

INNOVATION IN ENVIRONMENTAL POLICY OF COMMUNITY-BASED WASTE MANAGEMENT IN ACHIEVING A LOW-CARBON CITY

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Abstract. Study. This aim is to analyze the implementation of innovation management in a rubbish-based community to support achieving the *Low Carbon City* in Bogor Regency and study inequality between policy macro and conditions in the field. Although the National Policy and Strategy for Management of Garbage (Jakstranas) targets a 75% reduction in rubbish to 75%, realization in Bogor Regency is still in the range of 44%. This is caused by structural obstacles like TPST/TPAS infrastructure limitations, lack of transport fleet, and not yet optimal regulations and zoning. Research This study uses cases in three subdistricts (Cibinong, Bojonggede, and Cileungsi), and found that innovation communities, such as digital waste banks, maggot composting, and eco enzymes, are capable of reducing organic waste volume by 20–30% and increasing sorting up to 35%. Projection impact on emission shows that if innovation is replicated all over House households in Bogor Regency (± 600 thousand), then potential subtraction of GHG emissions can reach 48,000–72,000 tons of CO₂-e / year. Research This produces an integrative model for managing rubbish based on a community that can support the reduction of emissions concretely and strategically to realize a low-carbon city. Findings: This confirms the importance of multi-actor synergy and supports policy adaptive areas to initiate locally.

Keywords: *policy environment; management trash; community*

I. INTRODUCTION

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The increasingly global climate is pushing various countries, including Indonesia, to implement policies for a better, adaptive, responsive, and innovative environment. One of the approaches important in responding to the climate crisis is developing a low-carbon city (Low Carbon City), which aims to reduce greenhouse gas emissions (GHG) through various sectors, including waste management. Garbage House stairs and urban areas contribute to improving GHG emissions, especially if their management is done in an open, uncontrolled, or uses open burning and on-site disposal or open dumping.

The Indonesian government has committed to the Paris Agreement to lower GHG emissions by 29% with business alone and up to 41% with international help in 2030. In order to achieve these targets, the government area, including the Bogor Regency, must play an active role through concrete policies capable of lowering emissions significantly. One is

building a system to manage waste based on low-carbon, efficient, participatory, and innovative methods. Therefore, studying how to implement a policy environment, specifically in management rubbish, can be done through an innovation-based community. Therefore, implementation policy environment through innovation management rubbish-based community becomes very strategic in achieving the Low Carbon City goals, especially in areas experiencing fast urbanization, such as Bogor Regency.

Bogor Regency, one of the buffer zones for the nation's capital, has complex geographic, demographic, and social contexts. With a population of more than 5 million souls and spread across 40 sub-districts, Bogor Regency faces challenges in the management environment, especially waste management. Based on data from the Bogor Regency Environmental Service, waste production 2023 is estimated to reach more than 2,500 tons per day. However, the capacity for transportation and processing rubbish is minimal, and it can only manage around 60–70% of the total waste produced. Still, many are discarded carelessly, burned, or piled up in place of disposal, which is illegal.

Problems show that policy management is rubbish, conventional, top-down, and centralized at the local government level. Not yet effective in answering the

challenges in the local environment. Required approach newer, inclusive, participatory, and innovative, namely through a management rubbish-based community approach. This emphasizes empowerment of the public in sorting, collecting, processing, and utilizing garbage, so that it can reduce the volume of waste disposed of at the Place Final Disposal (TPA) and, at the same time, reduce GHG emissions. Management innovation rubbish-based community owns various forms, from waste bank, composting scale, house ladder, eco-enzyme technology, to digital-based rubbish independent management models. Some villages and sub-districts in Bogor Regency have started this initiative; however, its success is still partial and has not been comprehensively integrated into the system policy area. There is still a gap between policy macros issued by the government and implementation at the micro level (community). In this context, it is important to consider how implementing the policy environment, specifically the management of rubbish, can be done innovatively through the active involvement of the community.

