

Circular Value Chain for Indonesia's School Feeding: An SSCM Perspective

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Abstract

Indonesia's Makan Bergizi Gratis (MBG) program is a major national initiative aimed at improving equitable access to nutritious food for school-aged children, yet its large-scale implementation faces persistent challenges, including fragmented supply chains, operational inefficiencies, reliance on external suppliers, and rising food waste. As sustainability expectations intensify globally, incorporating Sustainable Supply Chain Management (SSCM) and Circular Economy (CE) approaches has become increasingly relevant for strengthening the resilience and public value of school feeding systems. This study proposes a Circular Value Chain (CVC) framework for embedding circularity within the MBG program. A Systematic Literature Review of 48 peer-reviewed sources was conducted to synthesize insights from CE, SSCM, food system governance, digitalization, and developing-country contexts. Findings indicate that transitioning MBG toward circularity requires integrated sourcing strategies, improved multi-level coordination, behavioral change in consumption practices, and the adoption of digital tools for visibility and efficiency. The proposed CVC encompasses four components: circular sourcing, circular production and distribution, circular consumption, and circular post-consumption loops. Conceptually, the framework offers a new perspective for redesigning public food systems, while, practically, it provides policymakers with a strategic pathway to reduce waste, strengthen local participation, and enhance the sustainability and effectiveness of the MBG program.

Keywords

Circular Value Chain, Sustainable Supply Chain Management, Circular Economy, School Feeding Program, Public Value

1. Introduction

The Makan MakanBerGizi (MBG) program of Indonesia is one of the most ambitious social investments of the country, which was literally aimed at promoting nutritional equity and building human capital. However, its operationalisation demonstrates structural weaknesses that are too well known to the researchers of global food systems. These are the fragmentation during procurement, logistical inefficiency, supply-chain volatility, and a consistent increase in food loss during production and consumption phases (Batista et al., 2021; Srijuntrapun et al., 2025; Leksono & He, 2025). The problem of such inefficiencies is reminiscent of the historically recurring disjoints of linear take-make-waste models inherent in modern food chains, thus enforcing the urgency of a complete system redesign based on a circular and sustainable approach to management (Fassio & Tecco, 2019; Fogarassy and Finger, 2020). Global sustainability requirements are entering a new reality, and Sustainable Supply Chain Management (SSCM) and the Circular Economy (CE) scholarship are converging on the need to experience a

value-chain metamorphosis that must be able to generate resource efficiency, socio-economic inclusion, and regeneration of the environment simultaneously (Arranz -Arranz & Arroyabe, 2023; Kirchherr and others, 2023).

Although the high-growth rate of CE research has been experienced, most conceptual and empirical research continues to be skewed in the manufacturing sector of the private sector, waste-management systems, and industrial ecology. Food programmes in the public sector, especially those in school feeding, are also conspicuously under-theorised (Medjdoub, 2020). Additionally, as shown by the recent reviews, the implementation of CE is highly contingent on the institutional capacities, governance structures, behavioural preparedness, and sociotechnical infrastructures (Gonella et al., 2024; Velandar, 2025), which are particularly relevant in Indonesia where the coordination between various governance levels, regulatory consistency, and digital traceability are uneven (UNDP, Bappenas and Denmark, 2020; The literature also highlights food systems as a high-impact area of a circular transition since they are material-intensive and have the potential for regenerative cycles; nevertheless, there is still conspicuously little empirical advice on how to operationalise circularity in state-led nutrition programmes (Nowicka,¹, 2026; Alexander et al., 2023).

This gap informs one of the main issues of the MBG programme the lack of a formal Circular Value Chain (CVC) framework that can guide the implementation of circular processes throughout sourcing, production, distribution, consumption, and post-consumption processes. Without such a framework, there are no opportunities to limit waste, shorten supply chains, strengthen local food economies, and increase the value to the population. In this line with, the aim of this research is to conceptualise a CVC model that integrates the perspectives of CE, SSCM, institutional governance, value-retention theory and emerging transitions scholarship (Charter, 2019; Garcia-Saravia-Ortiz-de-Montellano-van-der-Meer, 2022; Arora et al., 2023). The paper is based on 48 academic articles that have been curated to come up with a theoretically based, contextually focused model of restructuring the Indonesian school feeding system to be more sustainable, resilient, and circular public food regime.

