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MATERIAL FLOW COST ACCOUNTING (MFCA) IN THE CANANG SARI PRODUCTION VALUE CHAIN: MATERIAL OPTIMIZATION, REDUCTION OF RELIGIOUS WASTE, AND EMPOWERMENT OF FEMALE CRAFTSMEN

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Abstract:
This study examines the application of Material Flow Cost Accounting (MFCA) in the canang sari production value chain in Bali to address material inefficiencies and the problem of religious waste, while simultaneously empowering female artisans. Through a qualitative case study approach with observations and in-depth interviews with artisan groups, the study revealed that approximately 30% of raw materials are wasted as production waste, considered a given cost. The MFCA analysis successfully identified hidden costs and critical inefficiencies, and revealed the dilemma between ritual sacredness and environmental responsibility in canang sari waste management. The research findings emphasize that MFCA implementation must be tailored to the unique socio-cultural and spiritual context. As an output, this study designed a simplified participatory MFCA model that serves as a tool to improve artisans' financial literacy, optimize raw material use, and open a dialogue toward more ecological canang sari designs. Thus, this study not only extends the application of environmental accounting theory to the realm of the culture-based creative economy but also offers a holistic solution that synergizes economic efficiency, environmental sustainability, gender empowerment, and the preservation of local values.

Keywords: Material Flow Cost Accounting, Religious Waste, Women's Empowerment, Hidden Costs

INTRODUCTION

In Balinese Hindu religious rituals, canang sari (ceremonial offerings) are not merely a means of ritual but also a concrete manifestation of gratitude and spirituality that is integrated into everyday life. However, beyond its profound philosophical meaning, the mass production of canang sari, necessary to meet the daily demands of millions of devotees, has given rise to a complex environmental and economic paradox (Saputra, 2021). The production process, dominated by women artisans at the household and micro-enterprise level, involves a massive flow of materials: coconut leaves, flower petals, betel lime, and small plastic bags (ceper), much of which ends up as organic and inorganic waste after the ritual (Saputra, 2022). This religious waste is often poorly managed, creating a burden on the final processing facility and potentially diminishing the sacredness of the ritual itself. On the other hand, female artisans—who are the backbone of this traditional industry—typically work with a production system that relies on inherited experience without accurate material cost calculations, potentially leading to raw material inefficiencies and thin profit margins (Saputra et al., 2022). Therefore, an approach capable of analyzing material flows quantitatively and monetarily is needed to optimize processes, reduce waste, and improve the welfare of key stakeholders (Cucchiella et al., 2014).

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Material Flow Cost Accounting (MFCA) has emerged as an appropriate environmental management accounting methodology to address these challenges. MFCA is a tool that identifies and quantifies the physical flow of materials in the production process (in kilograms or liters) and links them to associated costs, including material, energy, and waste management costs (Usul & Olgun, 2025). By mapping material flows into products and waste, MFCA highlights inefficiencies previously hidden in general overhead costs. The application of MFCA to the canang sari value chain—from raw material acquisition, distribution, production, to the post-ritual stage—promises significant breakthroughs (Daromes et al., 2023). This study aims to analyze how MFCA can be implemented to map material inefficiencies, calculate the true cost of production and post-consumer waste, and design a more material-efficient and environmentally friendly business model. Focusing on the value chain allows for a holistic analysis, not only at the production stage but also at the environmental impact of the materials used and community consumption patterns (Rahayu & Jaya, 2025).

Beyond a technical-economic analysis, this study places the empowerment of women artisans as a central objective. Most canang sari artisans are women from low-income groups with limited access to financial literacy and modern management (Ebrahimi Sarindizaj & Karamouz, 2022). By translating the findings of the MFCA analysis into practical guidance and participatory training, this study aims to improve their capacity to manage raw materials, reduce costs, and negotiate fairer prices (Saputra et al., 2024). This initiative aligns with the principle of Pawongan (harmony among people) in the Tri Hita Karana philosophy, which emphasizes community empowerment (Uthami et al., 2024). The originality of this study lies in its attempt to synergize three usually separate domains: (1) precise contemporary environmental accounting (MFCA) theory, (2) unique socio-religious contexts (ritual waste and the culture-based creative economy), and (3) the sustainable development agenda (gender equality and poverty reduction). Thus, this research not only contributes to the development of EMA literature in the informal sector and cultural creative industries—which is still scarce—but also offers concrete and contextual solutions to real-world problems in Bali (Dewi et al., 2024). The results are expected to serve as an adaptive MFCA application model for other traditional crafts, while also encouraging sustainable practices born from a deep understanding of local culture and social justice (Liestiandre et al., 2024).

