement.

Keywords: Chili, feasibility study, intercropping, kenya beans

1 Introduction

Vegetable commodities in the current era of globalization have attracted a lot of public attention, this is because vegetables have an important role in meeting the needs of the community as a source of income, supporting national food security, and meeting nutritional needs [1]. Moreover, Indonesia is blessed with abundant natural resources, supported by geographical conditions such as soil conditions and favorable seasons for the development of the agricultural sector. Vegetable commodities have promising market potential both at the domestic and international levels, reflected in the growing demand in various market segments [2]. Among the various vegetable commodities, there are vegetables that have high economic value, namely cayenne pepper and kenya beans.

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Cayenne pepper with the scientific name *Capsicum sp.* is an agricultural commodity that has economic value and high selling price, because it is popularly used as a seasoning in Southeast Asian countries [3]. Demand continues to increase along with population growth and makes it excellent because it is consumed by various levels of society, strengthening its position as an agricultural commodity with bright prospects. The high consumer interest in chili is inversely proportional to the limited availability of cayenne pepper in the market, this phenomenon is caused by consumer preferences that prefer to consume fresh cayenne pepper because it has a taste and quality that is irreplaceable by other substitute products [4].

Table 1. Production of Chili Peppers in Indonesia

Cayenne Pepper Production in Indonesia (tons)		
2021	**2022**	**2023**
1,386,447	1,544,441	1,506,762

Source: [5]

The production of cayenne pepper in Indonesia experiences fluctuating conditions every year, such as the total production of cayenne pepper in 2021 of 1,386,447 tons increasing to 1,544,441 tons in 2022, then decreasing in 2023 to 1,506,762 tons [5], this is due to weather disturbances in several regions so that the average production of cayenne pepper in Indonesia for the last 3 years is 1,479,217 tons. In contrast to production in West Java, which has increased from 2021-2023, the average production is 150,166 tons per year with a percentage increase of 10% in 2022-2023 [5]. Apart from cayenne pepper, there are also chickpeas that experience similar conditions.

As a variety that is increasingly popular among farmers, chickpeas with the Latin name *(Phaseolus vulgaris L.)* Has a high economic value as well, one type that is quite in demand in Indonesia is baby chickpeas or known as French beans or Kenya beans. Although relatively new in Indonesia, these Kenyan beans have succeeded in redeeming the export and supermarket markets because they are able to replace animal protein including minerals, food fiber, fatty acids and various vitamins that support metabolic functions [6]. The presence of this variety is the result of innovation from Kenya, Africa which has successfully introduced new cultivars into the Indonesian agricultural industry and opened up opportunities for local farmers to develop high-value vegetables [7].

Chickpea consumption patterns in Indonesia experienced significant fluctuations from 2021-2023, where the average per capita consumption was recorded at 1.011 kg per year [5]. In addition to stable domestic demand, there is potential for exports of Kenyan chickpeas to Singapore, which reaches 2-3 tons per day [8]. Considering vegetables as a daily necessity for the community, especially Kenyan chickpeas, makes it a commodity with market opportunities and high nutritional value and is in demand by many people [9]. Facing this situation, farmers need to develop a good understanding of the cultivation of vegetable commodities such as cayenne pepper and Kenyan chickpeas in order to accelerate growth and harvest. There are several cropping patterns that are often carried out by farmers in farming, namely monoculture and polyculture (intercropping).

Monoculture involves planting a single crop in a specific area, while polyculture integrates several crops in one field, either in rotation or simultaneously [10]. Intercropping has more advantages than monoculture, including improved soil quality, diversification of agricultural products that mitigate the risk of crop failure, and optimization of land productivity [11]. This method streamlines land use by setting a planned planting pattern, to maximize the production potential of

each intercropped crop [12]. Therefore, intercropping planting patterns are used to maximize land functions and increase farmers' income [13].

Gapoktan Wargi Panggupay has been intercropping cayenne pepper and kenya beans since 2000. This practice was chosen because both commodities have similar nutritional needs, namely red KNO3, white KNO3, NPK 16-16-16, NPK glower, and NPK Boron. Another similarity is the pesticides used to control pests and diseases, namely Score, Cabrio, Ridomil Gold, Basoka, Antracol, Actara, Proclame, and so on. Thus, farmers can reduce production input costs and increase income.

In farming cayenne pepper and kenya beans in intercropping, a business analysis is needed to avoid losses and determine the feasibility of the business being run. This analysis provides the necessary information and helps farmers in determining their business so as not to experience losses. This study aims to determine the feasibility of cultivating cayenne pepper and kenya beans in intercropping at Gapoktan Wargi Panggupay.

