

Integrating Green Costing into the Cost of Goods Manufactured of Catering MSMEs in Malang

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ABSTRACT

Food-sector MSMEs contribute substantially to the Indonesian economy, yet their conventional cost of goods manufactured (COGM) calculation ignores environmental costs such as waste handling and energy consumption. This study implements a green costing approach in the COGM model of catering MSMEs in Malang City as a strategy towards simultaneous economic and environmental sustainability. A mixed methods explanatory sequential design with a multiple-case study was applied to three catering MSMEs selected purposively. Qualitative data from nine in-depth interviews, participant observation and internal documents were analysed using reflexive thematic analysis, while quantitative data were analysed using descriptive statistics and a costing model that traces five environmental cost components through the eco-costs and averting costs methods and charges them per portion. Coding produced 142 initial codes consolidated into ten sub-themes and four themes: habit-based COGM calculation, environmental costs as hidden costs, limited resources and accounting literacy as barriers, and market pressure as a driver. Integrating environmental costs raised COGM by 8.40 to 15.60 percent, with an average of 12.33 percent and an average environmental cost of IDR 1,890 per portion, with larger relative increases observed in the smaller cases. A joint display of the two strands explains this pattern, and a four-module spreadsheet-based COGM model was developed and pilot-tested.

Keywords: Cost of goods manufactured; Eco-costs; Environmental management accounting; Food MSMEs; Green costing

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INTRODUCTION

Environmental sustainability has become a global priority as the impacts of climate change and ecosystem degradation intensify. In this context, the business sector carries a strategic responsibility to transform conventional business models into more sustainable practices. In Indonesia, Micro, Small, and Medium Enterprises (MSMEs) play a crucial role, contributing more than 60 percent of Gross Domestic Product and absorbing around 97 percent of the national workforce (Ministry of Cooperatives and SMEs, 2024). The number of MSMEs reached approximately 66 million units in 2023, an increase of 1.5 percent compared with 2022 (Databoks, 2024). However, the rapid growth of MSMEs, particularly in the food sector, also generates significant environmental pressures, ranging from intensive energy consumption and the accumulation of organic and inorganic waste to a continuously rising carbon footprint. A systematic approach is therefore required to integrate environmental sustainability into the operational cost structure without compromising the economic viability of MSMEs.

Malang City, as one of the economic and culinary centres of East Java, shows rapid growth in food-sector MSMEs, especially catering businesses whose demand continues to rise along with economic activity, tourism, and urban consumption patterns. Nevertheless, most food-sector MSMEs still calculate the Cost of Goods Manufactured (COGM) conventionally, considering only raw materials, labour, and operational overhead, without integrating the environmental costs that actually arise from production activities. As a consequence, negative externalities such as pollution, waste, and environmental degradation are not reflected in the cost structure, creating an illusion of efficiency that is not sustainable in the long run. This condition is consistent with evidence that food-sector MSMEs in various countries face obstacles in adopting comprehensive environmental accounting practices (Swalih et al., 2024).

Green costing is an environmental management accounting approach that integrates environmental cost components into the production costing system. Environmental Management Accounting (EMA) has developed as a pragmatic instrument for strategic decision-making in the context of sustainability, emphasising proactive and comprehensive collection of environmental data (Burritt et al., 2023). For food-sector MSMEs, green costing identifies not only conventional costs but also costs related to organic waste management, energy consumption, water use, environmentally friendly packaging, and the procurement of sustainable raw materials. Applying green costing to the COGM model allows MSMEs to obtain a more comprehensive and accurate cost picture that reflects the environmental impact of each unit of product (Rahman & Islam, 2023). The model therefore functions not merely as a costing tool but also as a strategic instrument for achieving economic and environmental sustainability simultaneously.

