Synergizing Traders and Consumer Roles in Circular Agri-Food Supply Chain

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Abstract: The present study investigates the respective contributions of traders and consumers in advancing sustainability throughout the supply chain, specifically examining the traditional marketplaces and small and medium enterprises (SMEs) located in West Bandung Regency, West Java, Indonesia. With its prominent position as a vegetable producer in the region, West Bandung Regency encounters notable obstacles with agricultural and food waste. This makes it an optimal site for studying circular supply chain initiatives. Utilizing a mixed-methods methodology, this study integrates qualitative and quantitative data to examine the present condition of sustainability in the local supply chain. The results indicate that although traders are making increasing attempts to embrace sustainable methods, formidable obstacles persist, such as restricted availability of resources and technology. Despite growing awareness of sustainability, consumers frequently exhibit purchase patterns that do not align with their expressed preferences. The study highlights significant prospects for improving cooperation between traders and consumers, principally through educational efforts and government-backed programs. This study enhances the comprehension of circular supply chains in developing economies by providing practical suggestions for stakeholders in West Bandung Regency to collaborate their efforts in order to establish a more robust and ecologically sensitive supply chain. The findings derived from this study also establish a basis for further investigation in comparable settings, emphasizing the significance of collaboration between traders and consumers in attaining sustainable objectives.

Keywords: Circular Supply Chain, Trader-Consumer Synergy, Traditional Markets, Small and Medium Enterprises (SMEs), Agri-food

1. INTRODUCTION

The issue of global waste throughout the supply chain is a complex challenge that has a substantial influence on food security, environmental sustainability, and economic efficiency. Some 33% of the food produced worldwide is lost or wasted along the food supply chain (FSC), spanning from production to consumption. This not only constitutes a squandering of precious resources but also worsens environmental deterioration and weakens food security (Corrado et al., 2019). Statistical estimates suggest that food waste incurs an annual cost of almost $750 billion to the world economy, a figure that is equivalent to the gross domestic product of several countries (Gruber et al., 2016).

Food waste occurs at several points in the supply chain, and its underlying factors are frequently interrelated. Inefficiencies in agricultural techniques, processing, and retail operations are primary contributors to substantial waste production (Mishra & Singh, 2018; Teller et al., 2018). Evidence suggests that only a small number of studies effectively tackle food waste at various levels of the supply chain, indicating a lack of comprehensive knowledge on the whole magnitude of waste production (Bernstad et al., 2017). Furthermore, the significance of packaging and consumer behavior cannot be overstated; insufficient packaging can result in heightened spoiling, while consumer habits have a substantial impact on waste reduction at both the retail and households levels (Porat et al., 2018; Verghese et al., 2015)

The concept of a circular agri-food supply chain (CASC) is becoming more acknowledged as a crucial strategy for augmenting sustainability, minimizing waste, and expanding resource efficiency in the agricultural industry. For example, the recycling of crop wastes and animal waste can greatly improve soil fertility, hence decreasing the need

for synthetic fertilizers (Nguyen et al., 2024; Rodino et al., 2023). By minimising environmental effects, this method not only enhances soil health but also enhances the overall sustainability of agricultural methods (Rodino et al., 2023). One crucial element of circular agriculture is the incorporation of local food systems, which serves to streamline supply chains and decrease emissions associated to transportation, so further improving sustainability (Jurgilevich et al., 2016; Nguyen et al., 2024).

The involvement of traders and consumers in CASC is crucial for the effective application of CE concepts, especially in the realm of agri-food systems. Agricultural by-products and trash can be used by traders as inputs for various processes, such as composting organic waste to enhance soil health or transforming food waste into bioenergy (Chiaraluce et al., 2021; Duarte et al., 2021).

The integration of these methods not only facilitates waste reduction but also enhances the economic viability of traders by generating cost savings and increasing productivity (Giudice et al., 2020). Nevertheless, consumers have an equally significant role in facilitating the shift towards CASCs. They exert a substantial impact on manufacturing processes and waste generation through their buying preferences and consuming habits. The increased consciousness of sustainability concerns has led customers to actively pursue items that are sourced and packaged in a sustainable manner. This, in turn, motivates traders to embrace circular methods (McCarthy et al., 2019). Moreover, the active involvement of consumers in waste reduction activities, such as volunteering in food recovery programs or engaging in composting, can greatly diminish food waste inside households (Duarte et al., 2021).