2   Materials and methods

2.1   Research Time and Location

This research was conducted from January to March 2024. The selection of this research location was carried out purposive with the consideration that this location has been planting cayenne pepper and Kenyan chickpeas for a long time, namely since 2000 and is still continuing until now. This research was conducted at Gapoktan Wargi Panggupay in Gandok Village, Suntenjaya Village, Cibodas Lembang, West Java.

2.2   Data Type and Source

This type of research is quantitative by analyzing financial feasibility using Microsoft Excel tools and descriptive interpretation of the calculation results. The data source of this research comes from primary and secondary data. Primary data were obtained through interviews with resource persons in the form of cultivation processes, costs required, total revenue, and so on related to the cultivation of cayenne pepper and Kenyan chickpeas in intercropping. Secondary data were obtained from various related agencies, such as the Ministry of Agriculture, the Central Statistics Agency (BPS), internet searches, books, and literature related to the research.

2.3   Data Analysis Method

The data analysis method used is with the help of Microsoft Excel Software with the calculation of NPV, IRR, Net B/C and Payback Period, to analyze the farming and marketing mix of cayenne pepper and Kenyan beans.

2.3.1   Cost

According to is a sacrifice to produce something of greater value in the hope of getting a profit [14]. To calculate costs, the formula is used:

$$TC = FC + VC$$

Description:

TC = Total cost of farming

FC = Amount of fixed costs

VC = The amount of variable costs

2.3.2 Income

Farm income is the total value of products produced within a certain period of time, both for sale and self-consumption, which is calculated from the multiplication between the amount of production and the selling price [15]. To calculate acceptance, the formula is used:

$$TR = Y \times Py$$

Description:

TR = Total revenue

Y = Production obtained during the production period

Py = Price of production

2.3.3 Profit

Profit is the difference between the total revenue obtained from the sale of products or services and the total costs incurred in the production and operational processes. Profits reflect the effectiveness of resource management and the operational efficiency of a business[15], [16]. The formula of profit [15] is used to calculate revenue.

$$\pi = TR - TC$$

Description:

π = Profit

TR = Total Revenue

TC = Total Cost

2.3.4 Net Present Value (NPV)

This calculation aims to evaluate the feasibility of a business in receiving investment. According to Sri and Abel in 2017 through this calculation, investors can project future cash flows and determine the expected rate of return on investment [17]. The formula for finding NPV is as follows.

$$NPV = \sum_{t=0/1}^{n} \frac{Bt - Ct}{(1 + i)^t}$$

Description:

Bt = Benefit in year t

Ct = Cost in year t

i = Interest rate

t = Year

n = Economic value

Assessment criteria:

- If NPV > 0, then the proposed project is feasible.
- If NPV < 0, then the proposed project is not viable.
- If NPV = 0, then the proposed project is not recommended to proceed.

2.3.5 Internal Rate of Return (IRR)

Internal Rate of Return (IRR) is a calculation that describes the rate of return at which the net present value (NPV) of a project becomes zero, this concept includes the present value of all cash inflows with project outflows [18]. The formula for finding IRR is as follows:

$$IRR = i_1 + \frac{NPV_1}{NPV_1 + NPV_2} \times (i_2 - i_1)$$

Description:

i_1 = Discount rate that produces positive NPV
i_2 = Discount rate that results in negative NPV
NPV_1 = NPV that is positive
NPV_2 = NPV that is negative

2.3.6 Net B/C Analysis

Net Benefit-Cost Ratio (Net B/C) is a financial feasibility indicator that compares the discounted net benefits (+) with the negatively discounted net benefits (-) of a project. If the B/C Ratio exceeds 1, this indicates that the benefits of the project are greater than the costs, which indicates a potential profit [19]. The Net B/C calculation formula is:

$$Efficiency = \frac{B - C\ (+)}{B - C\ (-)}$$

Description:

B   = Benefit
C   = Cost incurred (Cost)

B/C criteria:

- If B/C > 1, meaning the project is profitable
- If B/C = 1, meaning the project is neither profitable nor loss-making
- If B/C < 1, meaning that the project is loss-making

2.3.7 Payback Period (PP)

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Payback Period is a calculation in investment analysis to measure the period of return on investment costs through additional net income generated from the business. The lower the resulting value indicates a faster return on investment, thus showing a lower level of risk for investors who have invested their capital [19].