The urgency of the study lies in the increasing pressure on environmental consequences, the high rate of production of trash, and the existing management system that is not yet optimally managed. Based on a Report from the Regional Development Planning Agency (Bappeda) of Bogor Regency in 2023, of the total waste produced per day, only around 900-1,000 tons can be transported to the Galuga landfill, the central landfill of Bogor Regency, which is currently exceeding capacity. The Galuga Landfill becomes crucial if not managed sustainably because it causes air, land, and water pollution. In addition, the burning of rubbish in an open way is still often found, especially in rural and suburban areas of cities, which contributes carbon emissions in the form of methane and carbon dioxide to the atmosphere.

In this context, the community becomes an object of policy and a subject actively capable of designing, implementing, and evaluating policy management for environmental garbage. Participation in the community will increase a sense of belonging, strengthen social control, and form a new culture in the management of rubbish in a sustainable way. However, so far, few studies have scientifically examined the role of the community in implementing policy management for innovative waste in the Bogor Regency area, as well as their contribution to realizing a Low Carbon City. Low Carbon City (LCC) is an approach to developing urban areas that emphasizes efficient energy, reduced carbon emissions, and environmental conservation. In many studies, cities' low carbon has proven to increase quality of life, strengthen the environment's resilience, and create an economy-inclusive circularity. However, LCC's achievements cannot be achieved without effective management of waste because the sector produces emissions of methane, which has the potential to cause global warming 25 times more than carbon dioxide.

Initial data show that of the 40 sub-districts in Bogor Regency, only around 18 sub-districts have a waste bank program active and integrated in the system management of

the rubbish area. Meanwhile, the rest still experience constraints regarding the education community, facilities, infrastructure, and support regulations. Related to emissions, based on the inventory of emissions from the GHG sector waste by the Environmental Service in 2023, the sector garbage contributes approximately 12% of the total GHG emissions of Bogor Regency, with the main composition originating from domestic organic matter that rots in landfills or illegal TPS. Another problem that becomes background behind important issues is the lack of strong synergy between device areas, such as the Environmental Service, Community and Village Empowerment Service, and the local community environment, in developing and implementing innovative management programs for rubbish. In addition, the Corporate Social Responsibility (CSR) program from the sector, which is a potential private sector support effort for management, has not been utilized optimally by the community. With the complexity and urgency of the problem, research is needed. This contributes to academics and practical applications in formulating and implementing an innovative and resource-based policy model in a public environment.

Adopting innovative approaches like zero waste, the circular economy concept, and urban farming with compost from organic waste becomes very relevant for developed schemes in policy areas. Communities that have initiated movements in some villages and sub-districts, such as in Cibinong, Cileungsi, and Bojonggede Districts, can become a replicated model on a broader scale. However, the initiative's success still depends on support from regulations, institutions, funding, and technical and social capacity from the public local.

Policy environment is a series of acts and regulations made by the state or other institutions to protect, restore, or increase the quality of life in the environment (Dovers & Hezri, 2017). In context change, the policy environment becomes an important instrument for reducing greenhouse gas emissions and supports adaptation to the impacts. According to the IPCC (2022), countries that have succeeded in reducing emissions significantly implement a policy environment integrated with the energy, transportation, and waste management sectors. In Indonesia, efforts to control climate change are reflected in Regulation President Number 98 of 2021 concerning the Economic Value of Carbon, which underlies the importance of the transition to low-carbon development, including waste management. The policy environment at the area level is also regulated by Constitution Number 32 of 2009 concerning the Protection and Management of the Environment, which emphasizes the principles of participatory justice and ecological justice. Research by Sari & Wibowo (2020) shows that the successful implementation of a policy environment depends on good governance, the role of local actors, and social innovation that encourages multi-party collaboration.

Sustainable waste management covers a series of processes from reducing waste at source, sorting, transportation, recycling, and repeating, until achieving a friendly ending environment. According to Kurniawan et al.