Economic and environmental sustainability are not competing objectives; they reinforce each other when managed with an appropriate strategy. Economically, applying green costing to the COGM model can improve operational efficiency by identifying resource waste, reducing waste handling costs, and optimising energy use (Christ & Burritt, 2015; Amicarelli et al., 2022). MSMEs that adopt environmentally friendly practices also gain higher competitiveness, particularly in accessing increasingly environmentally conscious markets; a global survey of more than 20,000 consumers found that four in five are willing to pay more for sustainably produced or sourced goods, by an average of 9.7 percent (PwC, 2024). Environmentally, the integration of green costing encourages MSMEs to use local organic materials that reduce the transport carbon footprint, to manage organic waste productively into compost or alternative energy, and to minimise the use of hazardous chemicals, which is central to achieving the Sustainable

Development Goals in agricultural cities (Thongplew et al., 2023).

Although environmental management accounting has matured as a field, its costing applications remain concentrated in larger organisations. In the food sector, material flow cost accounting studies have quantified the hidden cost of material losses in industrial potato chip production and meat processing (Amicarelli et al., 2022; Bux & Amicarelli, 2022), and case evidence from manufacturing firms shows that the host costing system shapes how environmental costs can be traced (Usul & Olgun, 2025). Christ and Burritt (2015) have noted the lack of systematic evidence on the applicability of such tools beyond manufacturing and across different firm sizes. Research on smaller enterprises, by contrast, has mostly examined the drivers of and barriers to environmental practices, identifying limited knowledge and human resource capacity, restricted access to environmentally friendly technology, the absence of practical frameworks suited to SME characteristics, and the perception that sustainable practices require heavy investment (Dasanayaka et al., 2022). In Indonesia, Bank Indonesia (2023) classifies environmentally oriented MSMEs into three categories, namely eco-adopter, eco-entrepreneur, and eco-innovator, and a survey of 194 MSMEs in East Java shows that environmental accounting strategy positively affects sustainability performance, with waste management mediating that relationship (Latifah & Soewarno, 2023). These survey-based studies establish that environmental accounting matters for MSMEs, but they do not show how environmental costs can be traced and charged to a unit of product in a micro enterprise that keeps no separate business records and has no sub-meters, which is the typical condition of catering MSMEs. In Malang City, several catering MSMEs have begun to use organic materials and to apply environmentally friendly practices partially, yet limited studies have developed a practical green costing COGM model specifically adapted to the characteristics and resource constraints of food-sector MSMEs in Indonesia.

The urgency of this research is reinforced by Indonesia's commitment to the Sustainable Development Goals, particularly Goal 12 on responsible consumption and production and Goal 13 on climate action, given that agriculture and food systems directly or indirectly influence 16 of the 17 goals (Miles et al., 2025). At the global level, the OECD (2025) emphasises that assessing and monitoring the environmental footprint of SMEs is crucial for effective greening policies, noting that SMEs account for around 40 percent of business-sector greenhouse gas emissions in the European Union. However, the gap between macro-level policy and micro-level measurement remains substantial. Taken together, the literature leaves three gaps. Empirically, there is little product-level evidence on how large environmental costs are relative to conventional COGM in Indonesian food-sector MSMEs. Methodologically, existing costing procedures assume a metering and record-keeping capacity that micro enterprises rarely possess. Explanatorily, survey-based studies measure whether environmental accounting is associated with performance, but not why environmental costs remain invisible in everyday pricing decisions. Accordingly, this study examines the implementation of green costing in the COGM model of catering MSMEs in Malang, identifies relevant environmental cost components, compares conventional and green COGM, and formulates a feasible implementation strategy. Its novelty is threefold: first, a two-layer costing procedure that combines the averting costs and eco-costs methods with sample-based proportional allocation, so that environmental costs can be charged per portion without sub-meters; second, an explanatory sequential mixed methods design whose joint display explains, rather than merely reports, the variation in the cost burden across cases; and third, a four-module spreadsheet-based COGM model designed for owners with limited accounting literacy and pilot-tested in the field.

METHODS OF RESEARCH

This study employs a mixed methods approach with an explanatory sequential design that combines qualitative and quantitative methods in sequence (Creswell & Creswell, 2023). Mixed methods research integrates both approaches to provide a comprehensive understanding of complex phenomena, enabling triangulation, validation of findings, and deeper insight into the research questions (Taheri & Okumus, 2024). The approach was selected because the complexity of green costing implementation in MSMEs requires an in-depth understanding of actual practices as well as quantifiable measurement of economic and environmental impacts.

