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Sustainable Development Communication in Digitalization of Waste Management through Digital Waste Banks in Serang City

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ABSTRACT: Waste management in Serang City faces challenges, such as low community participation and limited facilities, leading to increased waste volume and environmental pollution. The Digital Waste Bank, as an innovative solution, leverages digitalization to enhance waste management effectiveness through community participation. This study, applying a Sustainable Development Communication approach, aims to analyze communication strategies in digital waste management, identify factors influencing community participation, and propose an effective collaborative communication model between government, communities, and the private sector in the context of the Digital Waste Bank (BSD) in Serang City. Using a qualitative case study approach, data were gathered through in-depth interviews, participatory observations, and focus group discussions. The findings highlight that adaptive communication strategies, the use of social media, and community-based approaches are crucial for engaging the public. Key obstacles include low digital literacy and limited technology access, but opportunities exist in the form of economic incentives and CSR support. The study concludes that structured, cross-sector collaboration significantly enhances the sustainability of digital waste management. Recommendations include improving digital literacy and establishing an integrated communication system between stakeholders to ensure program sustainability.

Keywords: Digital Waste Bank, Multi-Stakeholder Collaboration, Sustainable Development Communication, Community Participation, Waste Management.

INTRODUCTION

Environmental management problems in urban areas are increasingly complex along with the increasing population and economic activity (Voukkali et al., 2024). In Serang City, as the center of Banten Province's government, this complexity is reflected in the increasing volume of daily waste and the limitations of existing management (Marjan et al., 2024). Data from the Serang City Environment Agency reveals that there are 126 illegal waste disposal sites. While 60% of these have been addressed, approximately 40% remain unresolved, highlighting underlying structural issues in waste management. Efforts to resolve the issue have been carried out through direct

transportation, socialization to the villages, and encouraging self-management initiatives at the community level. However, challenges still arise due to a lack of awareness among residents, limited facilities, and weak coordination between local actors. Although it seems to be a technical issue, the root of this problem is more profound: the weak development communication process, which should build awareness, encourage participation, and strengthen collaboration between stakeholders to create a sustainable environment (Mor & Ravindra, 2023). This insight identifies a blind spot in the prevailing literature. However, integrating a brief literature review or positioning this critique alongside similar studies would further strengthen its claim to originality. The implementation of technology-based Digital Waste Banks is one of the potential solutions (Lestari & Taufiq, 2025), however, more targeted problem mapping and strengthening synergy between the government, the private sector, and the community are needed to ensure the overall sustainability of the program.

The Digital Waste Bank is a technological innovation that allows people to exchange waste for points of economic value (Karnawijaya et al., 2022), as well as introducing the concept of circular economy by considering waste as a resource(T. A. Kurniawan et al., 2022). This system not only encourages citizen participation but also promotes the use of waste as a valuable resource of a circular economy by using waste as a resource (Ulhasanah et al., 2025). Digitalization makes waste management more efficient, transparent, and integrated with the city system (Liu et al., 2022). But**,** Its implementation is still constrained by the low digital literacy of the community so that not all residents understand this system (Soesilo & Alfarizi, 2024), lack of integration with regional policies (Ahmad et al., 2021), as well as unstructured digitalization initiatives (Zainal et al., 2021). Although the government has issued various regulations and campaigns (Kristian et al., 2025), public awareness in sorting waste, especially in areas with limited facilities, is still a major challenge(Fadhullah et al., 2022).

The success of digitalization in waste management relies on effective development communication to deliver information, enhance public understanding, and encourage behavioral changes (Purwanto et al., 2024). With the right communication strategy, environmental literacy among the community can be improved so that they are more aware of the importance of waste sorting and the use of Digital Waste Banks (Abus et al., 2024). In addition, development communication also serves as a liaison between the government, environmental communities, and the private sector to create innovative and sustainable waste management (Purwanto et al., 2025).