Literature Review. Material Flow Cost Accounting (MFCA) has emerged as a key tool in Environmental Management Accounting (EMA), systematically quantifying material and energy flows in physical and monetary terms, with the aim of identifying "hidden costs" resulting from waste and inefficiencies (Kokubu & Tachikawa, 2013). The literature predominantly places MFCA in formal manufacturing contexts, such as the automotive or chemical industries, which have standardized production processes and established accounting systems (Jasch, 2009). Its application has been shown to improve resource efficiency and profitability by reducing material scrap. However, there is a significant research gap regarding the application of MFCA in the informal sector and culture-based creative industries, where production processes are often fragmented, financial records are poorly documented, and cultural values are closely tied to products (Laksmi & Arjawa, 2023). Studies on traditional craft value chains, particularly those related to rituals, are still very limited from an environmental management accounting perspective (Laksmi & Saputra, 2024b).

In parallel, the discourse on religious waste management is beginning to gain attention in sustainability studies. Research in India and Thailand, for example, examines the environmental impacts of ritual flowers and offering materials, but generally focuses on the technological aspects of municipal waste processing or management, rather than optimizing upstream production

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processes through accounting instruments (Muthu, 2021). Meanwhile, literature on women's empowerment in the creative economy largely highlights sociocultural aspects and market access, but rarely integrates technical approaches, such as accounting, to improve business productivity and sustainability. This study aims to bridge these three gaps in the literature (Saputra & Laksmi, 2024). By adopting a modified MFCA framework for the socio-technical context of canang sari production, this study not only contributes to expanding the theoretical application of MFCA to the realm of cultural production but also offers a new perspective on managing ritual waste through a preventative approach at the production level. Furthermore, the integration of gender analysis in MFCA studies is a breakthrough that can enrich discussions on social justice in environmental accounting (Laksmi & Saputra, 2024a).

METHODS

This research will use a qualitative approach with an exploratory single case study design to enable in-depth and contextual exploration of the application of Material Flow Cost Accounting (MFCA) in the canang sari value chain. The case study was chosen because it is suitable for exploring contemporary phenomena ("how" and "why") in a real-life context that has not been widely explored by previous research. The research location will be centered on a group of female canang sari artisans who have been operating for at least three years in a hamlet in Denpasar or Gianyar City, selected purposively based on accessibility criteria and stakeholder willingness to participate. The research subjects include 5-7 core artisans, 1-2 raw material collectors/distributors, and 1 community or religious leader who understands the ritual aspects (Aspers & Corte, 2019).

The primary data collection techniques were participant observation (directly observing the waste generation and disposal process), in-depth semi-structured interviews guided by open-ended questions, and simple document analysis, such as daily shopping logs (if available) and photographs of material flows. The data analysis process followed a simplified form of Miles and Huberman's interactive thematic analysis model, beginning with data transcription and reduction to identify key patterns related to material flows, waste points, barriers, and empowerment opportunities (Nassaji, 2020). Findings from the interviews and observations were then verified through member checking, presenting summarized interpretations to several artisans for confirmation, to enhance data validity. Overall, this method was designed to be simple by minimizing complex instruments and focusing on the strengths of narrative and visual data from the field, making it feasible to implement with limited resources while still producing a holistic and meaningful picture as a basis for practical recommendations (Myers, 2019).

RESULT AND DISCUSSION

This study reveals the complexity of the canang sari value chain, which, despite its apparent simplicity, harbors significant material inefficiencies and hidden costs. Participatory observation of the production process at the research site revealed that the material flow is linear, with no feedback mechanism to monitor remaining material. Of each Rp 50,000 package of raw materials containing young coconut leaves, flowers, and leaves, an estimated 30% of the material becomes waste during the initial cutting and sorting stage. As explained by Mrs. Putu, a craftswoman with 15 years of experience,

"*We cut off any damaged or discolored coconut leaves and throw them away. Even slightly wilted flowers are unusable. It is all commonplace; it is included in the cost.*"

This statement indicates that production waste is considered a given cost, and there has been no systematic effort to minimize it from the outset. Further analysis through in-depth interviews

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identified three key critical points of inefficiency: first, in raw material acquisition. Artisans purchase materials in bundles or kemoran (loose units) without a clear understanding of the usable yield. Second, during the production stage, there is no standard size or optimal cutting pattern; it depends entirely on individual habits. Third, and most critically, there is post-ritual waste. All the canang sari (ceremonial offerings) end up as a mixture of organic and inorganic waste (from flat plastic and staples). I Wayan, a traditional leader, expressed his concern:

"It is a dilemma. It is very difficult to separate the ceremonial waste because it's already been purified. However, seeing the piles of canang sari and plastic in the public trash bin makes my heart uneasy."