The study is carried out in West Bandung Regency, an area in West Java, Indonesia, distinguished for its significant agricultural output, namely in the growing of vegetables. It is a distinctive regional center for multi-commodity agriculture production. The region is renowned for its wide range of agricultural products, encompassing horticulture, fruits, and spices (Kemenko, 2024). With its prominent role as a primary provider of vegetables to both local and regional markets, West Bandung Regency produces a substantial quantity of agricultural and food loss and waste, which poses serious environmental issues (Perdana et al., 2023). The characteristics render it a very suitable site for investigating the incorporation of sustainable practices into the supply chain, namely within the framework of conventional markets and small and medium companies (SMEs).

Based on the research context provided, here are two research questions that align with the objectives:

1. How do traders and consumers in West Bandung Regency contribute to the development of a sustainable CASC within traditional markets and SMEs?
2. What are the key challenges and opportunities faced by traders and consumers in implementing sustainable supply chain practices in West Bandung Regency, and how can these be addressed to enhance synergy?

The aim of this study is to analyze and comprehend the interdependencies between traditional market traders, SMEs, and consumers in the sustainable CASC in West Bandung Regency. Explicitly, the study seeks to determine crucial elements that impact sustainable practices, examine the obstacles and possibilities encountered by traders and consumers, and suggest methods to improve cooperation among these parties. Applying a mixed methods methodology, this research aims to enhance the creation of supply chains that are both more robust and ecologically sustainable, especially in areas with substantial agricultural operations.

2. LITERATURE REVIEW

Circular supply chain

A circular supply chain (CSC) is defined by its capacity to integrate recovery activities such as reworking, remanufacturing, and recycling, therefore completing the cycle of product life cycles (Batista et al., 2018). This strategy not only tackles the environmental consequences linked to waste but also enhances economic advantages by resource utilization optimization and cost reduction in raw material acquisition (Dey et al., 2020). This shift from linear to CSCs is especially important for SMEs, as they typically struggle to reconcile economic success with environmental obligations (Dey et al., 2020). According to (Geissdoerfer et al., 2017), the adoption of CE concepts can improve the sustainability of SMEs by changing their operational methods and promoting innovation.

However, the implementation of CSCs is not without its challenges. Issues such as supply chain complexity, lack of transparency, and coordination among multiple stakeholders can hinder the effective adoption of circular practices (Gupta, 2024). To overcome these barriers, organizations must develop strategic partnerships and foster collaboration across their supply chains (Putra et al., 2023). Additionally, performance measurement systems must evolve to capture

the multifaceted nature of CSCs, addressing economic, environmental, and social dimensions (Vegter et al., 2021). This holistic approach is necessary to ensure that CSCs contribute positively to the overall sustainability agenda.

Consumer behavior in managing waste

Consumer behavior plays a pivotal role in managing waste, particularly in the context of food waste. In the realm of food waste, various studies have highlighted the impact of consumer attitudes and social norms on waste behaviors. For instance, established a causal relationship among social norms, consumer attitudes, and behavioral intentions, demonstrating that these factors significantly influence food waste behaviors in restaurant settings (Huang & Tseng, 2020). Similarly, 's research indicated that individual decisions and sustainable local food practices are crucial in addressing food waste, particularly among students in urban environments (Warshawsky, 2019). These findings underscore the importance of fostering positive consumer attitudes and social norms to mitigate food waste effectively.

3. METHOD

Research design

This study investigates the functions of traders and customers in the CASC in traditional markets and SMEs in West Bandung Regency using a mixed methods methodology. According to Creswell (2014), mixed methods are highly efficient in offering comprehensive and in-depth research by effectively integrating both quantitative and qualitative data. This method enables the gathering of survey data on food loss and waste (quantitative) and, by conducting subsequent interviews, a more profound comprehension of how stakeholders handle these problems (qualitative approach).

Research procedures

1. Literature Review: An exhaustive examination of current literature on sustainable supply chains, the responsibilities of farmers and consumers, and the particular environments of traditional market and SMEs in agricultural regions.
2. Data collection conducted by surveys and interviews to traditional markets, SMEs, and consumers in West Bandung Regency.
3. Data Analysis: Examination of qualitative and quantitative data to detect trends, obstacles, and possibilities for improving sustainability in the CASC.
4. Reporting: Consolidation of results into a cohesive storyline, together with suggestions for stakeholders to enhance the collaboration between traders and consumers in the chosen area.

