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The Role of Waste Bank Management Information System in Increasing Community Participation in Environmental Management in Dumai City

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ABSTRACT

This study analyzes the implementation of the Waste Bank Management Information System (Sistem Informasi Manajemen Bank Sampah/SIMBA) and its role in enhancing community participation in environmental management in Dumai City, Indonesia. Waste management has become a pressing issue in urban areas, and Dumai faces significant challenges due to limited infrastructure and low public awareness. SIMBA, a web-based platform developed by the Ministry of Environment and Forestry, integrates national waste bank data to support efficient, transparent, and measurable waste management. Using a literature review approach, this study compiles and synthesizes findings from relevant national and international research related to management information systems and public participation in environmental governance. The findings indicate that SIMBA has improved data transparency, administrative efficiency, and citizen engagement by enabling residents to monitor waste deposits and economic returns in real time. The system motivates behavioral change by linking ecological awareness with tangible financial benefits. However, implementation barriers persist, including limited technological infrastructure, low digital literacy among waste bank managers and users, and insufficient local policy and funding support. To overcome these challenges, the study recommends capacity building through digital literacy training, stronger collaboration between government, community, and private sectors, and policy optimization using data-driven decision-making. Overall, SIMBA demonstrates strong potential as a strategic instrument for promoting participatory, adaptive, and sustainable environmental management at the local level.

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1. INTRODUCTION

The problem of waste management is a big challenge for almost all regions of Indonesia, especially in urban areas. According to data from the Ministry of Environment and Forestry (MoEF), Indonesia produces around 64 million tons of waste per year, with a composition of 60% in the form of organic waste and 14% plastic (Laksono, 2021). This condition is exacerbated by population growth, changes in consumptive lifestyles, and weak community-based management systems. As a result, various regions face garbage accumulation, pollution, and declining environmental and public health quality.

Dumai City, as one of the main industrial cities and ports in Riau Province, faces similar problems. Based on data from the Dumai City Environment Agency (DLH) in 2017, waste production reached 218.88 tons per day, while the transportation capacity was only around 138 tons. The rest, about 80 tons, accumulates in residential environments and causes degradation of environmental quality (Saputri et al., 2019). Limited fleets, Temporary Shelter (TPS) facilities, and low community participation worsen this situation.

Various studies show that the role of local governments, especially DLH, is not fully optimal because it is constrained by managerial aspects, human resources, and socialization to the community (Saputri et al., 2019). Waste management still focuses on activities *end-of-pipe* such as transport and final disposal, not on the reduction and reuse system (*3R – reduce, reuse, recycle*). In fact, in accordance with Law Number 18 of 2008 concerning Waste Management, local governments are obliged to ensure the implementation of waste management that is environmentally friendly and participatory (RI, 2008).

One of the innovative approaches that has developed to answer this problem is the implementation of the Waste Bank Management Information System (SIM). Waste banks are a forum for people to save waste of economic value, which is managed collectively in order to increase citizens' concern and participation in environmental management. The waste bank management information system allows waste collection, recording, and reporting activities to run efficiently, transparently, and accountably.

The digitization of waste banks through information systems not only increases administrative efficiency, but also encourages changes in people's behavior from passive to participatory in maintaining environmental cleanliness (Wardani et al., 2020). The information system makes it easy for residents to monitor their waste savings balances, the types of waste deposited, and the economic incentives obtained, thereby creating a sense of ownership of environmental management programs at the local level.

In the context of Dumai City, the implementation of the Waste Bank Management Information System is a potential strategy to strengthen synergy between the government and the community in dealing with the waste problem. Through information technology-based management, it is hoped that community participation will increase not only in waste sorting and saving activities, but also in supporting sustainable environmental policies.

Therefore, this study focuses on the analysis of the role of the Waste Bank Management Information System in increasing community participation in environmental management in Dumai City. This study is expected to provide an empirical understanding of the effectiveness of information systems in strengthening citizen involvement and realizing sustainable environmental management.

2. METHODS

This study uses the library research method, which is a research approach carried out by examining various scientific literature sources relevant to the topic of the Role of Waste Bank Management Information Systems in Increasing Community Participation in Environmental Management in Dumai City. These sources include national and international scientific journals, books, laws and regulations, government reports, and previous research results that discuss waste management, management information systems, and community participation. Through an in-depth analysis of the literature, the researcher seeks to identify interrelated theories, concepts, and empirical

findings to explain the role of information systems in the context of sustainable environmental management (Scott, 2019).