$$PP = \frac{I}{N}$$

Description:
I = Investment
N = Net benefits obtained each year

3   Results and discussion

Cultivation requires land preparation about 40 days before the planting period. Cayenne pepper and Kenyan chickpea plants can grow in soil that is fertile, loose, not prone to waterlogging, and rich in organic elements. Land preparation includes a variety of activities, including weed removal, hoeing to till the soil, mound formation, applying and mixing fertilizer into the mound, smoothing the mound, applying plastic mulch, and making holes for planting. Weed removal is done so that the cayenne pepper and chickpea plants can grow well. Then, hoeing is done so that the soil becomes loose. Next, make a mound with a width of 90cm, a length of 23.5cm and a height of 40cm. The distance between mounds is 50cm and the width of the trench is 60cm. so in 1 ha there are 284 mounds.

After hoeing, the next thing to do is to apply basic fertilizer to the soil. The fertilizer used is manure mixed with compost. The base fertilizer is placed on the soil and stirred until evenly distributed, then cover it again with soil. After mixing the fertilizer, rearrange the mounds that have been made. Then for the installation of plastic mulch, make sure that the installation is neat and strong. After installing, measure the planting distance for kenya beans and cayenne pepper, then perforate it with a mulching tool. The planting distance for chickpeas and cayenne pepper is 50 cm. The next step is to do seeding only for cayenne pepper plants. The initial stage of seeding is to make a seeding container, the container that is usually used is klontong. Klontong is a seeding container made from banana leaves that are glued together using sticks. The next step is to soak the seeds in warm water for about 8-12 hours, then drain. After that, transfer the seeds to a damp cloth and wait for the seeds to turn into sprouts. Then, transfer the sprouts to the containers that have been filled with seeding media.

When planting cayenne pepper, one seedling is inserted in one mulch hole, and 2 seeds are inserted for beans. A good planting time is in the morning or evening. Cayenne pepper seedlings that use cloves can go directly into the planting hole, but seedlings that use polybags must be removed first, the removal of polybags must be careful so that the roots are not damaged. When planting bean seeds, make a small hole with a depth of ±3-5cm, then insert the seeds. Do not put the seeds too deep and touch the base fertilizer, because it will cause the seeds to die. Seeds and seedlings that have been planted are watered every day and after planting day 7-10 the bean seeds and chili seeds are checked, whether there is damage or not, if there is damage to the seeds or seedlings, replanting must be done. Casting or giving nutrients to plants is carried out within a span of 10 days, and the dose is added after 15 days and 40 days of planting. Spraying or applying pesticides to prevent pests and diseases is given every 7-10 days. Pesticides include fungicides (for diseases) and insecticides (for pests).

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It takes 3 months to harvest kenya beans, while cayenne pepper takes 4 months. Cayenne pepper is harvested with a maturity level of 70%, which is when the chili is green to orange, do not harvest chilies that are green or too red. In harvesting cayenne pepper, per-one tree can produce 300-600gr of chili, while in kenya beans, per one tree can produce 300-500gr of beans. Harvesting is done in the morning or evening. This aims to maintain the freshness of the chilies and beans. Kenya chickpeas can be harvested 30 times with a period of 1-2 days, while cayenne pepper can be harvested 20 times with a period of 5 days.

3.1 Production Cost

Production costs in intercropping cayenne pepper and kenya beans consist of investment costs, fixed costs, and variable costs. Seeing the explanation [20], investment costs refer to the costs incurred by investors or business owners in the early stages of business establishment to prepare their business needs to be ready to operate. The following is a detailed table of investment costs for the intercropping farming of cayenne pepper and kenya beans at Gapoktan Wargi Panggupay.

Table 2. List of Investment Costs

No.	Component	Quantity	Unit Price (IDR)	Amount (IDR)	Durability	Total
1	Land	10.000 m^2	50,000	500,000,000	-	-
2	Pick Up Car	1 piece	180,000,000	180,000,000	240	750,000
3	Car Chiller Box	1 piece	300,000,000	300,000,000	240	1,250,000
4	Warehouse	1 piece	70,000,000	70,000,000	-	-
5	Cold Storage	1 piece	100,000,000	100,000,000	-	-
Total Investment Cost				1,150,000,000		2,000,000

Source: Data processed by researchers, 2024

The land required for intercropping cayenne pepper and kenya beans is 1 ha. One pick-up truck and one chiller box each are used to transport production inputs, transport harvested vegetables, and other operational activities. One warehouse measuring 10x7m is used to store and pack harvested vegetables and chilies. A 5x5m cold storage is used to store vegetables for longer storage.