The study adopts a multiple-case study design with catering MSMEs in Malang City as the unit of analysis, since it addresses "how" and "why" questions in which the boundary between the phenomenon and its context is not clearly separated (Yin, 2018). Cases were selected purposively using five criteria: operating for at least two years; using or being committed to using organic and/or local raw materials; generating annual turnover of at least IDR 50 million; willing to provide access to operational and financial data; and located in Malang City. Three catering MSMEs met all criteria and participated in the study, a number at the lower bound of the planned range of three to five cases that allows cross-case analysis and strengthens analytical generalisation.

Primary data were collected through semi-structured in-depth interviews with owners or managers, operational supervisors, and finance supervisors, each lasting 60 to 90 minutes, recorded with consent and transcribed verbatim. Participant observation was conducted for two to four weeks in each case, focusing on raw material procurement, production processes, waste management, and patterns of water and energy use. Financial and operational records covering the last six to twelve months, together with a structured questionnaire developed from the EMA framework, provided the quantitative input. Secondary data comprised internal MSME documents, statistics from local and national agencies, and policy documents on green MSMEs. Field notes, transcripts, and supporting documents were compiled in a case study database to maintain a clear chain of evidence between research questions, data, and conclusions (Yin, 2018)

Qualitative data were analysed using Reflexive Thematic Analysis through the six phases proposed by Braun and Clarke (2022), namely familiarisation with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Interviews were conducted in Indonesian and transcribed verbatim; the extracts presented in this article were translated into English and checked against the original transcripts by a second member of the research team. Coding was conducted both inductively, to capture meanings emerging from participants, and deductively, based on the EMA and green costing frameworks. Quantitative data were analysed using descriptive statistics and a costing model. Conventional COGM was calculated as the sum of raw materials, direct labour, and factory overhead. Environmental costs were identified and quantified in monetary terms using the eco-costs method (Vogtlander et al., 2001; Ecocostvalue, 2023) combined with the averting costs method for five components: organic and inorganic waste management, energy consumption, water use, environmentally friendly packaging, and the price premium of local and organic raw materials. The detailed calculation procedure is described in the following subsection.

Green Costing Calculation Procedure

Green costing in this study was operationalised as a two-layer costing procedure. The first layer

reproduces the conventional COGM that MSMEs already use, so that the comparison is made against their own practice rather than against a textbook norm. The second layer traces environmental costs that are currently absorbed in general operational expenses or borne implicitly, converts them into monetary terms, and charges them to the cost object, namely one portion of catering product. The calculation was carried out per case per month and then divided by the monthly production volume of that case. The four equations applied are as follows.

$$\text{COGM}_{\text{conv}} = \frac{\text{DM} + \text{DL} + \text{FOH}}{Q} \quad (1)$$

$$\text{EC}_{\text{unit}} = \frac{\text{EC}_{\text{waste}} + \text{EC}_{\text{energy}} + \text{EC}_{\text{water}} + \text{EC}_{\text{packaging}} + \text{EC}_{\text{premium}}}{Q} \quad (2)$$

$$\text{COGM}_{\text{green}} = \text{COGM}_{\text{conv}} + \text{EC}_{\text{unit}} \quad (3)$$

$$\Delta\text{COGM} (\%) = \frac{\text{EC}_{\text{unit}}}{\text{COGM}_{\text{conv}}} \times 100 \quad (4)$$

In Equations (1) to (4), DM, DL and FOH denote direct materials, direct labour and factory overhead; EC denotes environmental cost, with subscripts indicating the unit charge and the five components; and $\Delta\text{COGM} (\%)$ denotes the percentage increase of green over conventional COGM. Q denotes the total number of portions produced in the observation month, obtained from production records and order recapitulations. Because none of the cases charged labour and overhead systematically, direct labour was recalculated from working hours multiplied by the prevailing wage rate, while factory overhead was reconstructed from gas, utilities, depreciation of cooking equipment and transport records. This reconstruction was necessary to ensure that the conventional COGM used as the baseline is internally consistent across cases.