2. Theoretical Framework and Propositions

The move away to regenerative and resource-efficient food systems has added to the growing scholarly attention to the Circular Economy (CE) as a process of reorganizing the flows of value in production and consumption processes. CE scholarship is focused on resource optimisation, minimisation of waste, and the regenerative loops to increase product and material lifespan in socio-technical systems (Kirchherr et al., 2017; Kirchherr et al., 2023). CE principles have been applied to the food industry by localising sourcing, valorising organic waste, planning menus adaptively and redesigning the distribution networks to minimise loss and inefficiencies (Fassio & Tecco, 2019; Batista et al., 2021). All these studies propose that food systems can be seen as a high-impact area of circular transformation because they are material intensive and can be used to produce a significant environmental and social value.

In addition to CE, Sustainable Supply Chain Management (SSCM) offers some theoretical underpinning of the trade-offs between economic, environmental and social goals in the management of multi-actor networks in the flow of resources. The use of integration, coordination, and transparency to enhance the performance of supply chain resilience and sustainability is emphasized by SSCM research (Arranz, and Arranz, 2023; Gonella et al., 2024). In the context of food delivery by the public sector, SSCM is linked with the necessity to redesign the procurement frameworks, digitalize the traceability, and optimize interactions between the local suppliers, distributors, and institutions (Kurniawan et al., 2022; Leksono and He, 2025). These practices are compatible with the evidence that the supply-chain fragmentation, poor data systems, and institutional capacity are key impediments to the establishment of sustainable food governance in the developing-country setting (UNDP, Bappenas and Denmark, 2020; Velandar, 2025).

The concept of public value makes this lens even more analytical by highlighting the societal impact (equity, transparency, and collective welfare) and these are the primary objectives of state-led programmes including Makan Bergizi Gratis (MBG) programme in Indonesia. Research on governance and interaction of the state and community shows that multi-actor inclusion and institutional consistency are essential for sustainability transitions to take place (Ambler, 2023; Alexander et al., 2023). Governance arrangements to support participatory decision-making, bring about stronger local economic connections and good stewardship of the natural resources are thus necessitated in the public food systems.

Lastly, circularity evaluation frameworks, including value-retention processes (VRP) and circularity indicators, are also an analytical tool on pinpointing intervention points in supply chains that value can be retained or re-generated (Garcia-Saravia and Montellano de Monte, 2022; Chabowski et al., 2025). These frameworks highlight the necessity to incorporate the structural embedding of circular practices in the sourcing, production, consumption, and post-consumption cycles, and these models are in line with the reasoning of a Circular Value Chain (CVC) model. Although these theoretical contributions provide substantial grounds, there is clearly a gap in literature: there is no developed CVC framework that would be distinctly applied to the context of the school feeding system of the public sector, in particular, the emerging economy (Nowicka, 2026; Srijuntrapun et al., 2025). In line with this, this research will cover the following research question:

RQ: How is it possible to conceptualize a circular value chain in order to incorporate Circular Economy and Sustainable Supply Chain Management principles into the Makan Bergizi Gratis (MBG) school feeding programme in Indonesia?

To respond to this query, five research propositions (P1-P5) have been formulated in the paper which summarizes the learning of the CE, SSCM, theory of public value, and processes of value-retention. Although all of the propositions align with existing evidence that circular and temporal views contribute to a sustainability performance, the combination thereof in a context of a school-based feeding program with a focus on the population of a developing nation is a new and under-theorised field.

P1: Circular sourcing practices such as localized procurement and stakeholder-inclusive supplier networks enhance the environmental and socio-economic performance of school feeding value chains.

(derived from Fassio & Tecco, 2019; Leksono & He, 2025; UNDP, Bappenas & Denmark, 2020)

P2: Circular production and distribution processes reduce material losses, increase operational efficiency, and strengthen supply chain resilience in public feeding systems.