The literature review process is carried out systematically through three main stages: (1) the collection of relevant literature using scientific databases such as Google Scholar and Garuda Ristekdikti, (2) critical evaluation of the content and methodology of each source to ensure its validity and relevance, and (3) the synthesis of information into a conceptual framework that describes the relationship between the information system of waste bank management, community participation, and and the effectiveness of environmental management. With this method, the research focuses on conceptual and comparative analysis to generate theoretical understanding and policy recommendations without conducting direct field observations.

3. FINDINGS AND DISCUSSION

Overview of the Waste Bank Program in Dumai City

The Waste Bank program in Dumai City is part of the local government's strategic efforts to manage the waste problem that continues to increase due to population growth, changes in consumption patterns, and people's lifestyles. Waste Banks play an important role in sorting, collecting, and processing household waste with the 3R (Reduce, Reuse, Recycle) principle, so that it can reduce the volume of waste that must be disposed of in the Final Disposal Site (TPA) and help create a clean and healthy environment (Laksono, 2021b).

The Waste Bank program in Dumai City consists of two main levels, namely the Main Waste Bank (BSI) at the sub-district level and the Unit Waste Bank (BSU) at the village level. BSI functions as a management and coaching center for a number of BSUs, while BSU is the main implementer at the community level who is tasked with inviting and facilitating the community in sorting and collecting waste to be distributed to BSI or other processing parties. Through this system, people are encouraged to actively participate from the household by getting used to sorting waste according to its type. In addition to playing a role in environmental conservation, this program also provides economic benefits for the community through a savings system or incentives from the results of waste management that have a selling value.

The implementation of the Waste Bank program depends on synergy between local governments, communities, and various stakeholders such as recycling business actors and educational institutions. The Dumai City Government, through the Environment Agency (DLH), plays an important role in providing guidance, facilitation, and regulations to ensure the sustainability and effectiveness of the program. However, the challenges still faced include low public awareness in sorting waste, limited supporting facilities, and the need for continuous education and training.

Based on DLH data in 2022, the existence of BSI and BSU in Dumai City shows positive developments that can be used as a basis for evaluation and planning to strengthen community-based waste management in the future.

Table 1. Dumai City Waste Bank Data in 2022

No.	Name of the Waste Bank	Person in Charge	Address
1	BSI KELAKAP SEVEN	DMI	Jl. Kelakap Tujuh
2	THE WORK OF A HERO	Rudi Hartono	Copyright © 2019 Arifin Ahmad. All Rights Reserved.
3	BSU DW LH JAYA	DW LH	JL. Seven Daughters
4	BSU RISKY	Edy Tambunan	Mt. Merbabu
5	BSU AHYAT S	Ahyat Siagian	Copyright © 2019 Soekarno Hatta. All Rights Reserved.
6	BSU MANGUNGSUNG JAYA	Mangungsung	Copyright © 2019 Arifin Ahmad. All Rights Reserved.
7	BSU LAMBOK S JAYA	Squirrel.S.	Copyright © 2019 Soekarno Hatta. All Rights Reserved.
8	BSU BARUS JAYA	Südürü	Sicily End
9	BSU ALIKA SPOT	Hamdi	Copyright © 2019 Siliwangi Hotels. All Rights Reserved.
10	BSU HERI	Nurmia.M	Sicily End
11	BSU MELY JAYA	Aminoto	Jl. Abd Rab Khan
12	BSU DELIMATUAH	Stuttgart	Jl. Abd Rab Khan
13	BSU TUGIMAN JAYA	Tugiman	Jl. Tambusai Simpang Baru
14	BSU YOSEFRI JAYA	Yosefri	Copyright © 2019 Soekarno Hatta. All Rights Reserved.
15	BSU LIDYA JAYA	Lidya.F	Copyright © 2019 Soekarno Hatta. All Rights Reserved.
16	BSU 6 BOYS	Syria	Copyright © 2019 Soekarno Hatta. All Rights Reserved.
17	BSU ADI PLAS	Supriadi	Copyright © 2019 Imprint I. All Rights Reserved.
18	BSU HARDIYANTO JAYA	Hardiyanto	Copyright © 2019 Panam. All Rights Reserve
19	BSU EDY KARA	Aidi Ardianto	Copyright © 2019 Soekarno Hatta. All Rights Reserved.
20	BSU PUTRI JAYA	Ardi Winata	Jl. Simpang Japan
21	BSU EKO JAYA	Eko.N	Jl. Simpang Japan
22	BSU RISKY KARA	Heriawan	Copyright © 2019