The five environmental cost components were quantified using two complementary logics. The averting costs method was applied to components for which the MSME already incurs a real cash outlay to prevent or reduce environmental damage, namely waste handling, environmentally friendly packaging and the price premium of local and organic materials. The eco-costs method (Vogtlander et al., 2001; Ecocostsvalue, 2023) was applied to externalities that carry no invoice, namely the carbon emissions embedded in electricity and gas consumption and the water footprint, by multiplying the physical quantity consumed by the relevant emission factor and the eco-cost shadow price per kilogram of CO2 equivalent.

First, waste management cost was computed as the monthly expenditure on waste transport and disposal fees plus the labour time spent on segregation and composting valued at the wage rate. Second, energy cost combined the electricity and gas expenditure attributable to production with the eco-costs of the resulting emissions. Third, water cost was derived from metered or estimated cubic metres multiplied by the tariff plus the eco-costs of the water footprint. Fourth, packaging cost was measured as the price difference between environmentally friendly packaging and the conventional plastic packaging it replaces, multiplied by the number of units used. Fifth, the material premium was measured as the price gap between local or organic ingredients and their conventional substitutes, multiplied by the quantity consumed per month.

Because none of the cases possessed electricity sub-meters, separate water meters or waste scales, consumption at the process level was estimated through a combination of daily sample measurement over one production week and proportional allocation, in which the total consumption of the premises was allocated to the catering production line in proportion to its share of activity volume. Formally, the cost charged to production equals the total cost of the premises multiplied by the ratio of production volume to

total activity volume. This allocation rule was applied consistently across the three cases so that the comparison remains valid, and the resulting uncertainty is acknowledged as a limitation of the study.

Integration of the two strands was performed at the interpretation stage through *joint display* and *narrative weaving* (Creswell & Creswell, 2023). The joint display places qualitative themes alongside quantitative figures for each case to reveal convergence, divergence or complementarity, while narrative weaving uses the qualitative findings to explain and contextualise the quantitative results. Credibility was maintained through member checking, data triangulation across interviews, observation and documents, and peer debriefing with experts in environmental accounting and MSME practitioners. The overall research flow is presented in Figure 1.

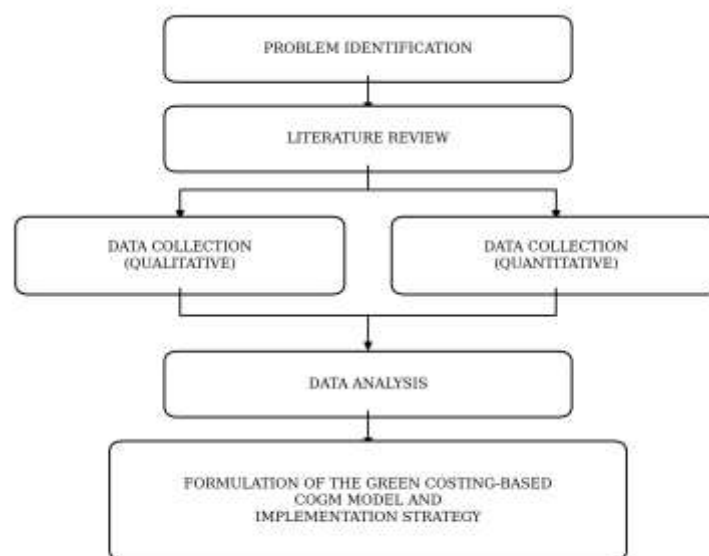


Figure 1. Research Framework
(Source: processed by the authors, 2026)

RESULT AND DISCUSSION

The research findings are presented in four parts, namely the profile of the cases together with their current COGM practices and thematic structure, the quantification of environmental costs and the comparison between conventional and green COGM, the integration of the two strands through a joint display, and the barriers, drivers, and prototype of the green costing model developed from the cross-case analysis.

1) Case Profiles, Current COGM Practices and Thematic Structure

Three catering MSMEs in Malang City participated as cases, selected to vary in business scale and product characteristics so that cross-case comparison would be meaningful. Their profiles are presented in

Table 1.

Table 1. Profile of the Participating Catering MSMEs

No	Case Code	Years in Operation	Average Portions per Month	Annual Turnover	Initial Green Practice
1.	MSME-A	9 years	330 portions	IDR 95 million	Organic waste segregation
2.	MSME-B	6 years	290 portions	IDR 70 million	Food-grade paper packaging
3.	MSME-C	4 years	240 portions	IDR 52 million	Local and organic raw materials

(Source: processed primary data, 2026)

Primary data collection involved nine informants, namely the owner or manager, the operational supervisor, and the person responsible for finance in each case. Reflexive thematic analysis of the interview transcripts, field notes, and supporting documents produced 142 initial codes, which were consolidated into ten sub-themes and four main themes. The thematic structure and the number of coded extracts supporting each sub-theme are summarised in Table 2.

Table 2. Thematic Structure of the Qualitative Analysis

Theme	Sub-theme	Coded extracts	Cases
1. COGM calculation based on estimation and habit	a. Pricing from raw material cost plus a fixed margin	18	A, B, C
	b. Owner and family labour treated as costless	14	A, B, C
	c. Overhead absorbed into the household budget	11	B, C
2. Environmental costs as hidden costs	a. Waste fees recorded under other operational expenses	16	A, B, C
	b. Electricity and gas metered jointly with the residence	13	B, C
	c. Packaging treated as a selling expense, not a product cost	10	A, B
3. Limited resources and accounting literacy as barriers	a. No separate bookkeeping for the business	15	A, B, C
	b. Limited time of the owner	12	A, B, C
	c. Absence of measurement devices	13	A, B, C
4. Market pressure and consumer preference as drivers	a. Requirements imposed by corporate clients	11	A, B
	b. Willingness of end consumers to pay for green claims	9	B, C
Total		142	

(Source: processed primary data, 2026)

The first theme, COGM calculation based on estimation and habit, shows that all three cases set selling prices from raw material cost plus a fixed margin of between 30 and 40 percent, without systematically charging labour and overhead. Labour contributed by the owner and family members was consistently treated as costless, and equipment depreciation was never recognised.

“We just count the ingredients and then multiply. The cooking is done by me and my

younger sister, so we never count it as a cost.” (Owner, MSME-C)

The second theme, environmental costs as hidden costs, reveals that waste transport charges, electricity and gas consumption, and purchases of environmentally friendly packaging were absorbed into a general "other operational expenses" account or, in two cases, into the household budget of the owner, and therefore remained invisible in decision making. This finding is consistent with the argument of Burritt et al. (2023) and Swalih et al. (2024) that the failure of conventional accounting systems to separate environmental costs prevents organisations from recognising the magnitude of economic losses arising from resource inefficiency.

“The electricity is on one meter with the house. The waste fee is paid every month by my husband, and we have never separated which part belongs to the catering.” (Finance officer, MSME-B)

2) Environmental Costs and the Comparison of Conventional and Green COGM

Applying the procedure described in the methods section, the five environmental cost components were traced for each case and charged per portion. This material-flow-based cost tracing follows the logic applied in food-sector studies by Amicarelli et al. (2022) and Bux and Amicarelli (2022), which demonstrate that the cost of material losses in the food industry is far greater than the amount recorded in conventional costing systems. The resulting breakdown is presented in Table 3.

Table 3. Breakdown of Environmental Cost Components per Portion (IDR)

Environmental Cost Component	MSME-A	MSME-B	MSME-C	Average
Waste management	200	230	295	242
Energy consumption	395	480	545	473
Water use	85	96	110	97
Environmentally friendly packaging	560	810	575	648
Premium of local/organic materials	310	360	620	430
Total environmental cost per portion	1,550	1,976	2,145	1,890

(Source: processed primary data, 2026)

The breakdown shows that environmentally friendly packaging is the largest single component, averaging IDR 648 per portion, followed by energy at IDR 473 and the material premium at IDR 430. The composition differs systematically across cases: MSME-B, which has converted entirely to food-grade paper packaging, bears the highest packaging cost, whereas MSME-C, which sources local and organic ingredients, bears the highest material premium. Waste and water costs are comparatively small in absolute terms, yet their per-portion value rises as production volume falls, because waste transport is charged as a fixed monthly fee that is spread over fewer portions.