(derived from Batista et al., 2021; Gonella et al., 2024; Kurniawan et al., 2022)

P3: Behavior-oriented circular consumption strategies such as nutrition education and portioning models significantly reduce plate waste and improve resource efficiency in school feeding programs.

(derived from Chabowski et al., 2025; Srijuntrapun et al., 2025)

P4: Circular post-consumption loops, including composting, bioconversion, and redistribution, generate regenerative environmental and community value while reducing disposal burdens.

(derived from Nowicka, 2026; Garcia-Saravia Ortiz-de-Montellano & van der Meer, 2022)

P5: Governance coherence and institutional readiness moderate the effectiveness of circular value chain integration across the MBG system.

(derived from Velander, 2025; Arranz & Arroyabe, 2023; Alexander et al., 2023)

Taken together, these propositions form the theoretical framework necessary to come up with a Circular Value Chain in the school-feeding context of Indonesia, and these propositions provide a systematic framework on which the conceptual model of this research is based.

The review purposely incorporates historical research on circular economy and sustainable supply chain management with more modern investigations into the field of governance, digitalisation, and food systems, both in recognition of the fact that circular public-food regimes be at the intersection of long-standing arguments of sustainability and the developing domain of transition theory. Even though the focus on the modern writings reflects the current developments, traditional expositions of the CE doctrines and SSCM synthesis remain as cornerstones of the analysis.

3. Research Methods

The study adopts a Systematic Literature Review (SLR) to develop a theoretically sound and contextually suitable Circular Value Chain (CVC) model to the school feeding system in Indonesia. In particular, an SLR best fits to assemble the disjointed conceptual, empirical, and methodological fibers that define nascent fields of research, like circular food systems, sustainable supply-chain governance, and the circularity of initiatives by the public sector (Alexander et al., 2023; Arora et al., 2023). Since this is an inquiry of a conceptual nature, the SLR is not a descriptive aggregation, but as an analytic activity, which reveals patterns, principles and logical interventions that form the basis of the CVC framework.

The review made use of the major academic databases, including Scopus and Web of Science. The search terms were combinations of such keywords as circular economy, circular value chain, circular food systems, sustainable supply chain, school feeding, public food programs, and developing countries using the Boolean operator (circular economy) AND (food system) AND (supply chain). These searches were conducted in between January 2017 and December 2025 and confined to peer-reviewed journal articles and scholarly monographs or edited volumes that provide contributions to theory.

The protocol followed to arrive at the methodological procedures is based on the guidelines of systematic searching, screening, eligibility evaluation and thematic synthesis. The peer-reviewed journal literature was prioritized to protect the methodological rigor and satisfy the requirements of primary theoretical sources. The reviewed literature included the topics of transitions in the circular economy, sustainable supply-chain management, food-system innovation, institutional governance, digitalization to circularity, and sustainability challenges in developing countries - areas well represented in the chosen corpus (Kirchherr, et al., 2017; Fassio, et al., 2019; Gonella, et al., 2024; Velander, 2025).

To start with, 52 documents were identified. The identification stage was followed by PRISMA 2020 standards, which entailed combating all sources and then removing duplicated entries. The screening eliminated research that did not have a direct contribution to circularity or supply chains that are sustainable. On the eligibility level, the full texts were evaluated in accordance with the pre-determined inclusion criteria, and 48 studies that have been found appropriate to include in the synthesis were selected. Relevance to (i) circularity in food systems, (ii) supply-chain sustainability, (iii) public or developing countries contexts, and (iv) conceptual or empirical contributions to circular system design were the focus of these criteria. This multistage selection is outlined in the PRISMA flow diagram (Figure 1) presented with it and contributes to the increased methodological transparency. Mendeley made it easier to manage the bibliography and screen, and NVivo helped with the coding and synthesis of the materials to organize the thematic categories and pursue inter-study relationships. The conceptual and methodological soundness of the identified studies was assessed and considered in terms of the clearness of circularity and sustainability constructs, the research design transparency, and the food systems or governance by the state relevance. During the eligibility stage, studies that were not well detailed in terms of methodology or had minor application in circular or sustainable supply chains were eliminated.