(2019), the 3R approach (Reduce, Reuse, Recycle) remains the foundation in modern waste management. However, this approach must be supported by the system, good institutions, and participation from high society. Based on a study by Firdaus et al. (2021), waste management in Indonesia still faces serious challenges, such as a lack of infrastructure, weak technical regulations, and low public awareness.

World Bank (2018) noted that Indonesia is one of Southeast Asia's largest producers of domestic rubbish. The report "What a Waste 2.0" mentioned that Indonesia produces more than 64 million tons of waste yearly, and about 60% comes from urban areas. A study by Yulianti and Winarni (2021) in Malang City concluded that the management strategy of rubbish-based public is far more effective in reducing embossed rubbish than the conventional government approach.

Innovation in managing trash is crucial for solving technical, social, and economic challenges in waste management. According to Schot & Steinmueller (2018), innovation that is transformative in the management environment can push significant systemic technological innovations, such as processing rubbish to generate energy (Waste to Energy), automatic sorting systems, digital composting, and IoT-based applications monitoring, which are increasingly developing. In Indonesia, a study by Nugroho & Wijayanti (2022) highlighted the importance of innovative social forms in digital waste banks, the education environment through interactive media, and the integration of e-waste systems. Research by Ayuningtyas et al. (2021) in Yogyakarta revealed that the waste bank's digital-based capability increases participation of inhabitants in a significant way, even providing an open opportunity economy for Mother House ladders and scavengers. Innovation based on community also includes simple but effective methods, such as eco-enzymes, BSF (Black Soldier Fly) maggots for processing organic rubbish, and biopores. A study by Purwaningsih and Syafrudin (2020) in Sleman Regency showed that combining simple technology and an approach to the community can reduce 30-40% of the waste volume of House ladders in just one year.

Approaching the community becomes key in the effort of sustainable waste management. Arnstein's (1969) participation theory emphasizes that meaningful participation can increase policy implementation effectiveness. In the Indonesian context, management-based community-based solid waste management has been applied in various cities, but with varying results. A study by Dewi & Suryani (2017) stated that the success of the management model for rubbish communities is heavily influenced by local leadership, availability of facilities, support, regulation, and funding. According to Rochman & Lestari (2022), a figure community, a cadres environment, and a group of ten guesthouses are important in forming a new cultural management waste at the RW level or village. Research by Trisyani and Zaman (2019) in Bandung City found that active inhabitants in activity sorting trash, composting, and managing waste banks directly reduce waste volume and increase environmental concern.

Similar things are also shown in a study by Tjahjono et al. (2020) in Surabaya, which showed that a management-based rubbish community can save the local government budget up to 25%.

The Low Carbon City (LCC) concept is becoming a paradigm for sustainable city development, which aims to reduce GHG emissions. According to Kennedy et al. (2015), LCC is cities developing reduction strategies for carbon emissions in transportation, energy, buildings, and waste. A Setyawan (2019) study stated that waste and garbage management contribute to reducing city emissions. In Indonesia, the Ministry of National Development Planning/Bappenas (2020) has released the Low Carbon Development Roadmap, one of the main pillars of waste management sustainability. Research by Damayanti & Prasetyo (2022) states that the role of the community in zero-waste lifestyle activities and reducing carbon footprint from House stairs is vital in the LCC strategy. Bogor Regency is in the strategic national area Jabodetabekpunjur and faces significant pressure related to the environmental consequences of urbanization. In that context, the LCC initiative is based on the public becoming relevant to developed countries. A study by Novitasari et al. (2023) concluded that the LCC program does not include community local potential failure because weakness supports social.

Success implementation policy management rubbish based community No Can released from synergy between various actors, including government, NGOs, the private sector, and society. Emerson et al. (2012) explained that the multi-actor collaboration model emphasizes integrating source power, communication, and commitment across sectors. In a study by Fitriyani & Ardiansyah (2020), collaboration between the device area and NGOs such as Greeneration and environmental youth organizations has been proven to strengthen the system management of garbage at the village level. The network governance approach is also relevant and applied, as described by Provan & Kenis (2008), where the actors form a local network based on trust and interests.