The calculation for MSME-B illustrates the procedure. Conventional COGM was IDR 15,200 per portion after labour and overhead were reconstructed. Monthly waste transport fees and segregation labour of IDR 66,700 divided by 290 portions yielded IDR 230; electricity and gas attributable to production plus the eco-costs of the associated emissions yielded IDR 480; metered water and its footprint yielded IDR 96;

the price gap of IDR 810 between one food-grade paper box and the plastic packaging it replaces was charged directly per portion; and the premium on local and organic ingredients yielded IDR 360. Summing the five components gives an environmental cost of IDR 1,976 per portion, so that green COGM equals IDR 15,200 plus IDR 1,976, or IDR 17,176, an increase of 13.00 percent over the conventional figure. The same steps were repeated for the other two cases, and the results are compared in Table 4.

Table 4. Comparison of Conventional COGM and Green Costing COGM per Portion

No	Case Code	Conventional COGM (IDR)	Environmental Cost (IDR)	Green Costing COGM (IDR)	Difference (%)
1.	MSME-A	18,450	1,550	20,000	8.40
2.	MSME-B	15,200	1,976	17,176	13.00
3.	MSME-C	13,750	2,145	15,895	15.60
	Average	15,800	1,890	17,690	12.33

(Source: processed primary data, 2026)

Descriptive statistics across the three cases show an average environmental cost of IDR 1,890 per portion, with a range from IDR 1,550 to IDR 2,145 and a standard deviation of IDR 307. Integrating environmental costs raised COGM by between 8.40 percent and 15.60 percent, with an average increase of 12.33 percent. Across the three cases, the percentage increase was larger where production volume was smaller: MSME-A, with 330 portions per month, recorded the smallest rise and MSME-C, with 240 portions per month, the largest. Because this ordering is observed in only three purposively selected cases, it is reported as a descriptive cross-case pattern rather than a statistical relationship and should not be generalised to MSMEs at large.

The qualitative findings help to explain this pattern. The larger case had already implemented waste segregation and purchased materials in bulk, so that environmental costs per unit were lower, whereas the smaller cases bore the fixed cost of waste transport and higher unit prices for environmentally friendly packaging. This interpretation is examined further through the joint display presented in the following subsection.

3) Integration of the Qualitative and Quantitative Findings

Following the *explanatory sequential* logic adopted in this study, the qualitative and quantitative strands were brought together at the interpretation stage through a *joint display* that places the dominant theme of each case alongside its quantitative result and the meta-inference drawn from the pair (Creswell & Creswell, 2023). The joint display is presented in Table 5.

Table 5. Joint Display of the Qualitative and Quantitative Findings

Case	Dominant qualitative finding	EC per portion (IDR)	Increase in COGM (%)	Meta-inference
MSME-A	Waste segregation already routine and materials bought in bulk, but electricity shared with the residence	1,550	8.40	Existing green routines and scale absorb the environmental cost, so integration is the least disruptive

Case	Dominant qualitative finding	EC per portion (IDR)	Increase in COGM (%)	Meta-inference
MSME-B	Full conversion to paper packaging driven by corporate clients, with no separate records	1,976	13.00	Market-driven adoption raises packaging cost, but the cost is already recoverable through client contracts
MSME-C	Local and organic sourcing as product identity, fixed waste fee spread over a small volume	2,145	15.60	The smallest case bears the highest relative burden, so phased adoption and shared logistics are required

(Source: processed primary data, 2026)

The joint display reveals convergence on one point and divergence on another. The strands converge in showing that the burden of environmental cost is not distributed evenly: the case with the largest volume and the most established green routine records the smallest relative increase in COGM, while the smallest case records the largest. The strands diverge, however, in what they identify as the binding constraint. The quantitative results point to the material premium and packaging as the dominant cost drivers, whereas the qualitative accounts point to the absence of records and measurement devices as the reason those drivers were never visible in the first place. The meta-inference is therefore that the obstacle to green costing in these cases is informational before it is financial: the additional cost of between 8.40 and 15.60 percent is real but modest, while the inability to see it is total.