Within the framework of sustainable development communication, the success of urban waste management is largely determined by effective communication between communities and stakeholders (Vasconcelos et al., 2022). Communication involving all parties can increase citizens' understanding and commitment in implementing environmentally friendly waste management and encourage synergy with local government policies(Fatmawati et al., 2022). This communication approach is also important to improve digital and environmental literacy, which is a major factor in the use of technology such as Digital Waste Banks to have a broad and sustainable impact(Hidayat-ur-Rehman, 2024).

Therefore, this research does not focus on the technical aspects of waste management, but on sustainable development communication strategies that are able to build participation,

collaboration, and environmental literacy through a digital approach. Structured communication involving various stakeholders is the key to the success of programs such as the Digital Waste Bank.

Based on this background, the focus of this research is not on the technical aspect alone, but rather on the communication strategy of sustainable development in encouraging digital participation and collaboration through the Digital Waste Bank. Structured and inclusive communication is the key to the program's success. Therefore, this study aims to: (1) analyze sustainable development communication strategies in the digitalization of waste management; (2) identify factors that affect community participation as well as existing obstacles and opportunities; and (3) formulate a collaborative communication model between the government, communities, and the private sector in the development of Digital Waste Banks in Serang City.

Development Communication

Development communication is a strategic communication process that supports social change in the context of development. (Rogers, 2003) explained that development communication uses communication to facilitate social change, particularly in health, agriculture, and education. Ariyani and Suyatno expand this understanding by emphasizing the importance of participatory communication that empowers communities as key actors in the development process (Ariyani & Suyatno, 2021). In line with that, Servaes emphasized that effective development communication must be based on dialogue and two-way interaction between the government and the community in order to create sustainable and socially just development (Servaes, 2022).

Sustainable Development

Sustainable development is a development concept that prioritizes a balance between economic, social, and environmental interests. (Brundtland, 1987) known as the Brundtland Report, defines sustainable development as development that meets the needs of the current generation without sacrificing the capabilities of future generations. Dresner added that this concept must be based on the principles of intergenerational justice and wise resource management (Dresner, 2008). Furthermore, Purvis, Mao, and Robinson emphasize the importance of integrating economic, social, and environmental policies to ensure that development can be sustained in the long term systemically and holistically (Purvis et al., 2019).

Digital Waste Bank

Digital waste banks are an innovative form of community-based waste management that utilizes digital technology to support the process of sorting and converting waste into economic value. Lestari and Taufiq explained that this system uses an application to record, weigh, and manage residents' waste savings in a transparent manner (Lestari & Taufiq, 2025). Kurniawan et al. stated that digital waste banks improve efficiency and accountability and facilitate integration with smart

city policies. Ulhasanah, Wahyuni, and Nugroho added that the existence of digital systems strengthens environmental education, facilitates community participation reporting, and supports circular economy movements at the local level (Ulhasanah et al., 2025).

METHOD

This study uses a qualitative approach with a case study method to understand the phenomenon of digitization of waste management through the Digital Waste Bank (BSD) in Serang City. This approach enables researchers to explore the perspectives of actors and stakeholders directly involved in the program. The informants included the Serang City government and BSD managers, participating communities, and the supporting private sector. Data collection was conducted through in-depth interviews, participatory observations, and focus group discussions (FGDs) to uncover perceptions, experiences, and implementation challenges. The data obtained was analyzed using thematic analysis techniques, which involved identifying and grouping key themes, as well as examining communication patterns that effectively encourage community participation and support the sustainability of the waste management digitalization program (Braun & Clarke, 2006).

RESULT AND DISCUSSION

This section presents research results obtained through the collection of field data, including in-depth interviews, official documents, and transcripts of activities. The main focus of this study includes three aspects, namely the analysis of communication strategies in the process of digitizing waste management, the identification of factors that affect the level of community participation, and the formulation of collaborative communication models between the government, communities, and the private sector. Each finding is systematically analyzed based on pre-designed research questions, and reinforced with theoretical approaches and expert views to provide a comprehensive understanding of the dynamics in the field.