Digital technology has become part of innovation management and modern waste management. Applications such as "Kang Sampah", "Gringo", and "e-Sampah" are examples of how technology can strengthen connectedness between House stairs, waste banks, and perpetrators' business recycling and rework. According to Santosa et al. (2021), digitalization can increase efficiency, transparency, and public participation. Research by Prabowo & Munandar (2022) in Bogor shows that integrating technology information in the system management of the rubbish community can increase the volume of waste sorted by up to 35%. This shows the potential big from digitalization as a supportive policy environment for the public.

Study This aim: How is the policy environment in Bogor Regency implemented through an innovative approach to trash management, and how does this contribute to achieving a low-carbon city? The focus of the study will cover aspects of regulation, institutions, participation in society, innovation

in technology, and achievements in environmental and social impacts. With this approach, it is hoped that an implementation model can be found effective, contextual, and applicable policies can be replicated in other regions with similar characteristics

II. RESEARCH METHODS

Research methods are important in studying scientific function as guidelines for obtaining data that is accurate, relevant, and feasible, and accountable in a scientific way. In this research, the approach used is a qualitative approach with case study methods. Approach: This was chosen because of objective research that needs to be described deeply regarding the implementation process, policy environment, particularly in a management research-based community, and how innovation contributes to achieving the Low Carbon City in Bogor Regency. It is qualitative and naturalistic, emphasizing meaning, experience, and the dynamics of social issues in the field. According to Creswell (2018), the social approach is suitable for qualitative research when researchers want to understand a social phenomenon from the perspective of the actors involved directly. Research. This has no focus on numbers and statistics, but instead on understanding contextual and interpretive aspects of reality, and the implementation of policy in an environment where it is participatory by the community. In this context, a rubbish-based management community is interpreted as a technical program and a social practice involving various actors with different roles and interests.

The study method is chosen because it allows researchers to explore the phenomenon, implementation policy, and environment in certain areas, namely Bogor Regency. According to Yin (2016), the case study is the right strategy when the study questions are "how" and "why", as well as when researchers have little control over the events being studied. In a case study, researchers can trace a policy's implementation process from the planning and implementation stage to evaluation and examine the interaction between the government area, the local community, and the stakeholders' interests.

Data in the study consists of two types, namely primary data and secondary data. Primary data is obtained directly from results, in-depth interviews, observation, participatory observation, and documentation in the field. Interview with a semi-structured guide to staying flexible, following the dynamic information in the field. Researchers also observed the activity community in sorting waste, managing compost, or operating a waste bank system. Documentation in Photo activities, reports, community brochures, and daily notes is also used as supporting data sources. Secondary data was obtained from official government documents like Regional Regulation (Perda), Regional Action Plan for Climate Reduction GHG emissions, Bogor Regency RPJMD documents, Environmental Service reports, scientific articles, NGO reports, and data from the Central Statistics Agency (BPS). All secondary data was analyzed to strengthen the

understanding of framework policies and conditions and the factual management of waste in Bogor Regency.

III. RESULTS AND DISCUSSION

Production and management waste in Bogor Regency shows sufficient dynamics significant in several years, reflecting a challenge at a time of potential in the governance environment area Based on official data and several news reports from 2019 to 2024, the amount of rubbish in this area is still at a high number, ranging between 2,700 and almost 3,000 tons per day. Although the amount of this has experienced fluctuations over time, especially during the COVID-19 pandemic, with large-scale social restrictions (PSBB) that reduced production of rubbish by up to ± 538 tons per day in 2020, the trend generally shows that the volume of waste continues to become a heavy load for the government area. Management efforts have also experienced gradual improvement, from around 18–19% of waste managed in 2020, to around 44% in 2024, indicating progress. However, handling the remainder of the uncollected trash optimally is still a big challenge. This data confirms the importance of innovation and collaboration across sectors in system management, making it more trash-efficient and sustainable.