Source and type of data collected

Data were collected by conducting surveys and interviews with traders and consumers, providing a comprehensive understanding of their responsibilities and viewpoints on sustainability throughout the supply chain. The interviews unveiled the pragmatic obstacles that traders encounter, including constraints in resources and the financial hurdles associated with implementing sustainable methods. From the perspective of consumers, the interviews underscored their consciousness of sustainability and their efforts in waste management. This analysis enhances comprehension of the present condition of sustainability initiatives and pinpoints areas where cooperation between traders and customers may be reinforced.

Sampling methodology

The study utilized a stratified random sampling technique to gather quantitative data from a total of 103 traders, comprising both traditional market dealers and SMEs, together with 145 customers. In order to obtain more precise and generalizable results, the study employed stratified sampling to ensure that major subgroups were represented proportionally (Singh & Mangat, 1996). The objective of the study was to record differences in food loss and agricultural waste produced among various business kinds by categorizing the population into these separate strata. In order to obtain qualitative insights into the management and mitigation of food loss and waste in business operations, interviews were performed subsequent to the quantitative phase.

Data testing and analysis

Descriptive statistics were used to succinctly characterize the attributes of the sample, offering a comprehensive summary of demographic data and sustainable behaviors among the participants. In addition, qualitative data obtained from interviews were subjected to thematic analysis. An in-depth analysis was conducted on the transcripts of these sessions to establish repeating themes and patterns, therefore facilitating a more profound comprehension of participants' views, behaviors, and issues pertaining to sustainability. These approaches collectively offered a thorough examination of both the quantitative and qualitative elements of the study.

4. RESULT AND DISCUSSION

Overview of current sustainable practices in West Bandung Regency

Figure 1. Efforts to increase capabilities to add economic value to products

Fig. 1 shows the distribution of efforts among traders to increase their capabilities in adding economic value to their products. According to the data, 52.8% of the respondents indicated that they are actively making efforts to enhance the value of their goods, signifying a majority who are focused on improving their products' marketability and competitiveness. On the other hand, 47.2% of the respondents reported that they are not taking such initiatives, suggesting that nearly half of the traders may face barriers or lack the resources or knowledge needed to implement strategies that could boost their products' economic value. This indicates a fairly even split between those who are working towards value addition and those who are not, highlighting potential areas for development or support within the trading community.

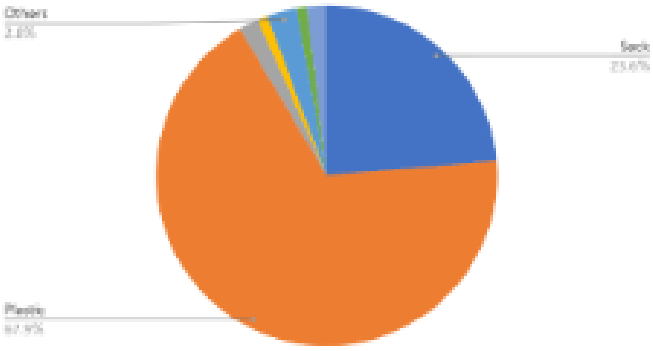

Figure 2. Packaging

Fig. 2 illustrates the distribution of packaging materials used by traders. Most traders, 67.9%, use plastic as their primary packaging material. This suggests that plastic is the most commonly used option, possibly due to its affordability and widespread availability. The second most common material is sacks, used by 23.6% of traders, which

could indicate its preference for bulk or larger products. A small percentage, 2.8%, use other packaging materials, highlighting some variety but on a much smaller scale. This chart suggests that while alternatives are available, the reliance on plastic remains dominant in the packaging practices of these traders. Small-scale traders sometimes have financial limitations, which hinders their ability to embrace more expensive sustainable packaging technologies without external assistance (UNEP, 2018).