Communication Strategies in Digitalization of Waste Management

Communication Strategies Used

The communication strategy in the implementation of the Digital Waste Bank (BSD) in Serang City has been developed gradually since 2012. In the early days, the Serang City Environmental Agency (DLH) carried out socialization traditionally, and it became more intensive after joining the cleanliness sector in 2018. Public communication is strengthened through the Serang Bersih program and community involvement such as KOMPAS. This approach is in line with the opinion of (Cutlip, 1962) who stated that the effectiveness of public communication is achieved through the active participation and empowerment of local communities. Research by (Bolan & Mahmood, 2023) adds that a community-based approach is important for the adoption of green technologies in developing cities.

BSD implements a community-based communication model that emphasizes value education, visual media, and waste savings systems. The communication process is carried out through environmental forums, direct socialization, and community meetings. This strategy describes the symmetrical two-way communication theory of Grunig and Hunt, which prioritizes mutual dialogue to build public trust (Grunig & Hunt, 1984). (Gong & Zhang, 2024) found that this approach increases community involvement in waste digitization programs.

Educational activities are also adapted to government programs such as Kampung Resik Lan Aman and collaboration with universities. It not only educates about waste sorting, but also improves environmental and digital literacy. Rogers through the theory of innovation diffusion emphasizes the importance of interpersonal and institutional communication in the dissemination of innovation (Rogers, 2003). Purnomo & Romlie also stated that the involvement of educational institutions accelerates the diffusion of ecoliteracy innovations in urban communities (Purnomo & Romlie, n.d.).

Main Communication Media

The communication media used include Instagram, WhatsApp groups, and spreadsheets. Efforts to develop Android applications were made, but due to limited funds and digital literacy of the community, BSD adapted a semi-digital system. This approach reflects the theory of multichannel communication as explained by Wilcox and Cameron, that the combination of various media can expand the effectiveness of message delivery (Wilcox et al., 2015). Huang and Liu added that the effectiveness of digital campaigns is largely determined by the relevance of the media to the target audience (Huang & Liu, 2017).

In addition to the spreadsheet system, manual recording with a passbook is still maintained so that it can be accessed by people who are not yet digitally literate. WhatsApp is actively used in communication between coordinators and residents regarding weighing schedules. This approach is in accordance with the theory of small group communication from Beebe and Masterson, and is supported by the findings of McQuail regarding the effectiveness of WhatsApp in community coordination (Beebe & Masterson, 2003; McQuail, 2010).

DLH also utilizes official communication channels and establishes partnerships with the community to socialize the program. The selection of media considers efficiency, accessibility, and suitability with the characteristics of the target. This is in line with Lasswell's model of communication, which emphasized the importance of tailoring the media to the audience profile (Lasswell, 1948).

Overcoming Digital Literacy Barriers

The limitations of digital literacy are overcome through a hybrid approach: data is managed with spreadsheets while people continue to use manual recording. Training was provided to participants and coordinators on how to sort waste, record, and report. This reflects Freire's approach to dialogical education, in which society is positioned as an active subject in the learning process

(Freire, 1970). Cook also emphasized that participation-based training increases the effectiveness of community-based environmental programs (Cook, 2024).

A simple savings system and regular socialization help overcome psychological and technical barriers. Local language and social narratives are used to convey messages in a more contextual way. This is in line with the idea of Hallahan et al. that cultural and linguistic context strongly determine the success of communication (Hallahan et al., 2007).

In the religious area, a religious values-based approach is applied by involving religious leaders to convey the message that cleanliness is part of faith. This strategy reflects the cross-cultural communication theory of Gudykunst and Kim, and is reinforced by the findings of Maulana et al. who show that religious approaches are able to increase community participation in environmental management programs (Fitryansyah, 2024; Gudykunst & Kim, 1992).

Factors Influencing Community Participation

Motivation and Perceived Benefits

Community involvement in the Digital Waste Bank (BSD) program in Serang City is driven by economic benefits, ease of access to services, and social values inherent in waste sorting activities. Residents benefit by converting inorganic waste into savings that can be used for household needs. These findings align with (A. Kurniawan et al., 2016) research, which shows that participation significantly increases when there are clear economic and social benefits.

In addition, an inclusive community-based approach encourages a sense of ownership of the program. The existence of a local coordinator who functions as a facilitator helps strengthen social relations between residents and supports the continuity of the program. This is in line with the theory of sense of community from McMillan and Chavis, which states that sense of belonging and social attachment are the main keys to increasing community participation (McMillan & Chavis, 1986).

In the local context of Serang City, the strategy of increasing motivation through environmental education and voluntary participation significantly strengthens the community's emotional attachment to the program. A study from Sosunova supports these findings, stating that intrinsic motivation and active participation in the environmental community contribute positively to the sustainability of waste management digitalization programs (Sosunova et al., 2022).

Barriers to Participation

Community participation also faces various obstacles such as time constraints, lack of understanding of sorting procedures, and limited access to digital devices. Residents who have busy daily activities find it difficult to consistently sort waste. Amiri et al. noted that structural barriers such as time and busyness are the main challenges in the implementation of community-based programs (Amiri et al., 2018).

In addition, the challenge of trust in the management institution is still an obstacle, especially for programs that are still in the early stages. BSD responds to this through information transparency and submission of testimonials from users. According to Elphick et al., public trust in management institutions is very important in determining the success of digital-based community programs (Elphick et al., 2021).

The low level of digital literacy is also an obstacle for some people. Therefore, BSD and DLH adopt a multichannel communication approach that blends verbal communication, social media, and hands-on training. Moitra et al. concluded that innovative approaches in communication are indispensable to reach people with limited access to technology (Moitra et al., 2021).

Influence of Education and Additional Incentives

The education provided by DLH and BSD includes technical training, counseling at school, and religious values in environmental education. This strategy has proven effective in forming long-term awareness and encouraging changes in people's behavior. Andrews et al. emphasized that community-based environmental education is better able to form sustainable behavior than a one-way approach from top to bottom (Andrews et al., 2002).

Incentives offered by BSD include a savings system, logistical support, and rewards programs for active communities. These incentives are a key driver of early participation and strengthen long-term attachment to the program. Schreuder and Horlings stated that the sustainability of incentives plays an important role in maintaining community commitment to digital waste management (Schreuder & Horlings, 2022).

In addition to material incentives, BSD also promotes social incentives such as recognition from the community and cross-group participation. BSD involves religious communities, educational institutions, and MSME actors to expand the reach of the program. Research from Sunarti et al. shows that diversity of social roles contributes greatly to building collective engagement in waste management initiatives (Sunarti et al., 2023).

Collaborative Communication Model between Government, Communities, and the Private Sector

Collaboration between the Government and Waste Bank Managers

The Serang City Environmental Agency (DLH) plays a vital role in policy formulation, technical supervision, and providing support for the sustainability of the Digital Waste Bank program. The collaborative vision between the government and the community is realized through the Serang Bersih program and the target of building 1000 waste banks launched by the local government. This is in line with the results of research by Zhang et al. who stated that the active involvement of local governments is a key factor in supporting the sustainability of environment-based community programs (Zhang et al., 2025).

The synergy between DLH and BSD includes technical training, field assistance, and operational legalization for the unit waste bank. This collaborative approach reflects an institutional governance model that prioritizes inclusivity and participation. Santoso and Astuti show that the clarity of the division of roles between stakeholders is the foundation for strengthening institutional synergy (Santoso & Astuti, 2020).

The government's commitment is shown through the procurement of physical facilities, the involvement of state civil servants (ASN), and educational efforts to the community. Dentoni et al. corroborate this by stating that cross-sector partnerships between public institutions and communities accelerate the achievement of sustainable environmental development (Dentoni et al., 2021).

The Role of Local Communities and Social Institutions

Community groups such as KOMPAS, educational institutions, religious communities, and MSMEs play an important role in disseminating information and operating waste collection points. The presence of local coordinators helps to strengthen social networks and ensure the continuity of daily activities. Johnson et al. identified that informal institutional structures are very effective in implementing community-based programs (Johnson et al., 2015).

The participatory approach is realized through multi-level training, community forums, and youth involvement in educational activities. This model refers to the collaborative governance framework as formulated by Ansell and Gash, which emphasizes the importance of collaborative dialogue and cross-actor commitment (Ansell & Gash, 2008). Hammad et al. added that the effectiveness of digital environmental communities depends on the strength of social networks and local institutions (Hammad et al., 2024).

Efforts to strengthen community capacity are also carried out through technical assistance programs, waste management training, and digital literacy education. Hickmann show that local capacity building is an important element in maintaining the sustainability of environmental programs, especially in the midst of limited resources (Hickmann, 2021).

Private Sector Contribution through CSR Programs

BSD has established strategic partnerships with companies such as Chandra Asri, Indah Kiat, and Krakatau Posco to support CSR activities in the form of training, waste collection point development, and industrial waste management. This practice reflects the concept of shared value from Porter and Kramer, who emphasize that the integration of social values in corporate strategies can have a significant social impact (Porter & Kramer, 2011).

The private sector's contribution significantly supports funding, expanded access, and program sustainability. Hong & Ryu noted that cooperation between the private sector and community managers is an effective solution in overcoming limited government funds and increasing the impact of programs (Hong & Ryu, 2019).

Furthermore, performance reporting based on ESG (Environmental, Social, Governance) indicators encourages increased accountability and strengthens program transparency. The findings of Becchetti et al. support this by showing that the synergy of CSR and ESG reporting is able to build a company's image while expanding the community's social network (Becchetti et al., 2022).

Interpretation of Key Findings

The findings of this study indicate that the successful implementation of the Digital Waste Bank (BSD) program in Serang City is strongly influenced by structured and inclusive development communication strategies. Specifically, community-based communication that combines traditional and digital media, participatory training, and the involvement of local leaders has significantly enhanced public awareness, participation, and collaboration in waste management activities. This aligns with the theoretical framework of symmetrical communication, which emphasizes two-way dialogue and trust-building as crucial elements for effective public engagement (Grunig & Hunt, 1984). Moreover, the integration of economic incentives and social recognition has been shown to motivate residents to participate actively in waste sorting and management, reflecting findings from Kurniawan et al. (2016) regarding the impact of perceived benefits on community engagement. However, this study also highlights persistent barriers, including low digital literacy, time constraints, and limited access to technology, which remain significant obstacles to achieving full community participation (Amiri et al., 2018; Soesilo & Alfarizi, 2024).

Comparison with Previous Studies

The results are consistent with prior research emphasizing the importance of participatory communication and multi-stakeholder collaboration in sustainable environmental programs. For instance, Melkote and Steeves highlighted that participatory development communication empowers communities as active agents of change, a principle reflected in the community forums, educational programs, and multi-channel communication observed in Serang City (Melkote & Steeves, 2001). Similarly, Porter and Kramer's concept of shared value supports the finding that private sector involvement through CSR programs contributes to program sustainability by aligning social and economic interests (Porter & Kramer, 2011). In contrast, the present study extends previous research by demonstrating that hybrid communication strategies—blending digital and manual methods—are essential to address digital literacy gaps and ensure inclusivity. This nuance is less emphasized in studies that focus solely on digital or technology-driven environmental interventions (Liu et al., 2022; Zainal et al., 2021). Additionally, while earlier studies often focus on technical or policy dimensions, this research emphasizes the central role of structured communication as a determinant of program success, highlighting an important contextual insight for developing countries or regions with heterogeneous digital capacities.