Based on official data and news reports, the following table summarizes production and management waste in Bogor Regency:



Figure 1. Waste Production and Management Data 2020-2024.

From the data, it can be seen that the daily production trend of rubbish in Bogor Regency over several years is in the range of 2,700 to 3,000 tons per day. This figure puts Bogor Regency as one of the regions with the most significant rubbish in West Java. However, reality shows that capacity management is systematically rubbish, and it is still far from adequate. Based on a comparison between total generation and the quantity of successful trash managed, it is known that the percentage of rubbish management only ranges between 18% 44% from 2020 to 2024. This means that over half of the

year, over two-thirds of the rubbish is handled daily in Bogor Regency, not handled properly through an official or structured system. This condition causes the accumulation of significant waste, with the amount of trash that is not managed ranging between 1,500 and 2,400 tons per day. In this situation, adequate management of the emptiness system, the community often practices handling independently, which can cause potential damage to the environment. One of the most common practices is burning rubbish in an open way, which is carried out in the yard, on empty land, or at the edge of a road. In addition to causing air pollution and health consequences from emission substances such as dioxins and furans, open combustion also contributes directly to the increase in greenhouse gas emissions, which makes the climate crisis worse.

Besides burning, much rubbish is thrown illegally into the river, garden, and forest outskirts. Practice. This causes land and water pollution and impacts the local ecosystem and the quality of life in the community. Waste piling up without handling not only becomes a source of smell and disease, but also triggers social conflicts and worsens the governance environment in the area. Therefore, this data shows that the problem is not only in large volumes of waste, but also in a weak system capable of managing the entire embossed trash. A more integrated, innovative, and collaborative approach is needed, including strengthening a management-based community, utilizing digital technology, and improving the capacity of institutions so that management waste in Bogor Regency can be improved significantly and sustainably. Achievement matrix policy garbage with production garbage, as follows:

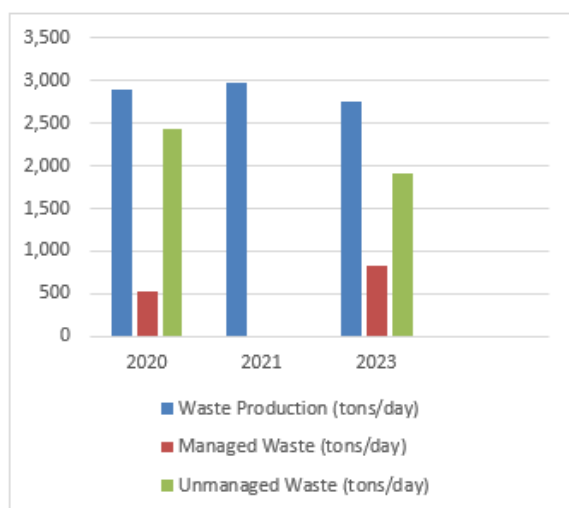


Figure 2. Waste Policy Achievement Matrix with Waste Production

Findings from case studies in three subdistricts active in Bogor Regency, namely Cibinong, Bojonggede, and Cileungsi, describe the existence of an innovative movement

based on community bags that contributes significantly to rubbish management in a participatory and sustainable way. In this context, local innovations appear as forms of adaptation and initiative from citizens who reduce garbage, improve environmental awareness, and empower society. One of the outstanding innovations is the implementation of the Digital Waste Bank, namely an integrated system for waste volume recording, scheduled pickup, and education to inhabitants through digital platforms. This innovation has pushed participation in an active society, with results that show that about 35% of rubbish is sorted from the source. This becomes a milestone in strengthening the management of data and technology-based.

In addition, composting House Black Soldier Fly (BSF) maggot cultivation and ladders are effective strategies in handling organic rubbish. This process changed the kitchen's remaining food and waste into high-quality compost and valuable maggot feed for the economy. In other areas, such as Sleman, the approach has proven capable of reducing the volume of organic waste up to 30–40% over one year. In Bogor Regency, the initiative began with the community showing potential subtraction up to 25% per RW, a sufficient achievement promising for replication on a broader scale. Activities. This reduces the burden of rubbish on landfills and opens up opportunities for a green economy for inhabitants.