This reading also qualifies the quantitative pattern. The larger relative increase in COGM observed in the smaller cases is not evidence that small enterprises are intrinsically less able to adopt green practices; in these cases it appears to reflect the indivisibility of waste transport fees and the absence of bulk purchasing power. Both are addressable through shared logistics and joint procurement among neighbouring MSMEs rather than through internal efficiency alone, which is a practical implication that neither strand would have produced on its own.

4) Barriers, Drivers and the Prototype of the Green Costing COGM Model

The third theme, limited resources and accounting literacy as barriers to adoption, is supported by 40 coded extracts and confirms that the absence of separate records, the limited time of owners and the lack of measurement devices such as electricity sub-meters or waste scales constitute the main obstacles to implementing green costing. This pattern of barriers is in line with the critical review by Dasanayaka et al. (2022) of the triggers for and barriers to environmental management practices in SMEs. The fourth theme, market pressure and consumer preference as drivers, indicates that demand from corporate clients for environmentally friendly packaging and sustainability claims is becoming a tangible economic incentive rather than a normative aspiration. This is consistent with stakeholder theory, which holds that firms respond to the demands of the stakeholders on whom their survival depends (Freeman, 1984), and with evidence that environmental management accounting practices are adopted to meet stakeholders' environmental concerns (Hanif et al., 2023).

"Honestly there is no time. After the last delivery at nine in the evening I am exhausted, so recording every expense is simply impossible." (Owner, MSME-A)

“Since last year two corporate clients have asked for paper boxes and no plastic bottles. If we cannot provide them, the order goes to another caterer.” (Operational supervisor, MSME-B)

Based on these findings, an initial prototype of the Green Costing-Based COGM Model for food-sector MSMEs was developed. The model consists of four modules, namely a module for identifying material and resource flows, a module for tracing environmental costs, a module for calculating the integrated COGM, and a module for simulating selling prices. It was designed as a simple Microsoft Excel worksheet so that it can be operated by MSME actors with limited accounting literacy. This simplification responds to the concern raised by Christ and Burritt (2015) about the limited practical application of material flow cost accounting and the lack of evidence across firm sizes, and to the implementation challenges documented in the case studies of Usul and Olgun (2025). The prototype is currently at version 1.0 and has been pilot-tested on a limited basis in MSME-A and MSME-C.

Two methodological limitations should be acknowledged. First, as explained in the methods section, none of the participating MSMEs possessed electricity sub-meters, separate water meters, or waste scales, so that resource consumption per product line had to be quantified through a combination of daily sample measurement and proportional allocation based on production volume, a procedure that is methodologically defensible but leaves a degree of uncertainty. A similar data constraint has been reported in applying material flow cost accounting in companies with different costing systems by Usul and Olgun (2025). Second, the availability of eco-costs conversion factors specific to the Indonesian context is limited, so that some parameters still refer to international databases and require adjustment through expert validation.

CONCLUSION

This study demonstrates that the conventional COGM practices of catering MSMEs in Malang City rely on estimation and habit, so that environmental costs remain hidden within general operational expenses and are absent from pricing and efficiency decisions. Quantifying five environmental cost components using the eco-costs and averting costs methods raises COGM by an average of 12.33 percent, ranging from 8.40 percent to 15.60 percent, with an average environmental cost of IDR 1,890 per portion. Environmentally friendly packaging is the largest component, averaging IDR 648 per portion, followed by energy and the premium of local and organic materials. Within the three cases, the percentage increase was larger in the smaller enterprises, which the qualitative evidence links to fixed waste transport fees and higher unit prices for environmentally friendly packaging; whether this pattern holds more widely requires

The green costing COGM model developed in this study consists of four modules and is operated through a simple spreadsheet, making it feasible for MSMEs with limited resources and accounting literacy. The joint display of the two strands indicates that the binding constraint is informational rather than financial, since the additional cost is modest while the inability to observe it is complete. Adoption is constrained by the absence of separate records and measurement devices, while demand from corporate clients acts as a genuine economic driver. Accordingly, a phased implementation strategy combining awareness building, technical assistance, access to green financing, and multi-stakeholder collaboration is required. Further research is recommended to validate the model with experts, to simulate partial and full implementation scenarios, and to develop eco-costs conversion factors specific to the Indonesian context.

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