Fixed costs are costs that do not change despite fluctuations in the level of activity associated with the production of goods or services within a certain range [21]. The following is a table of fixed costs in the farming of cayenne pepper intercropping and kenya beans for one planting period.

Table 3 List of Fixed Cost

No.	Component	Quantity	Unit Price (IDR)	Amount (IDR)	Durability	Total
1	Hoe	10 pieces	50,000	500,000	60	8,333
2	Bamboo Stakes	8.500 pieces	2,000	17,000,000	12	1,416,666
3	Mulching Tool	2 pieces	45,000	90,000	12	400,000
4	Casting Tool	2 pieces	700,000	1,400,000	60	1,500
5	Plastic Mulch	8 rolls	600,000	4,800,000	60	23,333
6	Worker Salary	1 period	105,000,000	105,000,000	-	-
Total Fixed Cost				128,790,000		1,449,833

Source: Data processed by researchers, 2024

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In the intercropping farming of cayenne pepper and Kenyan chickpeas, a fixed cost of IDR. 128,790,000 is required. These costs consist of worker salaries, chili seeds, chickpea seeds, and farming equipment such as hoes, bamboo stakes, plastic mulch, mulching tools, and casting tools. The largest cost incurred is the cost for workers' salaries, which amounted to IDR 105,000,000.

According to Nanik and Alfiyani in their book (2022), variable costs refer to costs that can change if there is a change in the number of units of production or sales [10]. The following is a table of variable costs in farming intercropping cayenne pepper and kenya beans for one planting period.

Table 4. List of Variable Cost

No.	Component	Quantity	Unit Price (IDR)	Amount (IDR)
1	Seeds of Cayenne Pepper	7 pack	144,000	1,008,000
2	Kenyan Chickpe Seeds	15 pack	450,000	6,750,000
3	Pesticides	1 pack	1,068,000	1,068,000
4	Nutrition	1 pack	555,000	555,000
5	Manure	2000 sacks	12,000	24,000,000
6	Fine fertilizer	1 period	25,000	25,000
7	Electricity	1 period	-	1,000,000
8	Car Gasoline	1 period	-	2,000,000
9	Ropes	5 kg	20,000	100,000
10	Large Plastic	1 pack	20,000	20,000
Total Variable Cost				36,526,000

Source: Data processed by researchers, 2024

In the farming of cayenne pepper and Kenyan chickpea intercropping, variable costs of IDR 36,526,000 are required. These costs consist of pesticides used for pests and diseases, nutrients, manure to be used as basic fertilizer, warehouse electricity, car gasoline, rapia rope to tie bamboo stakes, and large plastic to store vegetables. The largest cost of variable costs for cayenne pepper and Kenyan chickpea cultivation is manure, which is IDR 24,000,000.

3.2 Business Income

The planting area of the intercropping business of cayenne pepper and kenya beans is 1 ha. There are 13,348 cayenne pepper trees and 18,424 Kenyan chickpea trees. With an average tree damage rate of 10% during the planting period, the number of trees becomes 12,013 and 16,581 trees that can be harvested in 1 planting period. One cayenne pepper tree can produce 600 grams of chili, and one kenya bean tree can produce 500 grams each harvest period. The yield of cayenne pepper in 1 ha is 7,208 kg and Kenyan chickpeas is 8,291 kg, with an average price of cayenne pepper of IDR 40,000, the revenue for cayenne pepper is IDR 288,320,000.

Table 5. Operating Income Analysis

No	Commodities	Number of Trees	Result (-10%)	Tree (Gr)	Total (Kg)	Price/ Kg	Total (Idr)
1	Cayenne Pepper	13,348	12,013	600	7,208	40,000	288,320,000.00
2	Kenyan Chickpea	18,424	16,581	500	8,291	14,000	116,074,000.00
Total Revenue per Period							404,394,000.00
Revenue per Year							808,788,000.00

Production Cost in a Year	330,632,000.00
Profit	478,156,000.00

Source: Data processed by researchers, 2024

The average price of Kenyan chickpeas is IDR 14,000, so the revenue for Kenyan chickpeas is IDR 116,074,000. The total revenue for cayenne pepper and green beans obtained is IDR 404,394,000, so the revenue for chili and green beans in one year is IDR 808,788,000. With a total production cost of IDR 330,632,000, the profit received in one year is IDR 478,156,000.

3.3   Net Present Value Analysis

Net Present Value (NPV) is the net value received at a certain discount rate over a predetermined business life. The average loan interest rate used is 6.25% [22]. After obtaining the total revenue and costs from years 0-5, the amount of NPV can be calculated. The NPV calculation is as follows.