Besides the two innovations mentioned, some community members develop ecoenzyme products from organic waste, especially fruits and vegetables. Product: This is a natural cleaner, fertilizer, liquid, and disinfectant for a friendly environment. Accompanied by educational programs, a consistent environment, and activities, this not only reduces the volume of waste from household stairs, but also changes the method of viewing inhabitants to see rubbish as a source of power. Overall, findings from this field show that the innovation community has a real impact in supporting the reduction of waste, increasing the quality of the environment, and building a culture of caring and responsible answers to sustainability at the local level. The following is a flowchart for the innovation community to reduce the volume of waste:

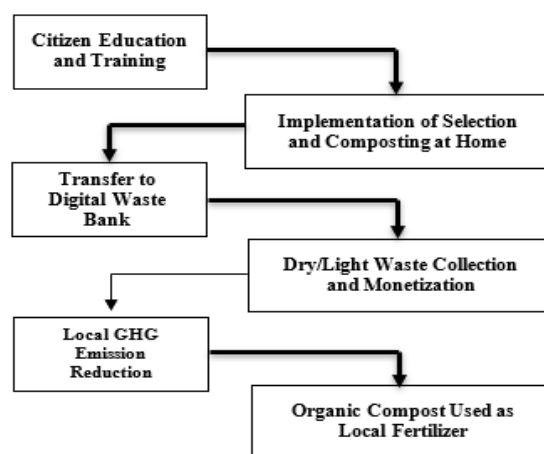


Figure 3. Community Innovation Flowchart

A management rubbish-based community is one of the innovative strategies that can support the achievement of a Low Carbon City through a holistic and participatory approach. This process started with educating and training inhabitants as a crucial step in building awareness and a collective understanding of the importance of a management-friendly trash environment. Through activity counseling, workshops, and simulations, residents understand types of waste, engineering sorting, the benefits of composting, and the negative impacts of disposing of rubbish carelessly. Education. This is intended to change public behavior in treating rubbish as a valuable economic and ecological power source.

After getting an adequate understanding, society starts to implement sorting and composting at home. Every family pushed for sorting rubbish into two categories: main, garbage, organic, and inorganic. Waste organic, such as leftover food and dry leaves, is processed in a simple composting technique in the yard at home. The resulting compost not only reduces the burden of rubbish on the House stairs, but also upgrades the fertility of the land and reduces the need for fertilizer chemistry. Meanwhile, trash inorganic like plastic, paper, and metal is separated and managed collectively through a digital system.

Furthermore, Stages is a transfer to a digital waste bank, where the community can weigh, record, and send waste data inorganic through a digital application. Digital waste bank works as an integrative platform that repeatedly connects inhabitants with institution managers, collectors, or partners in the recycling industry. Every transaction is recorded and converted into an incentive economy, such as balance savings or points that can be exchanged for goods or services. This digital system increases trash management transparency, efficiency, and accountability while empowering the local economy. Waste registered in the digital waste bank is then scheduled for pickup and monetization, especially for dry and light rubbish like plastic bottles, cans, or cardboard. A party manager works like a fleet of transporters and perpetrators in an economic cycle to ensure the industry can recycle or use rubbish. This process not only gives marks and economy for citizens, but also reduces the amount of trash that must be sent to the Final Disposal Site (TPA).

Meanwhile, compost organic products produced from the House ladder are used locally to fertilize plants and gardens for citizens. In addition to encouraging agricultural and urban farming practices, using local compost also reduces dependence on synthetic fertilizers, which have high carbon footprints. Initiative: This strengthens the resilience of local food, repairs the land's structure, and ecologically manages rubbish.

