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Circular Economy Based Food Waste Management in Public Feeding Programs: A Systematic Review of Makan Bergizi Gratis Implementation

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Abstract

The Free Nutritious Meal (Makan Bergizi Gratis/MBG) program is an Indonesian government initiative aimed at improving nutrition for vulnerable populations, implemented through Nutrition Service Units (SPPG). However, its operations generate significant food, packaging, and wastewater, contributing to environmental impacts if not properly managed. This study conducts a Systematic Literature Review (SLR) of publications from 2018–2025 to examine circular economy-based waste management in institutional food services. Findings reveal that food waste is predominantly organic and driven by technical, behavioral, and institutional factors. Although circular economy principles such as reduce, reuse, recycle, and recover are widely discussed, their implementation remains fragmented and context-specific. A key gap exists between holistic circular economy concepts and partial real-world application, particularly in government-led food programs in developing countries. This study proposes an integrated conceptual framework combining technical, behavioral, and institutional dimensions to support sustainable waste management in SPPG and strengthen MBG program sustainability..

Keywords: *circular economy, food waste, MBG, SPPG, SLR*

Vol. 15 No. 2 Desember 2025
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INTRODUCTION

The Free Nutritious Meal (Makan Bergizi Gratis/MBG) program is a strategic government initiative aimed at improving the nutritional status of the population, particularly among vulnerable groups. Its implementation through Nutrition Service Units (Satuan Pelayanan Pemenuhan Gizi/SPPG) has the potential to generate substantial amounts of waste, including organic waste from food leftovers, inorganic waste from packaging, and wastewater from kitchen operations. Globally, the food sector is recognized as one of the largest contributors to waste, with approximately one-third of all food produced being lost or wasted across the supply chain (FAO, 2019; UNEP, 2021). Furthermore, food waste significantly contributes to greenhouse gas emissions, particularly methane generated from the decomposition of organic waste in landfills (UNEP, 2021; IPCC, 2022).

The circular economy approach has emerged as a strategic solution to address these challenges by emphasizing resource efficiency through the principles of reduce, reuse, recycle, and recover. This concept aims to retain the value of materials within the economic cycle for as long as possible while minimizing waste generation (Geissdoerfer et al., 2017; Kirchherr et al., 2018). In the context of food systems, circular economy extends beyond waste management to include the transformation of production and consumption systems toward sustainability (Jurgilevich et al., 2016; van Berkum et al., 2018).

At the institutional kitchen level, such as SPPG, the application of circular economy principles has the potential to significantly reduce waste, improve operational efficiency, and create added value through the conversion of waste into useful by-products (Filimonau & De Coteau, 2019; Mourad, 2020). However, its implementation still faces several challenges, including limited human resource capacity, inadequate infrastructure, and the lack of integration between policy frameworks and operational practices (Kaza et al., 2018; UNEP, 2021).

Therefore, a systematic review is needed to understand how circular economy-based waste management transformation can be effectively implemented within the MBG program, particularly at the operational level of SPPG.

Vol. 15 No. 2 Desember 2025
DOI : doi.org/10.21009/jgg.152.06

METHODOLOGY

This study employs a Systematic Literature Review (SLR) approach to identify and synthesize existing research on circular economy-based food waste management. Relevant literature was collected from major academic databases, including Scopus, ScienceDirect, SpringerLink, and Google Scholar. The search strategy utilized combinations of the following keywords: “Makan Bergizi Gratis” OR “Free Nutritious Meal Program” OR “School Feeding Program,” “food waste management,” “circular economy,” “institutional food service,” “nutrition program waste,” “sustainable kitchen,” and “public feeding program.”

The inclusion of the keyword “Makan Bergizi Gratis” was essential to ensure contextual relevance to Indonesia’s national policy, although internationally recognized terms such as “school feeding program” and “public food service program” are more commonly used. This strategy enabled the integration of both global and local perspectives in the literature analysis.

