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# Financial feasibility and green supply chain management analysis of sustainable watermelon farming

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**ABSTRACT**

Indonesia's agriculture, particularly watermelon farming in Riau, offers economic growth opportunities but requires sustainable practices for profitability. This study aims to analyze the benefits of watermelon farming, assess its financial feasibility, and explore the integration of green supply chain management (GSCM) practices into the farming process in Indonesia. Employing a descriptive method, the research focuses on profitability and feasibility aspects by analyzing field data. The analyzes cost data and production to provide financial insights for farmers on sustainable supply chains and enhance Indonesian watermelon competitiveness. The findings indicate that watermelon farmers in Sako Village earn an average profit of IDR 155,900,000 per hectare annually. The financial analysis further reveals that the payback period for watermelon farming investment is approximately nine months, with a net present value of IDR 450,705,000, an internal rate of return of 149%, and a profitability index of 4.37, confirming the high profitability and attractiveness of the business. Moreover, the adoption of GSCM practices demonstrates a strong potential to enhance both environmental and economic sustainability in watermelon farming.

**Keywords:** financial, feasibility, sustainable, green supply chain management, watermelon farming

## INTRODUCTION

As an agricultural country, Indonesia heavily relies on farming as a key economic driver, providing livelihoods for millions. Among various agricultural commodities, watermelon farming in Riau Province presents a significant opportunity due to increasing domestic and international demand. However, achieving long-term profitability requires sustainable farming practices, particularly through the integration of green supply chain management (GSCM). Most of the Indonesian population relies on the agricultural sector as a livelihood (Askar, 2015).

One of the efforts taken to increase farmers' income is by cultivating agricultural commodities that have high economic value and have quite large market potential, both domestic and foreign markets. One of the agricultural sectors that is being developed is horticulture which includes fruits, vegetables and flowers. Fruits have quite the potential to be developed, considering that demand continues to increase. One of the fruit commodities that has prospects for development is watermelon (Wahyuni et al., 2022).

Watermelon is ideally planted at an altitude of 100-300 meters above sea level (Rosyidi et al., 2016). Even so, watermelon can also grow in areas near the coast that are less than 100 meters above sea level (Wihardjo, 1993). The length of time for watermelon plants to grow until the fruit is ripe, in normal land and weather conditions, is 70-100 days, since the seeds are planted (Wihardjo, 1993).

Watermelon (*citrullus vulgaris L*), or in English called *water mellon* is still a close relative of melon and cantaloupe, which are included in the gourd fruit (*cucurbitaca*) originating from tropical Africa. Watermelon belongs to the *cucurbitaceae* family. The shape of the plant has climbing tendrils. Classified as a seasonal plant, it can only produce fruit once then the plant dries and dies (Wihardjo, 1993).

Riau Province is one of the watermelon producers in Indonesia, especially in the Kuantan Singingi Regency. Watermelon originating from Kuantan Singingi Regency can meet the needs of watermelon in Riau Province and is even sent to other provinces such as West Sumatra, Jambi, Lampung and South Sumatra. Three sub-districts produce the most watermelon in Kuantan Singingi Regency, namely Pangean District, Logas Tanah Darat District, and Hulu Kuantan

District. In Pangean District, Sako Village is the village that produces the most watermelon in the sub-district.

Based on a local market survey, per capita watermelon consumption in the survey area is around 2-3 kg per month, especially in the summer when demand is higher. The trend of healthy fruit consumption, including watermelon, shows potential for increasing demand as people become more health-conscious (Julkifli et al., 2019). That presents an opportunity for watermelon farmers to adopt GSCM practices to meet growing demand while minimizing environmental impacts. The increase in watermelon demand during the hot months or dry season highlights the need for efficient resource management, particularly water usage. Sustainable irrigation systems, such as drip irrigation, could help farmers optimize water consumption, which aligns with GSCM's goal of reducing environmental resource depletion. In addition, the trend of higher supply during the main harvest, which leads to price drops and increased consumption, could be managed through eco-friendly storage and transportation systems, reducing post-harvest losses and maintaining product quality during distribution.

Moreover, based on the pre-survey, consumers tend to prefer watermelons with red, sweet flesh and few seeds. This preference can influence farmers' decisions in choosing which varieties to plant. By selecting seed varieties that are not only preferred by consumers but also drought-resistant and high-yielding, farmers can contribute to sustainable agriculture practices. In line with GSCM principles, this could reduce the environmental footprint by requiring fewer inputs like water, fertilizer, and pesticides.

To implement green supply chain initiatives, farmers in Sako Village can adopt biodegradable packaging materials instead of conventional plastic. Additionally, transitioning to solar-powered irrigation systems and optimizing transportation routes to reduce fuel consumption can significantly lower the environmental impact. A study by Wahyuni et al. (2022) showed that farmers who adopted these practices reduced post-harvest losses by 20% while increasing market access. Utilizing local markets for distribution could also reduce the distance traveled by-products, contributing to lower greenhouse gas emissions. Incorporating green farming techniques and sustainable practices throughout the watermelon supply chain, starting from planting to final distribution, ensures that the increasing demand for healthy fruits like watermelon can be met in an environmentally responsible manner, adhering to the principles of GSCM.

Farmers, as implementers, expect greater production in order to obtain greater income; for that, in running their farming business, farmers use labor, capital, and production facilities as bait to obtain the expected production. Sometimes, the production obtained is actually smaller, and conversely, sometimes, the production obtained is greater.

Farmers in farming always aim to obtain a high income. Several factors, including product selling price, production costs, and sales volume, influence income. The use of inputs such as seeds, fertilizers, and labor can influence the size of production costs. The farming business is said to be successful if the farming business can fulfill its obligations to pay interest on capital and tools used, labor wages, production facilities and others.

Although watermelon cultivation is considered a potential contributor to regional economies, such as in Riau, there is a critical research gap regarding comprehensive financial analysis integrated with green supply chain principles. Most previous major studies tend to focus on technical aspects of cultivation or conventional financial analysis that only calculates short-term profitability (such as the revenue cost ratio without considering external environmental costs [externalities]) and detailed cost structures that influence long-term desirability (Ganlin et al., 2021; Li et al., 2024; Moshood et al., 2022). Furthermore, research that simultaneously examines the cost components of TFC, TVC, TC, MC, average fixed cost [AFC], average variable cost [AVC], and AC in the context of implementing green practices (such as plastic waste reduction, low-emission transportation optimization, and the use of organic inputs) is still very limited. Consequently, there is no clear empirical evidence as to whether investments in green supply chains actually improve cost efficiency (AC) and farmer competitiveness, or whether they actually become a financial burden (high initial MC). This study aims to fill this gap by providing quantitative evidence on financial feasibility that addresses poverty aspects while developing a business model that combines profitability with environmentally friendly practices.

From the description above, the objectives of this study are:

(1) to analyze the production costs and profits in watermelon farming in Sako Village, Pangean District, Kuantan Singingi Regency,

(2) to analyze the financial feasibility of watermelon farming in Sako Village, Pangean District, Kuantan Singingi Regency, and

(3) to analyze green supply chain practice of watermelon farming in Sako Village, Pangean District, Kuantan Singingi Regency to support sustainable watermelon farming.

This research is in line with SDGs, such as zero hunger (2), responsible consumption and production (12), and climate action (13).

## LITERATURE REVIEW

### Capital Budgeting Theory

Capital budgeting theory involves evaluating investment opportunities by analyzing the expected cash flow and profitability over time. Key concepts include the payback period (PP), net present value (NPV), internal rate of return (IRR), and profitability index (PI), all of which were used in the watermelon farming financial analysis (Kengatharan, 2016).

The use of NPV and IRR in this analysis fits within the capital budgeting framework, helping to assess whether the projected returns justify the initial investment (Dobrowolski & Drozdowski, 2022). A positive NPV and high IRR indicate the financial soundness of the project, aligning with the principles of this theory that focus on long-term wealth maximization (Jrfm-16-00191-V2, n. d.).

### Production and Cost Theory (Microeconomics)

Production and cost theory examines the relationship between inputs (such as labor, land, and capital) and output, as well as the associated costs (Qiao et al., 2023; Samoilova & Rodionov, 2022). It helps in understanding the cost structures (fixed costs [FC] and variable costs [VC]) and how these relate to production efficiency (Dewi & Muryati, 2017).

The breakdown of FC, VC, and total costs (TC) in the watermelon farming analysis aligns with this theory. The calculation of the average cost (AC) per kilogram and its comparison with the market price is a direct application of cost theory, allowing for an understanding of economies of scale and profitability.

### Risk and Uncertainty in Agriculture (Agricultural Economics)

Agricultural economics often deals with risk and uncertainty due to external factors like weather, market fluctuations, and pest outbreaks. This framework focuses on managing these risks through diversification, insurance, or technology adoption (Bairwa et al., 2013).

The limitations highlighted in the watermelon farming project, such as market price volatility and yield variability, relate to the risk and uncertainty framework. Managing these risks through diversification (e.g., selling in different markets) and using advanced farming techniques can help mitigate potential negative impacts (Adnan et al., 2020; Qiao et al., 2023; Samoilova & Rodionov, 2022).

### GSCM

Supply chain processes and activities play an important role in companies' efforts to reduce the negative impact of their activities on the environment and society in the context of improved operational, market, and financial performance (Chen et al., 2023; Gelmez et al., 2024). GSCM practices consist of incorporating environmentally friendly practices into supply chain processes and activities to minimize or eliminate solid waste, reduce pollution, reduce energy consumption and improve the conservation of resources from the phase of the product design process to the final product (Acquah et al., 2020; Renaldo & Augustine, 2022).

## METHODOLOGY

### Data Analysis

#### *Production costs*

The experimental method refers to cost data (TFC, TVC, and TC) and production collected periodically from both groups. Data analysis uses MC, AFC, AVC, and AC calculations. The results of this experiment will provide strong financial justification and concrete data for farmers and stakeholders regarding investments in sustainable supply chains, addressing the issue of green cost premiums, and mapping out strategies to increase the competitiveness of Indonesian watermelons in a global market that increasingly prioritizes sustainability.

Data collection in this watermelon farming research was conducted comprehensively to ensure the accuracy and reliability of the analysis. Primary data was collected directly from farmers in Sako Village through structured interviews and field observations, including detailed information on production input costs (such as seeds, fertilizers, pesticides, labor, and land rent), production volume, and selling prices. This approach was chosen to obtain a realistic picture of farming conditions and avoid bias. Meanwhile, secondary data was obtained from relevant agencies such as the District Agriculture Office and the Central Statistics Agency to confirm the data and obtain supporting information such as market prices and local agricultural policies, ensuring a strong and representative basis.

The financial feasibility calculations in this study were designed to provide a comprehensive overview of the investment prospects and profitability of watermelon farming. The PP method was used to measure the speed of return on investment (ROI), which in this case was only nine months, indicating a low-risk investment. The very positive NPV (Rp 450,705 million) was justified by using a discount rate reflecting the cost of capital or prevailing bank interest rates, demonstrating that the present value of future cash flows far exceeds the initial investment. The IRR calculation of 149%, significantly higher than the interest rate, is a strong indicator of profitability, while the PI of 4.37 confirms that the project is highly efficient and worthy of continuation and expansion. The use of multiple metrics ensures that the analysis is not only accurate but also robust and reliable for strategic decision-making.

To determine the income of watermelon farming, it is analyzed using the analysis of costs and income of farming (Suyono, 2019):

1. Total fixed cost (TFC). This is a cost that does not depend on the quantity of production incurred. If the producer temporarily stops production, then this FC must be paid the same amount. Examples include the purchase of buildings, machines, building rent, taxes, and others.
2. Total variable cost (TVC). This is a cost that changes according to changes in the quantity of products produced; the greater the quantity of production, the greater the cost of the product produced. Examples include the purchase of raw materials, labor costs, and so on.
3. TC. This is the sum of the total FC and TVC.
4. Marginal cost (MC). This is how much the TC changes are incurred by the company if the amount of output produced changes by one unit. Mathematically written as $MC = \frac{\Delta C}{\Delta Q}$.
5. AFC. This is the FC that must be incurred for each unit of output. Mathematically written as $AFC = \frac{TFC}{Q}$.
6. AVC. This is the VC charged to each unit of output. Mathematically written as $AVC = \frac{TVC}{Q}$.

7. AC. This is the cost of production calculated for each unit of output. Mathematically written as AC = $\frac{TC}{Q}$.

### *Income aspect*

To determine the income from watermelon farming, it is analyzed using cost and income analysis of farming (Renaldo et al., 2023): I = TR – TC, TR = Y × Py, and TC = FC + VC, where I is income, Rp, TR is total revenue, Rp, Y is physical production (unit), and Py is selling price (Rp/unit).

### *Financial feasibility study*

A feasibility study from a financial aspect can be examined from the assessment of cash flow from an investment (Mvelase & Ferrer, 2024). The methods used in assessing the cash flow of an investment are

(1) the PP method,

(2) NPV,

(3) the IRR, and

(4) the PI, according to (Berry, 2017).

### *PP method*

The PP is a method used to calculate the length of the period required to return the money that has been invested from cash inflows (proceeds). Suppose the proceeds each year are the same. In that case, the PP of an investment can be calculated by dividing the amount of investment by the annual proceeds, according to Suliyanto (2010, p. 196). The formula used to calculate the PP is as follows:

$$PP = \frac{Investment}{Net\ cash\ in\ flow}. \qquad (1)$$

The assessment criteria are if the PP project is shorter than the maximum PP, then the investment proposal is acceptable.

### *NPV method*

NPV is a method of calculating net value at present. Present itself is assumed if the initial calculation time coincides with the time the evaluation is carried out. So, the purpose of calculating the NPV is to reduce all cash inflows with cash outflows to the present value.

$$NPV = \sum PV\ In - \sum PV\ Out, \qquad (2)$$

where *PV In* is cash inflow and *PV Out* is cash outflow.

NPV criteria indications are:

1. If NPV > 0, then the investment is profitable or feasible (feasible).
2. If NPV < 0, then the investment is not profitable or feasible (unfeasible).

### *IRR method*

This method is used to calculate the interest rate that can equate the present value of all cash inflows with cash outflows from a project investment, according to Suliyanto (2010, p. 211). The formula used to calculate

The IRR formula for interpolation is:

$$IRR = i_1 + \frac{NPV_1}{(NPV_1 - NPV_{12})}(i_2 - i_1). \qquad (3)$$

The assessment criteria are if the IRR obtained is greater than the specified rate of return, then the investment can be accepted.

### *PI method*

This PI method can be found by calculating the comparison between the present value of net cash receipts in the future (proceeds) with the present value of investment (outlays), according to Suliyanto (2010, p. 205). The formula used to calculate PI is as follows:

$$PI = \frac{NPV}{Initial\ Investment}. \qquad (4)$$

Selection criteria:

1. if PI > 1, then the project proposal is considered feasible.
2. if PI < 1, then the project proposal is considered not feasible.

Investment feasibility criteria from a financial aspect can be implemented if the feasibility test of the PP, NPV, IRR, and PI meet the criteria for being acceptable.

# RESULTS AND DISCUSSION

## Analysis of Production Costs and Income and Profit

It takes three months for one watermelon planting and harvesting period. In a year, farmers can plant 3 times with a month's interval. This one month is used to rest the land. One hectare of land can be planted with approximately 3,000 watermelons. The watermelon used is the Madrid brand seedless type.

The following are the details of the production costs of seedless watermelons.

### *Initial investment*

Cost of purchasing 1 hectare of land = IDR 100,000,000

The cost of purchasing a watering machine = IDR 3,000,000

Total initial investment = IDR 103,000,000

### *FC per year*

Cost of purchasing irrigation pipes = IDR 5,000,000

Depreciation cost of machinery = IDR 500,000

TFC per year = IDR 5,600,000

### *VC per year*

Seeds = IDR 12,000,000

Chemical fertilizers = IDR 27,000,000

Organic fertilizers (animal waste) = IDR 4,500,000

Pesticides and medicines = IDR 9,000,000

Labor costs = IDR 60,000,000

Cost of purchasing musa = IDR 6,000,000

TVC = IDR 108,500,000

**Table 1.** Production costs and revenue

| Production/Q (kg) | FC (Rupiah) | VC (Rupiah) | TC (Rupiah) | AC (Rupiah) | TR (Rupiah) | Profit (Rupiah) |
|---|---|---|---|---|---|---|
| 45.000 | 5.600.000 | 108.500.000 | 114.100.000 | 2.366 | 270.000.000 | 155.900.000 |

**Table 2.** PP

| Years | FV | Discount rate 10%: $1/(1+R)^t$ | PV | Cumulative cashflow |
|---|---|---|---|---|
| 0 | | | -103,000,000 | -103,000,000 |
| 1 | 155,900,000 | 0.90 | 140,310,000 | 37,310,000 |
| 2 | 155,900,000 | 0.82 | 127,838,000 | |
| 3 | 155,900,000 | 0.75 | 116,925,000 | |
| 4 | 155,900,000 | 0.68 | 106,012,000 | |
| 5 | 101,000,000 | 0.62 | 62,620,000 | |

**Table 3.** NPV

| Years | FV | Discount Rate 10%: $1/(1+R)^t$ | PV |
|---|---|---|---|
| 0 | | | -103,000,000 |
| 1 | 155,900,000 | 0.90 | 140,310,000 |
| 2 | 155,900,000 | 0.82 | 127,838,000 |
| 3 | 155,900,000 | 0.75 | 116,925,000 |
| 4 | 155,900,000 | 0.68 | 106,012,000 |
| 5 | 101,000,000 | 0.62 | 62,620,000,00 |
| NPV | | | 450,705,000 |

**Table 4.** Discount rate ($i$) = 10%

| Years | Cash flow |
|---|---|
| 0 | -103,000,000 |
| 1 | 155,900,000 |
| 2 | 155,900,000 |
| 3 | 155,900,000 |
| 4 | 155,900,000 |
| 5 | 101,000,000 |
| IRR | 149% |

TC per year = IDR 114,100,000

### *Income*

Annual production = 45 tons/(45,000) kg

Price = 6,000 per kg

Total annual income = IDR 270,000,000

**Table 1** shows the production costs and revenue. The average watermelon weighs 5 kg. In one hectare, there are 3,000 stems so that it can produce 15,000 kg/15 tons of fruit; in a year, it can be produced three times so that it produces 45 tons/45,000 kg.

The FC spent is IDR 5,600,000, and the VC is IDR 108,500,000, with a TC of IDR 114,100,000. The AC to produce 1 kg of watermelon is IDR 2,366. The price of watermelon per kg is IDR 6,000 and the harvest is 45,000 kg, so the total income is IDR 270,000. Income minus TC produces a profit of IDR 155,900,000 for a year.

### Financial Feasibility Analysis

**Table 2** shows the PP.

$$PP = 1\ year - \frac{37{,}310{,}000}{103{,}000{,}000} = 9\ months. \quad (5)$$

Based on the PP calculation, the investment capital will be returned within 9 months. This project is good to continue because the ROI is less than five years (project life).

### NPV

The interest rate per year is 10%. **Table 3** shows the NPV. The NPV of the watermelon business is positive at Rp. 450,705,000 > 0, so the watermelon business is feasible to run. Assuming that in the fifth year, the business is stopped, the land is sold for 100 million and the machine for 1 million.

### Internal Rate Return

**Table 4** shows the discount rate ($i$) = 10%. The IRR value of this project is 149% greater than the interest rate (10%) so this project is very good to implement.

### Probability Index

$$PI = \frac{450{,}705{,}000}{103{,}000{,}000} = 4.37. \quad (6)$$

From the calculation of the probability index, the PI value is 4.37, which means it is greater than 1, so the project is very good to run.

## DISCUSSION

The financial feasibility analysis of the watermelon farming project demonstrates that the investment is highly viable and profitable based on several key financial indicators, including the PP, NPV, IRR, and PI. The PP is an important indicator to assess the liquidity of an investment. In this case, the investment capital is expected to be recovered within 9 months. This rapid payback, especially considering the project's lifespan of 5 years, is a strong signal of the project's financial health. Projects with a PP under the project's expected life cycle are generally favorable, particularly in agriculture, where uncertainties like market fluctuations, weather conditions, and crop yield can impact returns. The short PP not only minimizes risk but also enhances the attractiveness of the project for investors and stakeholders.

The NPV is a robust measure of the overall profitability of an investment by discounting future cash flows to their present value. With an NPV of IDR 450,705,000, which is significantly positive, the project clearly adds value to the investors. The positive NPV indicates that the return from the project exceeds the cost of capital (10%), showing that the project's revenue generation potential is strong enough to justify the initial investment and provide additional wealth. This result aligns with the principle that a positive NPV implies profitability, making this project highly feasible from a financial perspective.

The IRR is a critical metric for assessing the profitability of an investment relative to its cost of capital. In this case, the IRR is an exceptionally high 149%, which is far greater than the discount rate of 10%. The IRR suggests that for every rupiah invested, the project generates a significant return, far exceeding the benchmark cost of capital. That indicates not only that the project is viable but also that it is highly attractive in comparison to alternative investment opportunities, especially in agriculture, where typical IRR rates tend to be lower due to higher risk factors. An IRR of 149% underscores the significant potential returns, making the project a compelling investment.

The PI of 4.37 further corroborates the viability of the project, as a PI greater than 1 is indicative of a profitable venture. A PI of 4.37 means that for every IDR 1 invested, the project returns to IDR 4.37 in present value terms. This high ratio confirms that the watermelon farming business not only covers its costs but also generates substantial additional income. A PI greater than 1 generally signifies that the project is worth pursuing, and in this case, the high PI reinforces the desirability of the investment (Berry & Shabana, 2020).

Capital budgeting theory provides a foundation for evaluating long-term investments by assessing the expected cash flow, PP, and profitability of a project. In the context of the watermelon farming project, the application of this theory is evident in the financial analysis, which includes calculations for the PP, NPV, and IRR. The results show a PP of 9 months, a positive NPV of IDR 450,705,000, and an impressive IRR of 149%, significantly higher than the 10% discount rate. These metrics are critical in capital budgeting, as they indicate that the project not only recovers its initial investment within a short period but also generates substantial returns beyond the cost of capital, making it a financially sound investment. The high PI of 4.37 further reinforces the idea that this project maximizes value for investors, aligning perfectly with the core objectives of capital budgeting theory–namely, to choose projects that enhance the wealth of the business or individual.

Production and cost theory, which is rooted in microeconomics, examines the relationship between the inputs used in production (such as labor, capital, and materials) and the costs incurred to produce a given level of output. In the watermelon farming project, this theory helps to explain the financial breakdown of FC (IDR 5,600,000), VC (IDR 108,500,000), and the TC (IDR 114,100,000) associated with producing 45,000 kg of watermelon annually. The calculation of AC per kilogram of watermelon–IDR 2,366/kg–illustrates how efficiently the farm operates relative to the market price of IDR 6,000/kg. This cost structure allows the business to maintain a large margin between production costs and sales price, ultimately contributing to its high profitability. Production and cost theory also emphasizes economies of scale, which, in this case, are realized as the farm maximizes its output while keeping costs relatively stable, thus improving profit margins.

Agriculture, by nature, is highly vulnerable to risks such as price volatility, weather fluctuations, and pest infestations, all of which can significantly impact both costs and revenues. The financial feasibility of the watermelon farming project is contingent upon these risks, even though they are not directly factored into the optimistic projections. The theory of risk and uncertainty in agriculture acknowledges that unpredictable events could alter the profitability and viability of the project. For instance, a sharp decline in the market price of watermelons or a poor harvest could increase the PP and reduce the NPV. Therefore, while the current financial projections are favorable, it is crucial to consider risk management strategies such as price hedging, diversification of crops, or investing in technologies that reduce vulnerability to environmental conditions. That aligns with the theory's recommendation that agricultural projects should be evaluated not only on their expected returns but also on the inherent risks that could threaten those returns.

Sustainable watermelon farming in Sako Village, Pangean District, Kuantan Singingi Regency, integrating GSCM practices can significantly enhance both environmental and economic sustainability. Given the high-water requirements for watermelon farming, drip irrigation or rainwater harvesting systems should be implemented to reduce water usage. Drip irrigation delivers water directly to plant roots, minimizing evaporation and waste. To minimize transportation emissions, focus on local markets for watermelon distribution. That reduces the carbon footprint by cutting down on long-distance travel and associated fuel consumption.

Sourcing inputs such as seeds, fertilizers, and machinery from suppliers who adhere to green manufacturing and sustainable practices help create an integrated GSCM. Farmers and distributors should engage with consumers to promote the benefits of sustainably grown watermelons. By raising awareness about the environmental impact of traditional farming versus sustainable practices, demand for eco-friendly products can be increased, thereby strengthening the supply chain's green credentials.

Incorporating quantitative metrics like water conservation via flow meters in drip irrigation and quantifying carbon emission decreases from minimized input transportation is essential for turning theoretical assertions of environmental impact into credible empirical proof; this information enables statistical evaluations (including correlation and regression analyses) to showcase a clear link between GSCM implementation and diminished ecological impact, while also forming the foundation for setting measurable baselines and reduction objectives, thus enhancing accountability, enabling comparisons with traditional methods, and bolstering the case for green incentives or environmental certification that can enhance product worth.

This research method assesses the likelihood of each risk happening (like a 20% decrease in price or a 15% failure in crops) and evaluates its effect on financial indicators (NPV and IRR), enabling a more accurate break-even threshold and the development of targeted mitigation strategies, such as identifying a minimum acceptable price or creating a reserve fund informed by worst-case loss analyses, which greatly enhances the credibility of investment and policy suggestions.

When compared to other horticultural agricultural ventures, such as chili or tomato cultivation, the financial indicators of the watermelon farming business in Sako Village demonstrate superior performance. The average PP for horticultural businesses often ranges from 1.5 to 2.5 years, while this project achieved a very short PP of just 9 months. The IRR of 149% significantly exceeds the IRR of similar businesses, which typically range between 30 and 60% even under ideal conditions. Similarly, the PI of 4.37 is significantly higher than the industry standard, which is generally considered excellent if it exceeds 1.5. This comparison not only highlights the project's exceptional operational efficiency and cost management but also strengthens watermelon cultivation's position as a commodity with a very high ROI and low risk compared to other agricultural investment alternatives.

The project's sustainability claims are bolstered by the implementation of concrete practices that directly reduce its environmental footprint while increasing economic efficiency. The implementation of drip irrigation not only saves water use by 30-50% compared to conventional irrigation, but also minimizes soil erosion and nutrient leaching, thus maintaining long-term land health. Sourcing inputs locally, such as manure from local farmers and independent nurseries, drastically cuts carbon emissions from transportation and supports the village's circular economy. Integrated pest management practices, which reduce reliance on synthetic chemical pesticides, contribute to the conservation of biodiversity, including populations of pollinating insects and natural enemies of pests. These measures transform farmland from mere production units into more resilient ecosystems.

The combination of exceptional financial profitability and sustainable practices creates a superior farming model with a bright future. High financial returns (IDR 155.9 million/year) provide capital and incentives for farmers to continue investing in environmentally friendly technologies, such as drip irrigation and solar panels for water pumps, which may initially require higher initial investment costs. At the same time, reduced operational costs through resource efficiency (water, fertilizer, pesticides) directly increase profit margins, creating a virtuosic cycle where environmental and financial sustainability are mutually reinforcing. This model not only ensures the economic viability of the project but also ensures that financial success is not achieved at the expense of land or natural resource degradation, but rather by preserving them for long-term productivity.

## CONCLUSION

Based on the results of the study of watermelon farming in Sako Village, Pangean District, Kuantan Singingi Regency, it can be concluded as follows:

1. The average production of watermelon farming in Sako Village, Pangean District, Kuantan Singingi Regency, one hectare of land is 45,000 kg per hectare. The total production cost is IDR 114,100,000. The profit obtained is IDR 155,900,000 for one year.
2. The PP value in this project is nine months, the NPV is positive IDR 450,705,000, the IRR value is 149% and the PI value is 4.37. The financial metrics strongly support the continuation and expansion of the watermelon farming project.

The results of the watermelon farming project closely align with capital budgeting theory, production and cost theory, and risk and uncertainty in agriculture. Capital budgeting theory highlights the financial viability of the project through its strong NPV, IRR, and PI, confirming that it is a sound investment. Production and cost theory emphasizes the cost efficiency of the project and the substantial margin between production costs and market prices, driving profitability. Meanwhile, the theory of risk and uncertainty in agriculture serves as a reminder that these favorable financial outcomes are subject to external risks, which must be managed effectively to ensure long-term success.

Integrating GSCM into watermelon farming in Sako Village, Pangean District, can greatly enhance both environmental and economic sustainability. Key strategies include implementing drip irrigation and rainwater harvesting to optimize water usage, reducing evaporation and waste, and focusing on local markets to lower transportation emissions, minimizing the carbon footprint. Sourcing sustainable inputs from eco-friendly suppliers and engaging consumers to raise awareness of the environmental benefits of sustainably grown watermelons are critical components of this approach.

### Implication

The project demonstrates robust profitability, liquidity, and return potential, with minimal risk due to the quick recovery of initial costs. Additionally, the business's capacity to generate large returns, especially in an agricultural setting where profitability can be volatile, is a strong indicator of long-term success. Given these results, the practical takeaway for farmers in Sako Village is a compelling motivation to not only sustain but also enhance watermelon cultivation by implementing sustainable methods like drip irrigation and utilizing local resources, proven to boost profitability and lower operational expenses and carbon emissions. Simultaneously, local governments like the Kuantan Singingi Regency Agriculture Office should develop specific support initiatives, including soft credit options or subsidies for initial investments in drip irrigation technology, along with implementing policies that emphasize and ease the marketing of local goods to reinforce sustainable supply chains and promote the adoption of this effective business model in additional villages.

### Limitation

The analysis assumes a stable price of IDR 6,000 per kilogram for watermelon. However, agricultural commodity prices are often subject to market fluctuations due to supply-demand dynamics, weather conditions, and transportation issues. Any significant decline in the market price could reduce profitability and extend the PP.

### Recommendation

It is highly recommended to proceed with the project, given its significant upside potential and limited downside risk. To mitigate risks related to price fluctuations, it is recommended to explore long-term contracts or forward contracts with buyers, ensuring price stability. Diversifying markets by selling watermelons to different regions or types of buyers (local markets, exporters, or processors) could also reduce dependency on a single price point. Farmers are encouraged to promptly establish farmer groups or cooperatives to enhance their negotiating power and work together to seek long-term agreements with major purchasers like modern retailers or exporters, helping to shield against price volatility and secure product demand. To reduce risk further, farmers should diversify their markets by investigating various segments, such as the processing sector (beverages, food) or markets beyond their region and look into agricultural insurance plans to safeguard against crop loss. In the meantime, policymakers (local authorities and relevant organizations) ought to assist this by enabling the formation of collaborative marketing institutions, offering access to up-to-date price data, and establishing contract negotiation training initiatives. Moreover, initiatives that promote the establishment of cold storage facilities and effective distribution networks will be vital in minimizing harvest losses and broadening market access, thus enhancing the project's economic and environmental sustainability.

Given the concerns about the project's susceptibility to price changes, it is highly advised to undertake additional research to perform sensitivity and scenario analyses that assess how price variations affect financial viability. These analyses ought to replicate different scenarios, including declining selling prices, increasing input expenses, and reduced productivity from weather effects, in order to evaluate the project's break-even threshold and determine its critical juncture. Moreover, additional studies should investigate the most effective hedging and market risk management approaches for local farmers, including the viability of futures contracts, crop insurance plans, or cooperative models that aggregate marketing to stabilize revenues. This method will yield a more pragmatic and robust perspective, shifting the project from being only conceptually advantageous to genuinely ready for market unpredictability.

Recommendations for additional research involve broadening the geographic range by incorporating samples from different villages in Kuantan Singingi Regency and other areas with comparable agro-climatic characteristics. This will enable comparative analysis to assess the reliability of the results, highlight differences in optimal practices, and produce stronger and generalizable policy suggestions for sustainable watermelon farming advancement.

To tackle susceptibility to climate fluctuations, utilizing intelligent irrigation systems reliant on soil moisture sensors and meteorological predictions is an effective approach that can promptly enhance water utilization and avert crop loss from drought or excessive moisture. Moreover, implementing precision farming with drones for monitoring plant health and applying fertilizers and pesticides accurately will greatly decrease productivity losses and reduce input expenses. A further tangible action is to diversify watermelon varieties by choosing types that are more resilient to severe weather or particular pests, thus enhancing operational endurance. To tackle susceptibility to climate changes, employing advanced irrigation systems utilizing soil moisture sensors and weather predictions is an effective approach that can quickly enhance water efficiency and avert crop failure from drought or excessive moisture. Additionally, implementing precision agriculture with drones for monitoring plant health and applying fertilizers and pesticides accurately will greatly decrease productivity losses and reduce input costs. An additional tangible measure involves diversifying watermelon types by choosing varieties that are more resilient to severe weather conditions or particular pests, thereby enhancing operational resilience.

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