By decreasing the amount of discarded garbage sent to the landfill via sorting, composting, and recycling, a significant reduction in waste volume to the landfill occurs. This impacts the bottom line of landfill operations, extending the age of landfill services, and reducing potential pollution to the resulting environment from waste residue. The volume of organic waste, which usually causes methane gas formation

in landfills, is successfully pressed through the composting house stairs system. All series contribute to the decline in greenhouse gas emissions (GHG) at the local level. Carbon emissions can be significantly reduced with decreased activity, reduced rubbish transportation to the landfill, minimal decay of organic waste on-site disposal, and improved rural and urban farming practices. This makes a management-based community an integral part of adaptation and mitigation strategies, changing the climate in urban areas, and becoming an implementable model to realize the Low Carbon City vision in Bogor Regency and other areas.

Analysis to impact management rubbish based community in context decline greenhouse gas emissions greenhouse gas (GHG) and the achievement of *Low Carbon City* targets show promising results, especially in the Bogor Regency area. Based on the report West Java *Open Data*, the contribution of the waste sector to reducing GHG emissions at the provincial level is still classified as very low, namely less than 1% of the total reduction target planned for emissions in 2017. This shows that sector waste has not yet become a primary focus in the mitigation agenda for climate change, although its potential is significant. The latest official data about emissions specific to the waste sector is not yet available for Bogor Regency. However, a study in Neglasari Village (Bogor Regency), which was collected in *IPB Repository*, notes that every House ladder produces emissions of approximately 411.4 kg CO₂-e per month, resulting from waste management activities, or equivalent to a total of approximately 1,247 tons CO₂-e per month only from one village.

Through a simulation based on field data and practice community, it can be estimated that if innovation communities like composting House stairs, maggots cultivation, and digital waste banks are implemented in a consistent and widespread way, then potential emission decline can be roughly estimated. For example, if the volume of waste organic can be reduced by 20–30% per house stairs, then the efficiency of emissions per home ladder can reach 80 to 120 kg CO₂-e per month. With assumptions about the number of House stairs in Bogor Regency reaching around 600 thousand, the estimated decline in emissions collectively can range between 48,000 and 72,000 tons of CO₂-e per year. This figure significantly contributes to the support effort transition going to *Low Carbon City*, especially if integrated into the policy environment, regional and planning programs, and sustainable development.

More than just number statistics, projections. This shows that solutions from lower, namely from community inhabitants, can become key in reducing the burden of emissions and sectoral waste, which is often overlooked. The effect of a synergistic education environment, citizen participation, and the use of low-carbon technologies like composting and the digitalization of waste banks can change the consumption and production patterns at the local level. With strong institutions and an incentives-based performance environment, impact subtraction of emissions from sector waste. It will be measurable quantitatively and become an

important foundation for the transformation of ecology in Bogor Regency, heading towards a low-carbon and resilient climate. Contribution against LCC dimensions can be seen in the following table:

Table 1. Contribution Table to LCC Dimensions

LCC Dimensions	Community Innovation Contribution	Indicator Effectiveness
Subtraction emission carbon	Sorting & composting organic → lower CH ₄ from decay / burning	Estimate reduction of 48 -72 k tons CO ₂ -e/ year
Circular economy local	Waste bank, compost commercial, BSF maggots	Income community, minimum cost operational
Efficiency system	Reduction of landfill volume and the needs of DLH operations	Landfill load reduced by 25-30 %
Environmental participation & culture	Training & engagement active inhabitant	Satisfaction, social, and sense of belonging increase.

Discussion about the dynamic management of waste in Bogor Regency reveals the existence of inequality between policy macro-nationals with conditions real at the level of the regional government center through policy *Jakstranas* (National Policy and Strategy for Management) Household Waste. Target level management reduces rubbish by up to 75%. However, based on the latest realization in Bogor Regency, the achievements management new touch is around 44% only. This shows that the implementation policy is not yet fully adaptive to the local capacity, resources, power, and characteristics. One of the main obstacles is the lack of an optimal transport fleet for garbage, a lack of infrastructure processing, such as Place Processing Rubbish Integrated (TPST), and TPA zoning, which has not yet been realized. Misalignment. This directly impacts the high volume of waste that is not managed well and accumulates in the public environment.