Table 6. Net Present Value Analysis

Year-	Income (Bt)	Cost (Ct)	Year Value	NPV
0	-	1,150,000,000	(1,150,000,000)	(1,150,000,000)
1	808,788,000	330,632,000	478,156,000	450,029,176
2	808,788,000	330,632,000	478,156,000	423,556,872
3	808,788,000	330,632,000	478,156,000	398,641,762
4	808,788,000	330,632,000	478,156,000	375,192,246
5	808,788,000	330,632,000	478,156,000	353,122,114
NPV of the Project				850,542,171

Source: Data processed by researchers, 2024

The resulting Net Present Value is IDR 850,542,171. because the NPV value of the project for 5 years is more than 0 (zero), then the farming of cayenne pepper and Kenyan chickpea intercropping with a land area of 1 ha is feasible to run.

3.4   Internal Rate of Return Analysis

The Internal Rate of Return (IRR) is the interest rate that results in a Net Present Value (NPV) equal to 0. After obtaining the NPV of the project, the IRR can be calculated. In this case, the loan interest rate of 6.25% is taken from the BI-Rate rate issued by Bank Indonesia in 2024.

The IRR value is obtained by identifying the last positive NPV and the first negative NPV that comes after it, through the use of various interest rates. [23] Based on the calculations that have been carried out, the results of the Internal Rate of Return analysis reached 31% which indicates that this business has the maximum potential to generate profits of 31% of its production. Given that this IRR value far exceeds the loan interest rate of 6.25%, it can be concluded that this business is feasible to implement.

3.5   Net B/C Analysis

B/C Ratio is a measure of the comparison between benefits and total production costs. Within the limits of the B/C value, it can be seen whether a business is feasible or not feasible to continue. After

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obtaining positive NPV and negative NPV values, Net B/C data is calculated. The Net B/C calculation is as follows.

Table 7. Net B/C Analysis

Year-	Income (Bt)	Cost (Ct)	Year Value	NPV
0	-	1,150,000,000	(1,150,000,000)	(1,150,000,000)
1	808,788,000	330,632,000	478,156,000	450,029,176
2	808,788,000	330,632,000	478,156,000	423,556,872
3	808,788,000	330,632,000	478,156,000	398,641,762
4	808,788,000	330,632,000	478,156,000	375,192,246
5	808,788,000	330,632,000	478,156,000	353,122,114
NPV Year 1-5				2,000,542,171

Source: Data processed by researchers, 2024

Based on the above calculations, the Net B/C > 1 is obtained, which is 1.74, so the farming of cayenne pepper and Kenyan chickpea intercropping with a land area of 1 ha is feasible to run.

$$Net\frac{B}{C} = \frac{2,000,542,171}{1,150,000,000} = 1.74$$

3.6 Payback Period (PP) Analysis

The payback period is used to calculate how long it takes to return the money that has been invested. The PP calculation is as follows.

Table 8. Payback Period (PP) Analysis

Year to	Income	Cost	Year Value	NPV	Effect on Initial Investment
0	-	1,150,000,000	(1,150,000,000)	(1,150,000,000)	-
1	808,788,000	330,632,000	478,156,000	450,029,176	(699,970,824)
2	808,788,000	330,632,000	478,156,000	423,556,872	(276,413,952)
3	808,788,000	330,632,000	478,156,000	398,641,762	122,227,810
4	808,788,000	330,632,000	478,156,000	375,192,246	497,420,057
5	808,788,000	330,632,000	478,156,000	353,122,114	850,542,171

Source: Data processed by researchers, 2024

Based on the above calculations, it can be seen and concluded that the initial investment in cayenne pepper farming and intercropping is IDR 1,150,000,000 will return with a period of 2 years and 11 months.

4 Conclusion

The intercropping of cayenne pepper and kenya beans has long been carried out by Gapoktan Wargi Panggupay, since 2000. The intercropping of these two commodities is done because they have several similarities in cultivation. The process of intercropping cayenne pepper and kenya beans consists of land preparation, seeding, planting, maintenance, and harvesting.

Based on the feasibility test through Net Present Value (NPV), Internal Rate of Return (IRR) and Net B / C farming intercropping cayenne pepper and Kenyan beans is feasible to run, because the project NPV for 5 years is more than 0 (zero) which is IDR 850,542,171. In addition, the IRR is above the loan interest rate of 31%. and Net B/C is more than one, which is 1.74. Payback period (PP) is 2 years and 11 months.

5 Acknowledgements

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