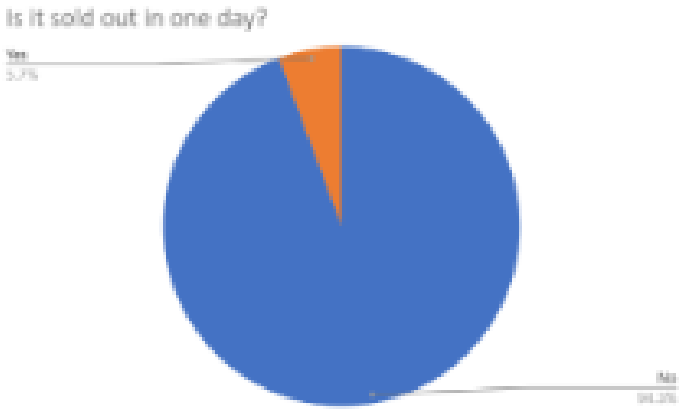

Figure 3. Items old out

The pie chart displays in Fig. 3 is the percentage of products sold out in one day. A significant majority, 94.3%, of traders reported that their products are not sold out in one day, indicating that most of the products remain unsold by the end of the day. The traders and SME owners in the traditional markets of West Bandung Regency employ many strategies to manage unsold merchandise. A significant number of retailers resell unsold merchandise the following day, employing refrigeration for perishable commodities such as meat and vegetables. Some traders categorize the remaining products, eliminating those that have been damaged while retaining the quality ones for the purpose of reselling. Another method to prolong the longevity of products is by reheating or storing them, particularly when commodities such as vegetables or meat are still in optimal condition.

Food loss, which constitutes around 10.5% of the total, takes place at many points in the supply chain, including as procurement, retail unloading, product presentation, shipping, and within the HORECA industry. Erroneous handling, incorrect storage, excessive purchasing, and insufficient preservation all contribute to this loss. Merchants and SME owners in West Bandung Regency suggest strategies such as exercising greater caution in product handling, implementing storage organization, preventing excessive inventory, and engaging in the exchange of unsold products with distributors. Nevertheless, a significant number of organisations still lack specific measures to decrease food waste. While some merchants reheat or distribute unwanted products, others dispose of them. Many propose purchasing only essential items and ensuring hygienic storage, but recognize the need for improved preservation methods. It is essential for the government to intervene through laws that ensure cheap access to technology and infrastructure, including cold chain systems and adequate waste management facilities. Collaborations with private enterprises and non-governmental organizations (NGOs) to implement cost-effective and adaptable solutions specifically designed for small-scale traders can contribute to the more effective reduction of food waste (KC et al., 2016).

Based on Fig. 4, most respondents, 97.2%, answered No, indicating that nearly all traders do not use any form of technology to manage or reduce product waste. Only 2.8% responded Yes, suggesting that a very small fraction of traders are utilizing technology. However, for those who answered Yes, the technology they rely on is limited to basic refrigeration, specifically using refrigerators to store perishable goods and extend their shelf life. This highlights a significant gap in the adoption of diverse technological solutions that could help reduce waste and loss in the agricultural supply chain, pointing to a potential area for improvement and investment in sustainable practices.

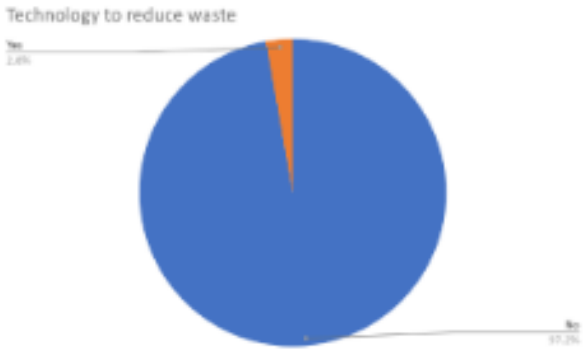

Figure 4. Technology to reduce waste

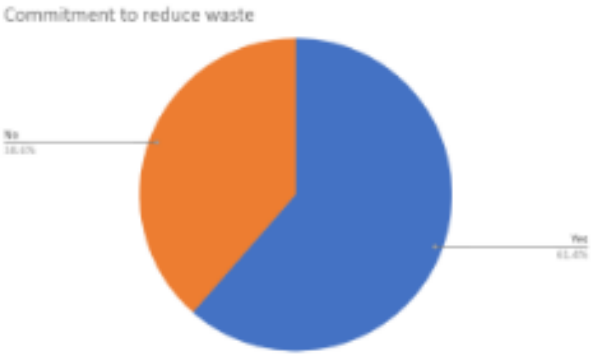

Figure 5. Commitment to reduce waste

The pie chart in Figure 5 illustrates the level of commitment to reducing waste at the household level. A majority, **61.4%**, of respondents expressed a commitment to reducing waste, indicating a positive attitude towards managing waste effectively and adopting practices that minimize waste generation. On the other hand, 38.6% of respondents indicated that they do not have a commitment to reducing waste. This suggests that while most households are aware of the importance of reducing waste and are actively trying to manage it, there is still a significant portion that may need more awareness or resources to implement waste reduction strategies.