Limitations and Cautions

Despite the insights gained, several limitations should be acknowledged. First, the qualitative case study design, while providing in-depth understanding, limits the generalizability of findings to other urban settings with different socio-cultural or economic characteristics, similar to concerns raised by (Hickmann, 2021). Second, the reliance on interviews, FGDs, and observations may introduce subjective biases, particularly in the assessment of residents' motivations and perceptions. Third, the study focuses primarily on the Serang City context, which may not fully capture regional variations in governance, community structure, or technological adoption. Finally, while the hybrid communication approach addresses digital literacy barriers, it may not be scalable to larger urban populations without additional technological infrastructure and targeted literacy programs.

Recommendations for Future Research

Future research should aim to expand the empirical evidence on development communication strategies in digital waste management by including longitudinal designs to track behavioral changes and sustainability outcomes over time. Comparative studies across multiple cities or regions could elucidate contextual factors that influence program effectiveness, including governance quality, cultural norms, and digital infrastructure. Furthermore, quantitative approaches combined with qualitative methods, such as surveys assessing behavioral intentions alongside in-depth interviews, could provide a more comprehensive understanding of the drivers of community participation. Additionally, future studies should explore the role of digital literacy interventions and technological innovations in overcoming barriers to participation, as well as the impact of various incentive mechanisms—both economic and social—on long-term program sustainability. Finally, research could examine cross-sector collaboration models in greater detail to identify best practices for public-private-community partnerships in environmental management initiatives.

CONCLUSION

This study concludes that the communication strategy applied in the management of Digital Waste Banks in Serang City plays an important role in increasing public understanding of the concept of digital-based waste management. The strategy relies on a digital approaches through social media, visual messages, and community-based education. This approach is effective in reaching the wider community, although it is still faced with diverse digital literacy challenges.

Community participation in this program is influenced by a number of factors such as economic motivation, educational value, and social encouragement. The incentives provided in the form of waste savings and social programs strengthen citizen involvement. However, barriers such as limited digital devices, time constraints, and lack of trust remain significant challenges that require attention.

The collaborative model between local governments, local communities, and the private sector proved to be a major force in the success of the program. Policy support from the Environment Agency, community involvement such as Kompas, and private sector participation through CSR strengthen the sustainability of the program. This collaboration highlights the importance of inclusive, flexible, and long-term development communication, particularly by emphasizing key elements such as dialogicality and hybrid media use, which contribute to theoretical advancements in sustainable development communication.

Based on the results of the research, several recommendations can be proposed to strengthen the implementation and sustainability of the Digital Waste Bank initiative in Serang City. First, improving digital literacy remains essential; both the Serang City Government and the Digital Waste Bank are encouraged to enhance digital technology education through community-based training, particularly in areas with low levels of digital competence. Second, the development of user-friendly and affordable mobile applications tailored to diverse community backgrounds is necessary to accelerate the adoption of digital systems in waste management. Third, strengthening cross-sector collaboration is crucial, as broader partnerships among the Environmental Agency (DLH), local communities, the private sector, and educational institutions can foster innovation and support a more resilient community-based circular economy ecosystem.

Fourth, standardization and certification initiatives—such as the active waste bank certification program designed by DLH—serve as formal recognition of institutional consistency and professionalism, thereby enhancing public trust. Finally, the Digital Waste Bank model in Serang City, which has demonstrated effectiveness, has strong potential for replication in other regions, provided that adjustments are made to accommodate local social contexts and capacities. Conducting a more critical analysis of contextual variables, including regional policy landscapes, technological infrastructure, and cultural readiness, would improve the model's transferability and real-world applicability.Thus, development communication in the context of digital waste management is not only a tool for socialization, but also a strategic instrument for sustainable social and environmental transformation.

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