The thematic coding strategy used in data extraction allowed constructs to be inductively derived using the literature, but maintain theoretical grounding in CE, SSCM and the notion of public-value governance. The dimensions of coding included circular sourcing mechanisms, production and distribution processes, consumption behaviors and waste patterns, digital enablement and data infrastructures, institutional coordination mechanisms and post-consumption value-retention pathways (Batista et al., 2021; Chabowski et al., 2025; Garcia-Saravia Ortiz-de-Montellano and van der Meer, 2022). These coded observations were subsequently synthesized to reveal common theoretical patterns, system drivers, and system constraints, all of which contribute to the proposed CVC framework.

To enhance the reliability of the analysis, the synthesis focused on triangulation of theoretical, empirical, and policy-oriented studies. Cross-comparison of results made sure that the emerging conceptual model is not only representative of the prevailing discourses of the circular economy in the literature but also of the local context of the food systems of developing countries, including that of Indonesia (UNDP, BAPPENAS & Denmark, 2020; Kurniawan et al., 2022; Leksono & He, 2025). This methodological approach therefore supports an intensive compilation of various body of knowledge leading to research propositions and an elaborate, theoretically consistent, empirically based, and operationally applicable conceptual framework that can be implemented in the service of the public. The choice and screening steps were both strictly followed according to the PRISMA 2020 standards, and the final flow of the included studies is shown on Figure 1.

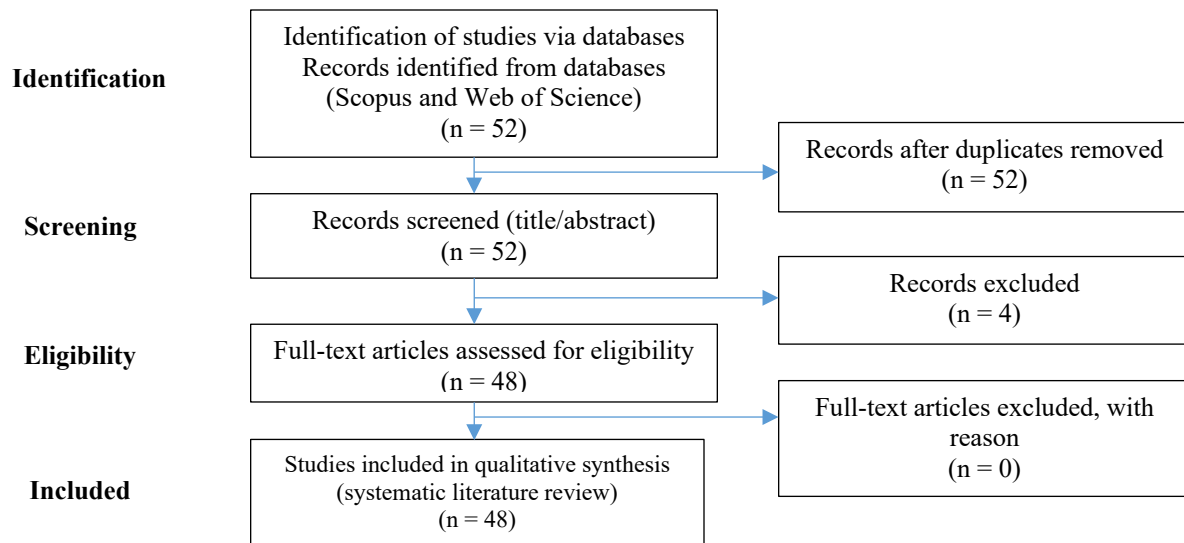


Figure 1. PRISMA 2020 Flow Diagram

To ensure transparency and methodological rigor, the article selection process followed the PRISMA 2020 protocol, which systematically documents each stage of identification, screening, eligibility assessment, and final inclusion. The flow diagram summarizes how the initial pool of studies was narrowed to the final set of 48 articles that met all predefined criteria and were subsequently incorporated into the thematic synthesis (Page et al., 2021).

4. Results and Discussion

The SLR discloses a sequence of repetitive structural, behavioral, and institutional issues that limit the process of replacing Makan Bergizi Gratis (MBG) program in Indonesia to a circular and sustainable one. In the analyzed studies, food systems in economies of the third world remain structurally fragmented, poorly digitalized, poorly coordinated multi-actor, unreliably stable supply, and food loss and waste throughout the value chain (Batista et al., 2021; Srijuntrapun et al., 2025; Leksono and He, 2025). These limitations are reflective of international experiences that show that linear supply chains do not optimize material flows or improve the socio-environmental performance, which means that they have a high level of conceptual consistency with the required Circular Value Chain (CVC) approach (Fassio & Tecco, 2019; Fogarassy and Finger, 2020). By synthesizing these understandings, there are four prevailing and connecting value-chain elements and these include circular sourcing, circular production and distribution, circular consumption and circular post-consumption loops.

The initial element, which is circular sourcing, corresponds to P1 and is based on the idea of improved relations with local suppliers, MSMEs, cooperatives, and suppliers that are community-based. It has been found in literature that localized procurement increases resource efficiency and socio-economic resilience through reduced supply chains, reduced supply variability, and increased livelihoods locally (UNDP, Bappenas and Denmark, 2020; Leksono and He, 2025). CE-oriented sourcing systems also mirror bigger institutional demands to integrate regenerative practices and distributed value generating food networks (Fassio & Tecco, 2019). In the case of MBG, it implies that the environmental consequences of local, low-waste ingredients should be considered as central to the procurement model that will provide both the reduction of environmental impacts and the enhancement of the legitimacy of the programs by strengthening the outcomes of the public value (Arranz & Arroyabe, 2023).

The second element, circular production and distribution (P2), is associated with the fact that production processes should be redesigned to enhance efficiency and reduce waste (which is supported by abundant studies pointing to the environmental and operational benefits of this change) (Batista et al., 2021; Gonella et al., 2024). The analysis of operations reveals that the preparation and distribution of food produce quantifiable waste because of the over-production, poor planning, and inconsistency of the processes (Chabowski et al., 2025; Kurniawan et al., 2022). Digital systems, such as traceability and real-time analytics, have been reported to enhance forecasting, optimization of the logistic, and decrease unnecessary material loss in the food systems (Alexander et al., 2023). This kind of understanding shows that MBG can gain significantly through technological management of the kitchen, streamlined

distribution channels, and flexible menu development within the boundaries of availability and nutritional requirements.

The third one, circular consumption, indicates P3 but emphasises the behavioural aspect of the circular food systems. Studies on food waste behavior indicate that awareness of consumers, portioning, and culture are decisive factors when it comes to the amount of waste at the consumption level (Srijuntrapun et al., 2025; Chabowski et al., 2025). Nutrition education, participatory meal planning, and plate-waste monitoring are some of the interventions that have been identified to decrease waste and strengthen long-term behavior. In school environments, the literature also points out that child interaction and community involvement can greatly increase the success of the intervention by introducing circularity in the daily consumption patterns (Nowicka, 2026). Such findings imply that MBG ought to embark on behavior influenced programs that foster responsible consumption behaviours.

Circular post-consumption loops are the fourth component that corresponds to P4 and forms the basis of regenerative CVC. In all the reviewed literature, the valorization of organic waste, either by composting, black soldier flies, biodigesters, or redistribution has been characterized as highly promising in terms of landfills reduction and the generation of new environmental and monetary value streams (Garcia-Saravia Ortiz-de-Montellano & van der Meer, 2022; Kurniawan et al., 2022). It is demonstrated in the literature of Indonesia and other developing economies that these regenerative loops rely heavily on the local government capacity, the involvement of the communities and the presence of infrastructure (UNDP, Bappenas and Denmark, 2020; Leksono and He, 2025). This means that the pathways of circular waste paths would need to be operationalized using institutional alignment and enabling policies in the case of MBG.

Lastly, drawing conclusions on all constituents, it can be conclusively stated by the literature that the success of circular interventions is mediated by the integrity of its governance, the preparedness of the institution, and the collaboration of multi-actors, and this supports P5. Empirical research shows that CE programs do not work when there is a lack of clarity in institutional requirements, the coordination process is not solid, and the incentives provided to stakeholders do not align (Velandar, 2025; Arranz and Arroyabe, 2023). In contrast, transparency and shared accountability coupled with participatory decision-making models that are linked to better sustainability outcomes in both food and waste systems are closely linked with collaborative governance models (Ambler, 2023; Alexander et al., 2023). Such dynamics are very applicable to MBG, which cuts across national ministries, district governments, schools, local producers, and community groups and demands integrated governance architectures to facilitate circularity in a large scale.

In general, the results indicate that a Circular Value Chain model is a consistent conceptual framework that can be used to restructure the school feeding system in Indonesia with the aim of applying the concepts of circularity and sustainability to the workflow, behavioral, and organizational levels. The discourse between these themes offers a theoretically informed platform on which to establish a context sensitive and policy relevant framework that can lead to future implementation and evaluation processes (Figure 2).

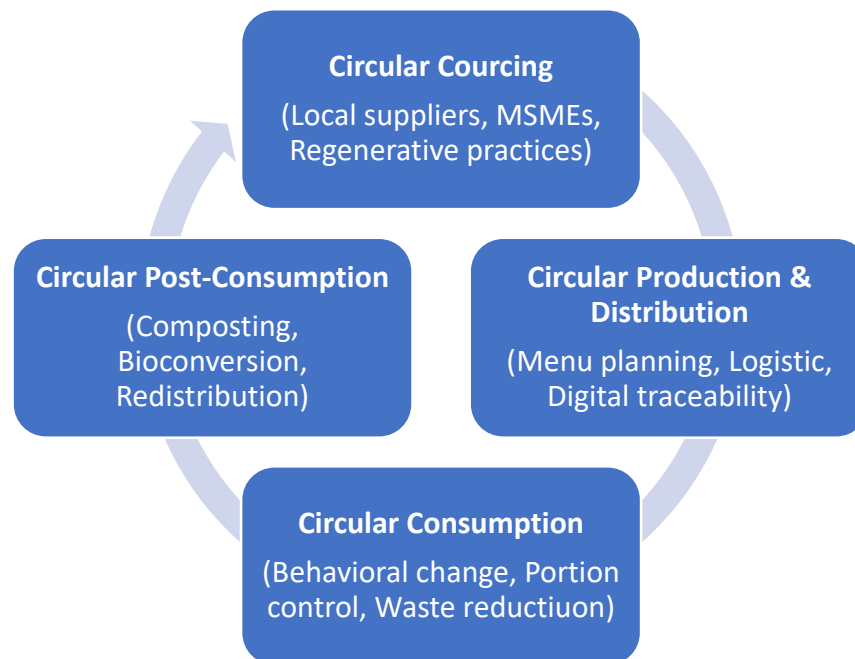


Figure 2. Circular Value Chain (CVC)

The Circular Value Chain (CVC) diagram demonstrates the chronological but interrelated actions, in which circularity can be integrated into the school feeding system in Indonesia. The model is grouped into four fundamental phases. The initial level is Circular Sourcing, which emphasizes the upstream core of the program, in which the exploitation of local suppliers, MSMEs, and regenerative agricultural inputs, base the program on community-based and resource-efficient procurement methods. Circular Production and Distribution is the second stage as it reflects the operational process where the ingredients are converted and delivered, through an efficient menu planning, lean logistics, and digital traceability, ensuring that the resources are flowing through the system and with minimum loss.

The third stage, Circular Consumption, focuses on cultural and behavioral aspects as the food is received by the beneficiaries. In this case, the methods of portion control, awareness-raising, and waste-related behavioral tendencies can be used to influence more responsible consumption habits among the students and food-service players. The last phase, Circular Post-Consumption Loops, considers the regenerative potential of the system through food scraps and organic residues reintroducing recycled value to the ecological or social systems in the form of composting, bioconversion, or redistribution. Together, these four entities illustrate a clear path of resources intake to the value creation and graphically shows how circular reasoning rearranges the school feeding chain into a more versatile, regenerative format.