In the middle of limitations, the innovation community appears as a solution, a practical approach *based on a bottom-up* approach. Several public initiatives, such as digital waste banks, maggot composting (BSF), and eco enzyme production, have shown efficiency on a local scale. In terms of months, some communities in the Cibinong, Bojonggede, and Cileungsi Districts can push sorting rubbish up to 35% and reduce the organic waste volume by ±25% of the total waste. House ladder. Success: This shows that the public has the capacity and willingness to contribute to the management environment, provided that space, support technology, and adequate assistance are given.

A thriving innovation community cannot stand alone; it requires synergy between good actors from the Government Regency, Environmental Service (DLH), local communities, NGOs, and innovative technology. Until now, policies like zoning management of rubbish are still stagnant and incapable of accommodating an active community as the subject management environment, not just an object. The existing regulations do not yet support a full practice economy circular, including an incentive scheme for households to sort rubbish or for communities that process independently.

Study This gives *novelty* with a combined approach of policy macro and innovation micro community. Thus, research has produced an integrative model for managing uncollected trash. Lots have been published, especially in the context of Bogor Regency. Furthermore, the study proposes projecting the impact of carbon emissions from an approach based on the community, starting from the village level to the district level. Simulation shows that combining digital waste bank strategies, maggot composting, and eco enzymes can lower GHG emissions in a general significant (up to dozens of thousands of tons of CO₂-e per year) if replicated on a wide scale. The program's success index can exceed 70% if integration with the policy area is effective and sustainable. Various obstacles still need attention; the TPAS and TPST infrastructure is unavailable in every sub-district, hindering efficient zoning. Budget DLH operations are still ongoing and cannot reach the entire region.

On the other hand, public awareness is still low in areas that the educational environment has not touched intensively. Regulations that should support the circular ecosystem economy are still normative and have not yet been translated into policy and operational technical terms. Considering various facts and findings, the innovation community is an effective strategy in reducing waste volume and GHG emissions. At the same time, this model can support achieving the *Low Carbon City* target in Bogor Regency, with the condition that support policies are integrated in areas, funding is sustainable, and the institutional environment is strengthened based on multi-actor collaboration.

VI. CONCLUSIONS

The implementation policy environment in Bogor Regency has shown a progressive direction, primarily through innovation management in the rubbish-based community. This effort reflects synergy between the policy government area, the active role of society, and support for technology and institutions. Innovations carried out, such as the waste bank program, eco-enzymes, waste management systems sorting rubbish, House stairs, and involvement of the community in the management of TPS 3R, have had a significant impact in reducing the volume of waste disposed of to the landfill and support the creation of a cleaner and healthier environment. Management of rubbish-based communities not only pushes efficiency in collecting and recycling garbage but also builds awareness of the importance of collective public will and a

behavior-friendly environment. Approach: This contributes realistically towards reducing carbon emissions in urban areas, which is an important part of the achievement strategy for a low-carbon city. Recommendation: strategic needs considered. First, the government area of Bogor Regency needs to strengthen institutional management of the rubbish-based community by providing support, regulation, financing, and ongoing training. This is important to ensure program continuity and increase the public's capacity to operate actively. Second, need to do program management integration with the rubbish community, based on the planning development area principle, for low-carbon development. This means that management rubbish must become an integral part of the mitigation strategy for climate change and carbon emission reduction, and be associated with developing indicators for sustainable regions (SDGs). Third, a development monitoring and evaluation system based on digital technology is highly recommended to increase program implementation transparency, efficiency, and accountability. Collecting data from the community can become a more accurate basis for planning and push decision-making based on evidence (evidence-based policy). Fourth, collaboration inter-factors, such as institutional self-reliance society, private sector, college and high school, and youth groups, must keep expanding in the ecosystem management of garbage. