

Feasibility Study of *Mucuna bracteata* Compost Business as a UMKM Product in Karo District

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ABSTRACT

Mucuna bracteata is a ground cover plant that can increase nitrogen availability in plantations. However, the biomass from pruning is often left to pile up or burned, potentially causing air pollution and increasing the risk of land fires. Utilizing this biomass as a raw material for compost is more productive, as it not only supports sustainable environmental management but also creates economic opportunities for Micro, Small, and Medium Enterprises (MSMEs). This study aims to assess the financial feasibility of a *Mucuna bracteata*-based compost business in Karo Regency by analyzing initial investment, operational costs, and revenue projections. Business feasibility is measured using the Net Present Value (NPV), Gross Benefit–Cost Ratio (Gross B/C), Internal Rate of Return (IRR), and Payback Period (PBP) indicators. The costs analyzed include raw materials, operational costs, marketing, and investment in processing facilities, with the selling price of compost ranging from IDR2,000 to IDR4,500 per kilogram. The results of the study indicate that the *Mucuna bracteata* compost business provides a positive NPV value of Rp85,154,866, a Gross B/C of 1.66, an annual IRR of 151.88%, and a Payback Period of 3.6 months at a discount rate of 6%. Financial feasibility was evaluated using a 12-month cash-flow projection as the analytical horizon. All indicators (NPV, Gross B/C, IRR, and Payback Period) were calculated based on monthly net cash flows and converted to annual values where appropriate. The results show a positive NPV of IDR 85,154,866, a Gross B/C of 1.66, an annualized IRR of 151.88%, and a Payback Period of 3.6 months under the base-price scenario. These results indicate that the business is financially feasible and capable of rapid capital recovery under the assumed conditions

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1. Introduction

Organic waste management through composting is a crucial strategy for achieving sustainable agriculture because it can improve soil physical, chemical, and biological properties and reduce reliance on synthetic chemical fertilizers (Maryani *et al.*, 2022). *Mucuna bracteata* is widely used as a cover crop in plantation systems. This plant can fix nitrogen, thereby increasing nutrient availability for the main crop (Duque-Acevedo *et al.*, 2020). However, in field practice, *Mucuna bracteata* requires regular pruning, and the resulting biomass is often left or even burned in plantation areas, potentially causing pollution and increasing the risk of land fires (PPID Ministry of Environment and Forestry, 2023). This

situation indicates that *Mucuna bracteata* biomass waste management is not yet optimal and continues to pose environmental risks. Several studies have shown that *Mucuna bracteata*-based compost can improve soil quality and enhance plant growth under various cultivation conditions (Saragih & Azhimah, 2022; Wahyuni *et al.*, 2020). Its organic matter content and nitrogen fixation capabilities make this plant biomass a potential raw material for economically valuable compost. From a socio-economic perspective, processing *Mucuna bracteata* biomass into compost also creates business opportunities for Micro, Small, and Medium Enterprises (MSMEs), particularly in agricultural centers such as Karo Regency, while helping farmers cope with price fluctuations and the limited availability of inorganic fertilizers (Haloho *et al.*, 2022). Thus, developing a *Mucuna bracteata*-based compost business has the potential to provide dual benefits: environmental and economic.

Utilizing organic waste as a value-added product aligns with the circular economy concept, which encourages the recycling of biomass waste to avoid environmental burdens (De Boni *et al.*, 2022). However, developing a compost business on an MSME scale still requires a financial feasibility study to ensure business sustainability. Financial feasibility analysis is generally conducted using Net Present Value (NPV), Gross Benefit-Cost Ratio (Gross B/C), Internal Rate of Return (IRR), and Payback Period (PBP) indicators (Masanja, 2020; Triansyah & others, 2023). Through these indicators, a business's ability to generate profits and recoup its investment can be objectively measured.

Karo Regency is a horticultural center in North Sumatra with significant potential for developing a *Mucuna bracteata*-based compost business. Utilizing this plant biomass is expected to support environmental management in plantations while strengthening the local economy through MSMEs. Therefore, the purpose of this study is to assess the financial feasibility of a *Mucuna bracteata* compost business as an MSME product in Karo Regency by analyzing initial investment, operational costs, and projected revenue. It also assesses the return on investment and break-even point using NPV, Gross B/C, IRR, and Payback Period indicators.

Although several agronomic studies have demonstrated the effectiveness of *Mucuna bracteata* compost in improving soil fertility and crop growth, empirical evidence regarding the financial feasibility of MSME-scale compost production using locally realistic cost structures and market prices remains limited. Therefore, this study contributes by providing a detailed cash-flow-based financial evaluation in the specific context of Karo Regency, offering practical implications for MSME investment decisions and for the implementation of the circular economy.

2. Methodology

This research was conducted in Karo Regency, North Sumatra, a horticultural center and a region where *Mucuna bracteata* is widely used as a ground cover crop in plantations. The location was selected purposively, based on scientific considerations regarding raw material availability and the potential for compost business development. The research was conducted from June to December 2024, in line with the established research schedule. The feasibility analysis was conducted using a 12-month project horizon with monthly cash-flow periodicity. Production capacity, selling volume, and cost structures were derived from documented operational records of local composting practices. All financial indicators were calculated using monthly net cash flows. The annual discount rate of 6% (Bank Indonesia benchmark rate) was converted to an effective monthly rate using:

$$r_m = (1 + 0.06)^{1/12} - 1.$$

Only real cash expenditures were included in cash outflows; depreciation was excluded as it represents a non-cash accounting cost. The analysis employed free cash flow to ensure consistency in NPV and IRR estimation. This study used a quantitative approach because the data analyzed were numerical, cost-, revenue-, and cash-flow-related, and could be objectively calculated to assess the financial feasibility of a compost business (Bell *et al.*, 2022). A quantitative approach is relevant in feasibility studies because it enables measurable, systematic financial analysis (Masanja, 2020).

The main variables in this study were:

1. Initial capital cost.
2. Operational costs.
3. Revenue.
4. Net cash flow.

Financial feasibility indicators, namely Net Present Value (NPV), Gross Benefit–Cost Ratio (Gross B/C), Internal Rate of Return (IRR), and Payback Period (PBP), are commonly used in investment feasibility studies (Mesly, 2017). This study did not involve respondents, as it was a secondary data-based feasibility study (desk study). All data was obtained through documents, scientific publications, official reports, and relevant statistical sources. In quantitative research, a desk study approach can be used when the focus is on analyzing costs, revenues, and financial feasibility derived from documentary data, rather than on individual perceptions or opinions (Borges *et al.*, 2020; Leow *et al.*, 2020). Therefore, the unit of analysis in this study was the *Mucuna bracteata* compost business, not the individual respondents.

The data used included:

1. Primary document data, in the form of details of investment costs, operational costs, and compost business structure, obtained from business actors and relevant agencies through documentation and archives.
2. Secondary data, in the form of scientific publications, statistical reports, government regulations, and relevant literature on composting businesses and financial feasibility indicators, were used.

The use of this combination of documentary data aims to produce credible financial estimates and support the validity of the analysis (Gebrezgabher & others, 2021).

Data analysis in this study focused on the financial feasibility of the *Mucuna bracteata* composting business using several standard investment indicators, namely:

2.1 Net Present Value (NPV)

NPV is used to measure the difference between the present value of all cash inflows and the present value of all cash outflows over the life of the project. A project is considered feasible if the NPV is greater than zero ($NPV > 0$).

$$NPV = \sum_{t=0}^n \frac{CF_t}{(1+r)^t} - I$$

Description:

CF_t = net cash flow in period t

r = discount rate

n = project duration (years)

I = initial investment

Decision criteria:

NPV > 0 ⇒ project is financially feasible

NPV ≤ 0 ⇒ project is not feasible

2.2. Internal Rate of Return (IRR)

IRR is the discount rate that makes NPV equal to zero:

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

This means that the IRR is the rate of return on investment generated by the project.

The project is feasible if the IRR > the specified discount rate.

Decision criteria:

IRR > r ⇒ project is feasible

IRR ≤ r ⇒ project is not feasible

2.3. Gross Benefit–Cost Ratio (Gross B/C)

Gross B/C is the ratio of total benefits to total discounted costs:

$$GrossB/C = \frac{\sum_{t=1}^n \frac{Ben_t}{(1+r)^t}}{\sum_{t=1}^n \frac{Cost_t}{(1+r)^t}}$$

Note:

Ben_t = benefit in period t

Cost_t = cost in period t

Decision criteria:

Gross B/C > 1 ⇒ project is feasible

Gross B/C ≤ 1 ⇒ project is not feasible

2.4. Payback Period (PBP)

Payback Period calculates the time period The amount of cash needed to recover the initial investment based on annual net cash flow.

$$PBP = \frac{\text{Initial Investment}}{\text{Annual Net Cash Flow}}$$

Decision criteria:

PBP shorter than the project life $\Rightarrow$ feasible

PBP longer than the project life $\Rightarrow$ not feasible

With this method design, this study is expected to provide a comprehensive overview of the financial feasibility of the *Mucuna bracteata* compost business as an MSME product in Karo Regency. A quantitative approach based on documentary data (desk study) enables systematic, measurable analysis through calculations of NPV, Gross Benefit-Cost Ratio, Internal Rate of Return, and Payback Period. All cost, revenue, and cash flow projections are analyzed using appropriate discount rates, ensuring results reflect realistic economic conditions. Thus, this method design not only provides a strong basis for assessing the financial feasibility of a compost business but also serves as a reference for decision makers, MSMEs, and stakeholders.

3. Results and Discussion

3.1 Investment and Operational Cost Structure

The analysis shows that the cost structure of the *Mucuna bracteata* compost business consists of three main components: equipment costs, consumables costs, and routine operational costs. The total initial investment reached IDR100,795,000, including equipment, consumables, pre-operational expenses, and working capital. consisting of equipment costs of IDR72,495,000, consumables costs of IDR17,100,000, and operational costs of IDR10,200,000.

The dominance of equipment costs indicates that the largest initial capital is allocated to fixed assets, such as composting facilities, scales, sprayers, and other production facilities. Meanwhile, variable costs, such as raw materials and operational expenses, are relatively low because *Mucuna bracteata* biomass is readily available through routine pruning, thereby eliminating the need to purchase raw materials. This condition is consistent with the findings of Mimbar Agribisnis and international literature that the agricultural waste-based compost business model has relatively higher fixed costs than variable costs, but remains financially efficient (De Boni *et al.*, 2022) (Velasco-Muñoz *et al.*, 2021). This cost structure serves as the basis for cash outflows in the financial feasibility analysis for subsequent periods.

3.2 Pricing Structure, Sales, and Business Cash Flow

Sales data, cost of goods manufactured, and monthly net profit are projected for the first 12 months. Cash inflows (sales) increase each month, from IDR7,800,000 in the first month to over IDR22,000,000 in the 12th month. Conversely, cash outflow consists of cash operating expenses such as COGS, labor, and marketing costs. Depreciation was excluded from the cash flow analysis because it does not represent an actual cash outlay. increases more slowly.

The cash inflow and outflow pattern of the *Mucuna bracteata* compost business during the first 12 months is presented in Figure 1. Cash inflows show an increasing trend each month, while cash outflows tend to be stable.

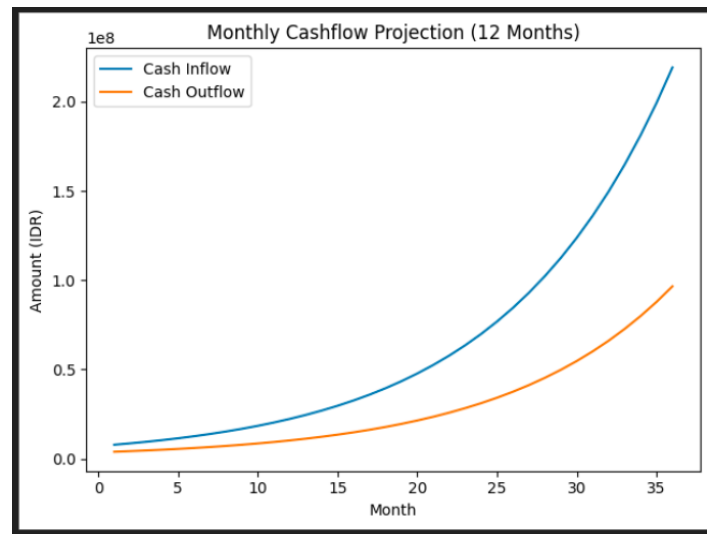


Figure 1. Diagram Cash Flow

Net Cash Flow increased from IDR3,928,933 in the first month to over IDR12,000,000 in the 12th month. This pattern is visually displayed in the Monthly Cash Flow Graph above. The graph clearly shows that:

- the Cash Inflow line is consistently above the Cash Outflow line
- the distance between the two lines widens from month to month
- Net Cash Flow increases progressively

This means the business's cash performance has shown positive cash flow from the first month of operation, and the trend has continued consistently. This trend aligns with agribusiness research, which indicates that waste-based businesses have the potential for stable profit growth because they do not depend on input price fluctuations (Gebrezgabher & others, 2021; Syafrudin & others, 2023; Iacovidou & Zorpas, 2022).

3.3 Cashflow-Based Financial Feasibility Analysis

3.3.1 *Net Present Value (NPV)*

Net Present Value (NPV) is used to assess the difference between the present value of all cash inflows (benefits) and the present value of all cash outflows (costs) over the life of the business. A business is considered feasible if the $NPV > 0$, meaning the net benefits received exceed the costs incurred. The formula used is:

$$NPV = \sum_{t=0}^n \frac{CF_t}{(1+r)^t} - I$$

where CF_t = net cash flow in period t and r = discount rate.

Based on research data, the monthly net cash flow is discounted at an interest rate of 6% per annum, resulting in a total present value of benefits of IDR185,949,866. In contrast, the total present value of costs (including the initial investment) is IDR100,795,000. Therefore, the NPV is calculated as follows:

$$NPV = 185,949,866 - 100,795,000 = \text{IDR}85,154,866$$

This value indicates that during the analysis period, the financial benefits received far exceeded the costs incurred. In other words, after all investment and operational costs are accounted for, the business still generates a substantial net surplus. This condition meets the investment feasibility criteria, where an $NPV > 0$ indicates that the business is financially viable (Masanja, 2020).

The 6% discount rate chosen in this study was based on Bank Indonesia's benchmark interest rate (BI Rate) at the time of the study, thus representing the relevant opportunity cost of capital for MSMEs in the agribusiness sector. The use of a discount rate based on the BI Rate is also common in Indonesian feasibility studies, as it is considered a measure of the minimum risk an investment must "surpass" (Nugroho & Margana, 2024). Therefore, the positive NPV obtained at a 6% discount rate indicates that the *Mucuna bracteata* compost business not only covers capital costs but also provides a rate of return above the bank benchmark interest rate.

In the literature, these results align with numerous studies on the financial feasibility of agribusiness. The feasibility of community-scale compost and digester installations in Malaysia was also reported to yield a positive NPV and to confirm that using organic waste as the primary raw material can generate stable and profitable cash flows (Leow *et al.*, 2020). Community composting schemes in Europe show a similar pattern, with community-based composting business models deemed economically profitable while providing environmental benefits (De Boni *et al.*, 2022). An assessment of the economic feasibility of composting facilities using an Industry 4.0 approach also found that investment in composting technology is financially viable when initial costs are offset by operational efficiency gains and sales revenue from the final product (Oliveri & others, 2023).

In a national context, various studies on small-scale agribusinesses have also reported similar results. Anggardha & Setiafindari (2023) found a positive NPV for broiler chicken farming compared to prevailing interest rates, while Komari & others (2022 and Afifah *et al.* (2024 reported positive NPV for food processing and skin cracker businesses. These studies indicate that MSME business models that utilize low-cost raw materials and have clear market access tend to generate positive NPV, as was the case for the *Mucuna bracteata* compost business in this study.