In addition to convergent findings, tension and gaps are also presented in the reviewed studies which are of relevance to MBG. As an example, most of the contributions highlight the local sourcing and regenerative waste practices, but few of them discuss the potential limitations to implementation through fragmented mandates, inadequate fiscal space, or uneven digital capacity in public programs. These discrepancies highlight the importance of the fact that the transfer of the principles of the circular value chain into the school feeding systems needs not only technical interventions but also governance reforms and context-specific sequencing of the actions.

5. Conclusion, Implications, Suggestions, and Limitations

This research concludes that to shift the Makan Bergizi Gratis (MBG) program in Indonesia to a more circular and sustainable one, a systematic redesign of the food supply chain in terms of the Circular Economy (CE) and Sustainable Supply Chain Management (SSCM) concepts is needed. This review led to the creation of a structure of Circular Value Chain (CVC) that presents a consistent system of analysis covering four inter-domain loops, circular sourcing, circular production and distribution, circular consumption and circular post-consumption. Each field is a key intervention avenue that the food systems of the population can mitigate wastage, improve efficiency, leverage local

economic involvement and create greater overall social value. The results show that circularity of school feeding programs is not only an operational redesign, but rather a governance transformation through institutional alignment, digital infrastructure, behavior change, and multi-actor collaboration.

The findings of the research have implications on both theory and practice. In theory, the research contributes to the current body of knowledge on CE because it deploys the principle of circularity to the issue of the food programs of the public sector, which has received little attention in the existing literature. It further enhances SSCM research, in terms of how sustainability principles may be implemented in state led nutrition systems with intricate governance networks. The paper should also be used in future studies as an embedded case study of MBG application to a district and school level to understand how circular sourcing and post consumption loops can be implemented in the context of real governance and infrastructure limits. Evidence regarding effectiveness, costs and institutional preparedness could be created through mixed methods assessments of pilot CVC interventions like local procurement schemes, digital kitchen dashboards or even school based composting. To a researcher, the CVC framework provides a systematic perspective to designing empirical studies that help to test certain intervention logics, including the effect of digitalization on the supply chain transparency or the effect of the school community partnerships in maintaining the circular practices.

In practice, the CVC framework provides policymakers with a strategic map of how to enhance MBG performance in terms of local sourcing strategies, data-driven distribution systems, behavioural intervention, and regenerative waste management. Through these, Indonesia can enhance the sustainability pledges of the broader State and can help the community to improve the sustainability of child nutrition and community resilience.

The paper recommends a few policies to be taken by policy-makers and practitioners. The government can start the pilot testing of CVC elements in some chosen districts to figure out its feasibility and improve implementation plans. Circular transitions can be made faster by strengthening collaboration with local producers, implementing digital traceability, and introducing nutrition education in schools. Furthermore, community-based composting or bioconversion plants would help to open up new sources of environmental and economic values as well as decrease the volume of disposal. Circularity on a scale will require institutional capacity-building especially in monitoring, procurement integration, and inter-agency coordination.

The policymakers in the short run must focus on low cost, high feasibility interventions like testing localized procurement and simple plate waste monitoring in few districts. These are medium term priorities such as investing in interoperable traceability systems that are digital, and conduction of institutional capacity to integrate procurement and monitoring. Augmenting regenerative waste systems (e.g. composting, bioconversion) and integrating the principles of circularity into national school feeding guidelines are all longer-term actions.

In spite of its contributions, this study is limited to a number of factors. The conceptual model is only based on the literature thus needs to be empirically validated before it is largely adopted. The SLR can also be limited by publication bias, language and availability of CE based studies within the developing countries settings. To explore the validity of CVC framework in practice, future studies ought to involve the use of qualitative case-studies, pilot-project research and mixed-method research. The analysis of digital infrastructure preparedness, the importance of a local government, and community approval of circular practices would contribute to the model even more and reinforce its utility and effectiveness. Comprehensively, this paper provides a basis to reconsider the idea of public food systems based on the principles of circular and sustainable value chains, which can create momentum that drives the current Indonesian initiative to improve the nutritional equity and the environmental sustainability. Publication bias may influence the synthesis since the focus was on peer reviewed materials and language bias since non English studies were not comprehensively covered. Furthermore, the conceptual model is based on literature that tends to be generated in the Global North, and this may not be sufficient to understand informal dynamics in the Indonesian food systems

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