Figure 6. Efforts to increase capabilities to add economic value to products

Figure 6 depicts efforts made by households to minimize waste through the use of sustainable packaging. A substantial majority, specifically 72.7%, of participants indicated that they employ sustainable packaging, demonstrating a firm dedication to embracing ecologically conscious methods that contribute to waste reduction. These findings indicate that a significant number of households possess knowledge regarding the ecological advantages of sustainable

packaging and are actively integrating it into their everyday routines. Nevertheless, a notable proportion of respondents, namely 27.3%, expressed their lack of implementation of sustainable packaging. This finding underscores the existence of households that may encounter obstacles related to the accessibility, expense, or knowledge of sustainable alternatives.

Challenges and Opportunities in Implementing Sustainable Practices

Food loss is a prevalent issue for many traders, mostly attributed to the perishable characteristics of items such as vegetables and fruits, which undergo rapid spoilage. Potential causes include extended shipping, inadequate handling, stacking, and unsold merchandise. Certain traders have reported repeated financial losses, particularly with delicate or perishable goods, while others have had less losses as a result of meticulous product selection, loyal consumers, or adequate refrigeration of unsold items. For certain individuals, losses are unavoidable, especially when managing substantial amounts or operating under unfavorable road conditions, resulting in damaged or unsold inventory.

The food waste generated by traders and SME owners is disposed of differently. Others dispose of their waste by depositing it in market or domestic garbage bins, or by delivering it to waste collectors or transporting it to local rubbish collection sites. Certain dealers convert organic trash into compost or dispose of it via burial. A number of traders have reported that waste is collected by either market personnel or municipal garbage collectors. In specific instances, organic waste is recycled for agricultural or fishpond purposes, while others discard it in adjacent vacant parcels of land. In general, food waste is handled using a variety of techniques, which include disposing of it in designated waste containers or reusing it for agricultural purposes. To support food waste reduction strategies for small traders, research highlights the importance of composting, storage technologies, and handling practices (Sharma et al., 2019; Waqas et al., 2023).

Considered the difficulties encountered by dealers and consumers, there exist multiple prospects to adopt sustainable practices. One significant possibility lies in enhancing food storage technologies, such as implementing refrigeration or natural preservation methods to prolong the longevity of perishable goods. Implementing this measure would effectively mitigate food deterioration and waste, especially for perishable commodities such as vegetables and meat (Nicastro & Carillo, 2021). Moreover, the implementation of sustainable packaging measures has the potential to mitigate the environmental consequences associated with the extensive use of plastic and improve the freshness of products (Afif et al., 2022). In addition, traders have the opportunity to reuse organic waste by converting unsold or damaged items into animal feed, compost, or bio-fertilizer, thereby further diminishing waste and so promoting sustainability (Martín et al., 2023).

The presence of price volatility offers an additional chance to enhance the efficiency of the supply chain by procuring locally sourced and seasonal products that are more cost-effective and lower carbon emissions by minimising transportation requirements (Hammond et al., 2015). Providing customers with information on appropriate food storage and management is of paramount importance in minimizing domestic food waste. Furthermore, the incorporation of technology, such as mobile applications or digital platforms, could facilitate the connection between merchants and customers more effectively, providing immediate updates on product availability, pricing, and freshness, therefore avoiding excessive inventory and wastage (Mah et al., 2024).

Strategic partnerships among traders, local governments, and sustainability organizations can equip traders with the necessary resources and expertise to embrace sustainable practices, including streamlined supply chain management, organic agriculture, and waste minimization techniques (Macedo et al., 2020). The integration of supply chain governance and the participation of farmers and cooperatives in coordinated production plans have enhanced its standing as a sustainable agricultural hub (Perdana et al., 2023). Through the utilization of these possibilities, both merchants and consumers have the ability to make valuable contributions towards a more sustainable supply chain, therefore mitigating waste, decreasing expenses, and fostering environmental and economic sustainability.

5. CONCLUSION

The challenges encountered by traders and consumers in effective management of fresh agricultural products underscore the necessity for the implementation of more sustainable practices throughout the supply chain. Significant challenges encompass the fast deterioration of commodities, the exorbitant price of perishable items, limited access to sustainable packaging, and a deficiency in technological integration for efficient waste management. Nevertheless,

there are evident possibilities for stakeholders to tackle these issues by implementing focused measures such as offering targeted training on food handling, enhancing availability of sustainable packaging, and advocating for local sourcing. Through the adoption of these strategies, traders and consumers can strive towards a supply chain that is more sustainable, efficient, and waste reducing. Adopting sustainable methods will yield advantages not only for the environment but also for enhancing economic profitability for all stakeholders.

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