			Soekarno Hatta. All Rights Reserved.
23	BSU SISWANTI JAYA	Siswanti	Copyright © 2019 Hatta Hotels. All Rights Reserved.
24	BSU ARCANA SUCCESS TOGETHER	Mother.S	E-Mail

Source: (Dharma et al., 2023)

Community Participation in Environmental Management

Community participation in environmental management can be categorized into different levels of involvement, ranging from passive to active. For example, in the study of Community Participation in Mangrove Management by Alfandi et al. (2019) in Lampung, community participation was classified using the ladder of participation theory from Sherry Arnstein which distinguishes between therapeutic/passive participation and active participation at the planning stage to implementation(Alfandi et al., 2019). Furthermore, the community is not only involved as physical implementers, but also through access to information, decision-making processes, and policy evaluation (Mariyam et al., 2023). Thus, conceptually active participation means that the community participates in the planning, implementation, monitoring and evaluation stages, not just being the object of the program.

Some studies emphasize that environmental awareness that grows from community empowerment, environmental education, and collective activities such as waste bank programs allows for increased participation. Concrete examples of communities in Tanjungsari Village being involved in all stages of the waste bank program from planning to evaluation (Rahayu, 2022). Other research by (Salsabila et al., 2021) emphasizing that sustainable municipal waste management relies heavily on active public participation and not just administrative responses. In the context of collective activities such as waste banks, community involvement through sorting activities, saving waste, and obtaining economic incentives can trigger behavioral changes from passive consumers to participating actors in environmental management.

The research also identified a number of factors that affect the level of community participation:

a) Economic motivation: For example, the existence of waste banks as an economic forum for waste increases people's motivation to get involved (Rachman et al., 2021).
b) Government and policy support: government dominating roles makes public participation limited if only "called in" without a more inclusive collective process (Taryono et al., 2025).
c) Availability of environmental infrastructure and education: in addition to economic incentives, access to education and environmental means of use (e.g. cost-sharing systems) also encourages community involvement (Sukwika, 2023).
d) Environmental awareness and literacy: communities with higher levels of environmental awareness are more likely to actively participate.

The Role of Management Information Systems in Increasing Community Participation

The implementation of the Waste Bank Management Information System (SIMBA) in Dumai City is a form of government innovation in realizing technology-based waste management and community participation. Based on the research of Dharma, Susanti, & Marlinda (2023), SIMBA is a web-based system and *database* developed by the Ministry of Environment and Forestry (MoEF) to integrate waste bank management data throughout Indonesia. This system is used by the Dumai City Environment Agency as a means of digitally recording waste bank activities, including customer data, volume and type of waste, to savings transactions. The use of SIMBA has been proven to improve the efficiency and accuracy of data management and provide wider access for the public to monitor the results of their activities in real-time. Thus, the system is not only an administrative tool, but also an instrument of

public transparency that strengthens the accountability of environmental management (Dharma et al., 2023).

Furthermore, the existence of SIMBA encourages community participation because this system allows residents to see the economic value of waste sorting and saving activities, which were previously difficult to do through manual recording. The public can know directly the weight and exchange rate of the waste they deposit, so that economic motivation as well as ecological awareness emerges. According to Wardani (2020), the digitalization of waste bank management can change the paradigm of society from just a waste dumper to a circular economy actor (Wardani et al., 2020) . The sustainability of waste banks is largely determined by the level of citizen participation, and information systems such as SIMBA can be a catalyst in maintaining the consistency of such participation.

In addition to its economic function, SIMBA also acts as an educational and communication medium between waste bank managers, local governments, and the community. Through the reporting features, digital socialization, and feedback provided in the system, people gain an understanding of the importance of the 3R (Reduce, Reuse, Recycle) principle and how to apply it in their daily lives. According to the results of Dharma et al.'s (2023) research, the data stored in SIMBA is not only used for administrative reporting, but also serves as a basis for local governments to carry out *monitoring*, evaluation, and waste management policy planning. With this integration, people feel more involved because their activity data becomes part of the public decision-making system (Dharma et al., 2023).

However, the study also noted that there are challenges in the implementation of SIMBA in Dumai, such as the limited digital literacy of waste bank managers and low public awareness in sorting waste from the source. This factor causes some waste banks to still do manual recording before entering data into the system. However, the government's efforts through training, socialization, and mentoring have gradually increased the public's understanding and ability to use SIMBA. Regional policy support through Regional Regulation No. 3 of 2021 concerning Waste Management is an important legal basis for the sustainability of this program. In addition, research shows that the success of environmental information systems is not only determined by technology alone, but is highly dependent on public literacy, clear public policies, and collaboration between stakeholders. (Resignation & Ali, 2025) emphasized that digital literacy, good public policy, and community participation significantly increase environmental awareness.