The SLR method was selected for its ability to provide a comprehensive synthesis of existing studies and to systematically identify research gaps (Kitchenham & Charters, 2007; Snyder, 2019). Inclusion criteria covered articles published between 2015 and 2025 that are relevant to food waste management and incorporate circular economy or sustainability approaches within food program contexts. Articles lacking direct relevance or a strong theoretical framework were excluded from the analysis.

RESULTS AND DISCUSSION

The findings indicate that waste in institutional food systems, including feeding programs such as MBG, is consistently dominated by organic waste, accounting for more than 50% of total waste generated (Filimonau & De Coteau, 2019; van Herpen et al., 2019). However, variations exist across studies in identifying the primary drivers of waste generation. Filimonau and De Coteau (2019) emphasize operational inefficiencies and inadequate staff training as dominant factors, whereas van Herpen et al. (2019) highlight consumer behavior and food preferences as key determinants. This suggests that food waste is not solely a technical issue but is also strongly influenced by behavioral dimensions, which are often not fully integrated into waste management system design.

Vol. 15 No. 2 Desember 2025
DOI : doi.org/10.21009/jgg.152.06

Regarding circular economy implementation, most recent studies still position the 3R approach (reduce, reuse, recycle) as the primary strategy, although differences exist in prioritization. Principato et al. (2019) argue that reduction is the most effective intervention as it addresses waste at the source, while Mourad (2020) finds that recycling practices are more commonly implemented due to their technical feasibility and minimal behavioral change requirements. Meanwhile, Kaza et al. (2018) highlight the significant potential of recovery approaches, such as biogas production, although their implementation remains limited to areas with sufficient infrastructure. These differences indicate a gap between ideal conceptual approaches and practical implementation.

The transition from linear to circular systems also reflects diverse approaches in recent literature. Di Foggia and Beccarello (2021) emphasize the importance of integrated waste management systems that address waste from upstream to downstream, while Velenturf and Purnell (2021) underline the role of policy and governance-based systemic approaches in supporting circular economy implementation. Additionally, community-based approaches remain relevant, particularly in developing countries, as they enhance participation and local sustainability (Thi et al., 2021). However, most studies still address these approaches separately, without integrating them into a comprehensive operational model.

Furthermore, factors influencing successful circular economy implementation vary across studies. Filimonau and De Coteau (2019) highlight the importance of human resource capacity building through education and training, while Principato et al. (2019) identify structural barriers such as limited infrastructure, lack of policy support, and organizational resistance to change. Van Loon et al. (2020) argue that effective food waste reduction requires a systemic approach that integrates behavioral change, technological innovation, and institutional support. This indicates that partial approaches are insufficient to achieve sustainable outcomes.

Overall, comparative analysis across studies reveals that although circular economy concepts have been well developed theoretically, their implementation in institutional food systems remains fragmented. Most research focuses on a single dimension—

Vol. 15 No. 2 Desember 2025
DOI : doi.org/10.21009/jgg.152.06

technical, behavioral, or policy—without integrating these aspects into a unified system. In the context of the MBG program, this condition presents both a challenge and an opportunity, highlighting the need for a waste management transformation model that integrates technological, behavioral, and institutional dimensions, particularly at the operational level of SPPG.

RESEARCH GAP

Despite the growing body of research on food waste management and circular economy, several significant gaps remain. First, studies focusing on government-led food programs, particularly the MBG program in Indonesia, are still very limited, resulting in a lack of comprehensive empirical insights into waste management practices at the implementation level. Second, most existing research concentrates on commercial sectors such as restaurants and hospitality, while studies on public institutional settings, including SPPG, remain scarce (Filimonau & De Coteau, 2019).

Third, the implementation of circular economy principles in food waste management tends to be partial, focusing on specific aspects such as recycling or waste treatment, without holistic integration into operational systems. This reflects a gap between the theoretical framework of circular economy, which is inherently systemic, and its fragmented real-world application. Fourth, research that develops context-specific implementation models is still limited, particularly in regions such as West Java, which have unique socio-economic and institutional characteristics.