This statement highlights the conflict between spiritual values and environmental impact, which has so far gone unaddressed by conventional waste management approaches. From a cost perspective, applying the MFCA lens reveals substantial "hidden costs." The cost of wasted material (material loss cost) includes not only the 30% of the cut residue, but also the labor costs incurred in processing the parts that are ultimately discarded. Ibu Komang, a craftswoman, indirectly confirmed this:

"Sometimes I spend a whole morning splitting young coconut leaves, but I only get half of the good ones. The time and effort have already been expended."

The cost of waste management, while not formally recorded as an individual business expense, has shifted to the community through the operational costs of waste collection by the traditional village (dana punia) and the external costs of environmental degradation. Thus, the current accounting system fails to capture the true cost of the entire life cycle of the canang sari. Another key finding is the central position of women in this value chain, as well as their vulnerability. All the craftswomen in this study are women who perform this work as a supplementary income alongside domestic duties. Production knowledge is transmitted informally, and even simple bookkeeping is lacking. Mrs. Nyoman admitted,

"I do not know the exact profit per item. The important thing is that I have money for daily expenses. If the ingredients are expensive, then the selling price will be higher."

This practice reflects the economic vulnerability resulting from the lack of control over accurate cost-based pricing. However, this study also found strong social capital in the form of trust networks and information exchange among neighbors, which serve as a potential foundation for the introduction of better material management systems. Discussing these results within the framework of MFCA theory and existing literature provides several new insights. First, the finding that production waste is considered a "common cost" aligns with earlier MFCA literature, which found that hidden costs of waste are often considered an integral part of overhead (Jasch, 2009). However, the context of the canang sari complicates the calculation due to the religious value attached to the materials. Therefore, the application of MFCA here cannot focus solely on minimizing physical waste but must also consider the religious value loss when materials become waste. It represents a conceptual extension of the objectives of conventional MFCA (Müller, 2019).

Second, the conflict between ritual sanctity and environmental responsibility—as reflected in the statements of traditional leaders—reinforces Muthu's (2021) study on the complexity of religious waste. This research suggests that solutions cannot be found solely at the end of the pipe (waste management), but must begin with production design (eco-ritual design) (Singh et al., 2022). MFCA can be a dialogue tool for designing more "eco-friendly" canang sari without diminishing the ritual meaning, for example, by optimizing size and encouraging the use of reusable or biodegradable plates (Karimi & Ataei, 2023).

Third, the findings regarding the lack of bookkeeping and intuitive pricing among women artisans confirm the literature on the informal sector. However, this study offers a solution by

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integrating simplified MFCA principles into gender-based financial literacy training. By understanding physical flow and cost flow in simple terms, artisans can better negotiate with suppliers and buyers. Thisanswers calls in the women's empowerment literature to provide concrete and contextual tools, not just general motivational training (Baskar et al., 2022; Kabir et al., 2020).

Overall, this research demonstrates that the application of MFCA in the canang sari value chain is not merely a technical process, but rather a socio-technical intervention that must be sensitive to cultural, religious, and gender dynamics (Kumar & Al-Sharif, 2024). The resulting MFCA model should be modular and participatory, in the form of a visual guide to material flow and a simple costing spreadsheet, developed in collaboration with artisans and traditional stakeholders. Thus, this research contributes to expanding the scope of MFCA from formal industrial settings to the creative-ritual economy, while also offering an integrative framework that links material efficiency with social justice and cultural sustainability (Rehan et al., 2014; Yin et al., 2019). The implication is that environmental management accounting cannot be universal; it must be translated and adapted to achieve relevance and meaning in unique local ecosystems such as Bali.

CONCLUSION

Based on the analysis, this study concludes that the application of Material Flow Cost Accounting (MFCA) in the canang sari value chain effectively uncovers significant material inefficiencies and hidden costs that have been considered normal. Key findings suggest that this technical accounting approach must be integrated with sensitivity to unique cultural and religious contexts, particularly in addressing the dilemma of ritual waste. This study offers a simplified and participatory MFCA model, designed to empower women artisans through increased financial literacy and raw material management, while also opening a dialogue space for designing more environmentally friendly canang sari without sacrificing its spiritual meaning. Thus, the main contribution of this study is to expand the discourse of environmental management accounting to the realm of the creative-ritual economy and offer a solution framework that links economic efficiency, environmental sustainability, gender equity, and the preservation of cultural values holistically.

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