Substantively, the present value of the benefits of Rp185,949,866, compared with the initial investment of Rp100,795,000, indicates that this business has successfully converted biomass waste into high-value cash flows. This strengthens the argument that the use of *Mucuna bracteata* as a raw material for compost is a form of circular economy implementation that not only reduces environmental problems but also provides real financial benefits (Duque-Acevedo *et al.*, 2020) (Gebrezgabher & others, 2021). Thus, from an NPV perspective, the *Mucuna bracteata* compost business has strong prospects for development as a sustainable MSME business unit.

3.3.2 Internal Rate of Return (IRR)

The Internal Rate of Return (IRR) is the internal rate of return on an investment derived from net cash flows over the life of the business. The IRR indicates the interest rate that makes the Net Present Value (NPV) equal to zero and can therefore be used to assess whether the rate of return generated by an investment exceeds the cost of capital employed. In general, an investment is considered feasible if its IRR exceeds the benchmark interest rate or the applicable discount rate (Ichsan *et al.*, 2020; Havard, 2013).

The IRR is the discount rate that makes the NPV equal to zero:

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

The IRR value is determined through an iterative process until a discount rate is found that makes the NPV value close to zero.

In this study, the monthly net cash flow of the *Mucuna bracteata* compost business was used as input for the IRR calculation, with an initial investment of IDR 100,795,000 as the cash outflow in period 0. Based on the iterative process using these monthly cash flows, the monthly IRR was obtained as 0.0800, or 8.00%.

This value was then converted to an annual IRR using the formula:

$$IRR_{annual} = (1 + IRR_{monthly})^{12} - 1$$

$$IRR_{annual} = (1 + 0,0800)^{12} - 1 = 151,88\%$$

Therefore, the annual IRR of the *Mucuna bracteata* compost business is 151.88%. Because the IRR is significantly higher than the 6% discount rate (BI Rate), this business is considered highly financially viable and offers a very large return on investment. The annual IRR of 151.88% reflects that investment in the *Mucuna bracteata* compost business generates a rate of return that far exceeds the opportunity cost of capital. This high IRR is primarily influenced by several external factors, namely:

1. The availability of abundant and very low-cost raw materials, as *Mucuna bracteata* is a biomass harvested from previously unused prunings.
2. Stable market demand from horticultural farmers in Karo Regency, resulting in a continuous increase in cash inflow.
3. Relatively constant operating costs, as most costs are fixed costs that do not increase significantly even with increasing production volume.
4. The absence of dependence on imported raw materials or high-cost components minimizes the risk of input price fluctuations.
5. This combination of factors results in rapid monthly net cash flow growth, accelerating the payback process and driving a high IRR.

The results of this study align with various financial feasibility studies in the agribusiness sector, both nationally and internationally. Research (Leow & others, 2020) in Malaysia showed that community-scale composting businesses generated a higher IRR than commercial interest rates due to lower raw material costs. (De Boni *et al.*, 2022) also reported that the community composting model in Europe had a competitive IRR because it sourced raw materials from household organic waste at minimal cost. In the national agribusiness context, Anggardha & Setiafindari (2023) found that broiler chicken farming generated an IRR above the benchmark interest rate but still lower than that of waste-based businesses due to high feed costs. Similarly, Komari & others (2022) reported a positive IRR for food MSMEs, but it was lower than that of composting businesses due to their reliance on market-priced raw materials.

Meanwhile, Syafrudin & others (2023) showed that businesses that use waste as the main raw material tend to generate high IRR due to low variable costs, proximity to raw

material sources, and short distribution chains conditions identical to those of the *Mucuna bracteata* compost business in this study.

Thus, the annual IRR of 151.88% obtained in this study is consistent with empirical findings that circular economy businesses based on agricultural waste have excellent financial profitability.

3.3.3 Gross Benefit–Cost Ratio

The Gross Benefit–Cost Ratio (Gross B/C) is a financial feasibility indicator that compares the present value of all economic benefits (benefits) with the present value of all costs incurred over the life of the business. In general, a business is considered feasible if the Gross B/C value is greater than 1, as this indicates that the economic benefits exceed the total costs (Gittinger, 1984; Scarborough & Kydd, 1992). This indicator is widely used in agribusiness investment analysis because it can comprehensively describe financial efficiency.