Therefore, further research is needed not only to examine the technical aspects of waste management but also to integrate operational, behavioral, and institutional dimensions into a comprehensive and context-sensitive framework.

Proposed Conceptual Framework

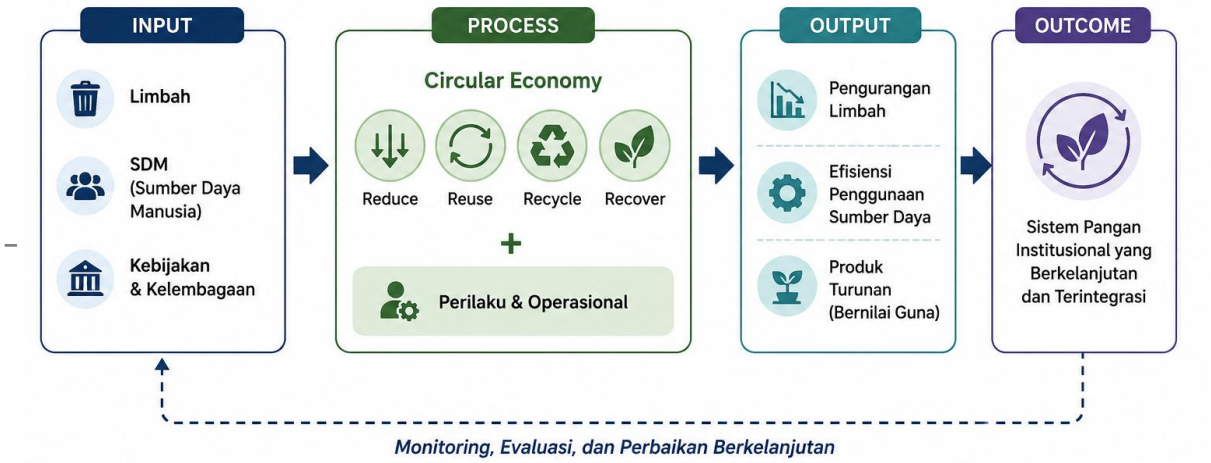
Based on the synthesis of findings from the reviewed studies, this research proposes a conceptual framework for transforming waste management based on circular economy principles within the Free Nutritious Meal (MBG) program, particularly at the operational level of Nutrition Service Units (SPPG). Unlike previous approaches that tend to be partial, this framework integrates technical, behavioral, and institutional dimensions

Vol. 15 No. 2 Desember 2025
DOI : doi.org/10.21009/jgg.152.06

into a comprehensive system.

Conceptually, the transformation process begins with the input stage, which includes food waste characteristics, human resource capacity, and policy and institutional support. The literature indicates that these factors significantly influence the effectiveness of circular economy-based waste management implementation. The next stage is the process, which involves the application of circular economy principles—reduce, reuse, recycle, and recover—along with the integration of behavioral aspects through education and habit change, and operational aspects through standardized kitchen management procedures.

The outputs of this system include waste reduction, improved resource efficiency, and the conversion of waste into value-added products. The expected outcome is the establishment of a sustainable and integrated institutional food system. This framework highlights that the effectiveness of circular economy implementation in waste management depends not only on technological solutions but also on the interaction between human factors and institutional systems.



Picture 1. Conceptual Framework of Circular Economy-Based Waste Management Transformation in SPPG

CONCLUSION

This study demonstrates that although circular economy concepts have been widely developed in the literature, their implementation in institutional food waste management remains fragmented

Vol. 15 No. 2 Desember 2025
DOI : doi.org/10.21009/jgg.152.06

and not yet fully integrated. Through a Systematic Literature Review approach, this study identifies key factors, implementation models, and challenges in managing food waste.

Based on this synthesis, the study proposes a conceptual framework that integrates technical, behavioral, and institutional dimensions in transforming waste management within the Free Nutritious Meal (MBG) program. This framework is expected to serve as a foundation for developing more contextual and applicable implementation models, particularly at the operational level of Nutrition Service Units (SPPG).

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