Thus, the implementation of SIMBA in Dumai City shows that the management information system plays a significant role in increasing community participation through transparency, economic incentives, and two-way communication between the government and residents. SIMBA not only functions as a data management tool, but also as a means of empowering the community towards behavior change that cares more about the environment. Through this approach, Dumai City has the potential to become a model for the implementation of an effective environmental information system at the regional level, which combines technology, public policy, and citizen participation in one sustainable digital ecosystem framework.

Challenges and Strategies for Strengthening the Waste Bank Management Information System in Dumai City

The implementation of the Waste Bank Management Information System (SIMBA) in Dumai City faces a number of challenges that hinder its effectiveness as a community-based waste management tool. According to Dharma, Susanti, and Marlinda (2023), most waste banks in Dumai still do manual recording before data is input into SIMBA due to limited human resources and technological facilities (Dharma et al., 2023). The limitations of network infrastructure, computer devices, and low digital literacy of managers cause the data input process to be slow and inconsistent. This condition hinders the accuracy of the data that should be the basis for decision-making by the Dumai City Environmental Agency. A similar obstacle was also found by Wicaksono (2020) in a study in Semarang, that the lack of managerial and technological skills in waste bank managers has a direct effect on the sustainability of community-based waste management systems (Wicaksono & Warsono, 2020).

Budget limitations and suboptimal policy support are also factors that hinder the implementation of this information system. Based on the evaluation of Dharma et al. (2023), the budget for training, system maintenance, and infrastructure development in Dumai is still limited, making it difficult for local governments to maintain program consistency (Dharma et al., 2023). The results of Salsabila et al.'s (2021) research also show that without policy support and sustainable financing, the digitalization of waste management is vulnerable to stopping halfway (Salsabila et al., 2021). This condition shows that the success of the management information system is not only determined by technological readiness, but also by aspects of public policy and strong institutional commitment at the regional level.

Facing these various obstacles, the strategy to strengthen SIMBA in Dumai City needs to be focused on human resource capacity development and cross-sector collaboration. Based on the study by Sukwika (2023), improving the ability of operators and the community through digital literacy training, technical guidance, and environmental education programs has been proven to be able to increase the effectiveness of environmental information systems (Sukwika, 2023). On the other hand, collaboration between the government, waste bank managers, the private sector, and educational institutions can expand access to resources, technological innovations, and marketing networks for recycled products. This multi-stakeholder approach is also strengthened by the findings of Taryono et al. (2021) which affirm that the success of digital-based environmental management is greatly influenced by the synergy between the government and the community through participatory and open mechanisms (Taryono et al., 2025).

Furthermore, optimizing digital data-based environmental policies is a strategic step in strengthening the sustainability of SIMBA. The Dumai City Government can utilize the data generated from this system to monitor, evaluate, and plan evidence-based policies. With an integrated and transparent information system, the decision-making process can be more accurate and responsive to field conditions. This approach is in line with the recommendations of Dharma et al. (2023) who emphasize the importance of making SIMBA not only an administrative tool, but also a strategic instrument in formulating sustainable environmental management policies (Dharma et al., 2023). Thus, strengthening the waste bank management information system in Dumai City not only serves to improve technical efficiency, but also to build a collaborative ecosystem that is adaptive, participatory, and oriented towards environmental sustainability.

4. CONCLUSION

Based on the results of the study, this study concludes that the implementation of the Waste Bank Management Information System (SIMBA) in Dumai City has a strategic role in increasing community participation in environmental management. SIMBA has been proven to strengthen the efficiency and transparency of waste data management, provide economic incentives that motivate the community to actively participate, and become a means of education and communication between the government and citizens. Thus, this information system not only serves as an administrative tool, but also as an instrument of community empowerment and increased public accountability.

However, the main challenges faced include the limitations of technological infrastructure, low digital literacy of managers, and suboptimal regional policy support. For this reason, a strengthening strategy is needed in the form of increasing the capacity of human resources, cross-sector collaboration between the government, the community, and the private sector, as well as the implementation of digital data-based policies.

This research provides a conceptual foundation for local governments to expand the application of SIMBA as an adaptive and sustainable waste management model. Further research is recommended to conduct field studies or quantitative analyses to measure the direct impact of the implementation of SIMBA on changes in community behavior and the effectiveness of environmental policies at the local level. Some follow-up research is also being directed at the development of a mobile application-based system to expand public access to waste bank programs.

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