The Gross B/C formula used is

$$\text{GrossB/C} = \frac{\sum_{t=1}^n \frac{\text{Ben}_t}{(1+r)^t}}{\sum_{t=1}^n \frac{\text{Cost}_t}{(1+r)^t}}$$

The results of the cash flow analysis in this study yielded:

$$\begin{aligned} \sum PV(\text{Benefit}) &= \text{Rp}155.451.736 \\ \sum PV(\text{Cost}) &= \text{Rp}93.968.910 \end{aligned}$$

Therefore, the Gross B/C value is calculated as follows:

$$\text{GrossB/C} = \frac{155.451.736}{93.968.910} = 1,66$$

Gross B/C value of 1.66 (> 1.00) indicates that every Rp1,000 in costs incurred will generate economic benefits of Rp1,660. Thus, the *Mucuna bracteata*-based compost business is declared financially feasible and efficient, as the economic benefits obtained exceed the total costs incurred during the business period (Gittinger, 1984). These findings are also consistent with other financial indicators, such as a positive NPV, a high IRR, and a relatively short Payback Period, thus strengthening the conclusion that the *Mucuna bracteata* compost business has profitable economic prospects.

This relatively high Gross B/C value is influenced not only by internal efficiency factors but also by several external factors that support the business's cash flow generation. First, raw material costs are relatively low because *Mucuna bracteata* is biomass from routine pruning that was previously unused. This condition reduces production costs and increases profit margins. Second, demand for compost in horticultural areas such as Karo Regency is quite stable, thus maintaining business revenue. Third, the business's proximity to raw material sources and markets reduces distribution costs, which are generally a significant component of agribusiness. Fourth, policy support and environmental awareness regarding reducing biomass burning have contributed to farmers' preference for compost products that

are environmentally friendly. These factors also align with the very high IRR, as the combination of low costs and stable revenue accelerates the accumulation of positive cash flow.

Compared with other studies, the Gross B/C of 1.66 aligns with empirical findings on the processing of agricultural waste into value-added products. For example, a study (Maryani *et al.*, 2022) in Mimbar Agribisnis reported that composting in organic farming systems yielded a Gross B/C above one due to low raw material costs. In the journal *Agriekonomika*, Putra & Sari (2021) also found that agricultural waste-processing MSMEs were deemed financially viable when the raw materials were derived from production waste that had no market value. Internationally, a study by Cobo *et al.* (2020) showed that implementing a circular economy in agricultural waste management can increase economic efficiency by utilizing previously wasted resources. Similarly, a study (Psomakes *et al.*, 2021) in the *Journal of Environmental Management* reported that small-scale composting models yield a positive benefit-cost ratio when located close to biomass sources and user markets. Thus, the Gross B/C value of 1.66 in this study not only demonstrates financial feasibility but also shows that the *Mucuna bracteata*-based compost business model can operate efficiently within a circular economy framework. Utilizing previously worthless biomass into commercial products offers dual benefits: increasing MSME income while supporting sustainable environmental management. This positions the *Mucuna bracteata* compost business as an alternative agribusiness investment that is not only financially viable but also relevant to the direction of sustainable agricultural development.

3.3.4 Payback Period (PBP)

The Payback Period (PBP) is used to measure how long it takes for an investment to recover its initial cost through net cash flows generated each period. This indicator is widely used in agribusiness feasibility studies because it provides a simple illustration of the speed of capital recovery and the level of investment risk. In general, the shorter the payback period, the lower the business's financial risk (Mesly, 2017). Because the business's net cash flow varies each month, the PBP is calculated using the formula:

$$PBP = \frac{\text{Initial Investment}}{\text{Annual Net Cash Flow}}$$

The initial investment for the *Mucuna bracteata* compost business was IDR100,795,000, with a gradual increase in monthly net cash flow, from IDR3,928,933 in the first month to over IDR12,000,000 in the 12th month. The accumulated monthly net cash flow indicates that the capital has not yet been fully recovered in the third month, but is already approaching the investment value. Based on the cumulative calculation, we obtain:

$$PBP = 3.6 \text{ months}$$

This means that all capital can be recovered before the fourth month of operation. With a payback period of 3.6 months, the *Mucuna bracteata* compost business has a very high return on investment compared to its much longer economic life. This value indicates that the business's financial risk is relatively low, as the invested capital only lasts for less than four months before being fully recovered.

This rapid payback period is influenced not only by internal operational efficiency but also by several highly supportive external factors, namely:

1. The availability of free and abundant raw materials.
Mucuna bracteata is a ground cover crop that is regularly pruned, providing biomass without purchasing costs. This significantly reduces variable costs, accelerating profit accumulation.
2. Strong and stable market demand.
Karo Regency is a horticultural center. Farmers need compost to improve soil structure, providing a clear market for the product. This stability ensures consistent cash flow from the start of the business.
3. Low distribution costs.
The business is located close to raw material sources and consumers, minimizing logistics costs—a highly advantageous situation for MSMEs.
4. Minimal dependence on fluctuating inputs.
Unlike businesses that rely on imported animal feed or materials, compost businesses are not directly affected by international price fluctuations, ensuring a more stable cash flow.

These factors collectively explain why this business can achieve a very rapid PBP, which aligns with the very high IRR value in the previous analysis.

The PBP value of 3.6 months in this study is faster than those reported in other agribusiness financial feasibility studies. For example, Anggardha and Setiafindari (2023) reported a PBP of around 1–2 years in broiler chicken farming due to high feed costs (Anggardha & Setiafindari, 2023). Furthermore, some household-scale food processing MSMEs require a PBP of more than a year (Komari & others, 2022). However, some organic waste-based businesses can achieve a shorter PBP due to very low raw material costs a finding consistent with this study (Syafudin & others, 2023). Internationally, community and small-scale composting models have a relatively short PBP when raw materials are available locally and through direct markets. However, the exact value is still longer than the 3–6 months obtained in this study (Leow & others, 2020) (De Boni *et al.*, 2022).

Thus, the rapid PBP in this study reinforces the conclusion that a *Mucuna bracteata* compost business is a low-risk, high-profit investment, especially in agricultural areas with abundant biomass supplies and a growing organic market.

A simple scenario analysis was conducted to evaluate price uncertainty using three compost price levels: IDR2,000/kg (low), IDR3,250/kg (base), and IDR4,500/kg (high). The results indicate that NPV remains positive in the base and high scenarios but declines substantially under the low-price scenario, suggesting that profitability is sensitive to market price fluctuations. Therefore, price stability and market access are critical determinants of financial sustainability.

4. Conclusion

This study aims to assess the financial feasibility of a *Mucuna bracteata*-based compost business at the MSME level in Karo Regency. The analysis showed that equipment costs accounted for 80% of the total initial investment of IDR100,795,000, while *Mucuna bracteata* biomass was readily available as waste, resulting in relatively low raw material costs. This resulted in increasing net cash flow from the start of the business.

Using a 6% discount rate, the NPV was IDR85,154,866, the Gross B/C was 1.66, the annual IRR was 151.88%, and the Payback Period was 3.6 months. All these indicators indicate that the *Mucuna bracteata* compost business is highly feasible and financially profitable, with relatively faster capital recovery under base-case assumptions. In practice, this biomass utilization reduces agricultural waste while increasing the economic value of local MSMEs. This study is limited to a 12-month projection and does not incorporate detailed risk simulations or long-term market fluctuations. Future research should incorporate sensitivity and stochastic modeling to strengthen the robustness of financial projections.

Recomendation

1. Practical Suggestions

- a. The *Mucuna bracteata* compost business is feasible to replicate in areas with similar raw material availability, with support from business management development, capitalization, and strengthened market access.
- b. Product quality standardization and organic certification are recommended to increase competitiveness and sales value.

2. Academic/Theoretical Suggestions

The NPV, Gross B/C, IRR, and PBP indicators have proven relevant for assessing circular economy business models, enabling this approach to be applied in another organic waste-based financial research.

3. Further Research Suggestions

- a. A broader sensitivity analysis is needed to address price, production volume, and changes in the discount rate.
- b. It is recommended to include ecological and social benefits in the financial model for a more comprehensive picture of business sustainability.
- c. Field research on farmer adoption rates and compost market dynamics is essential to strengthen the validity of the findings.

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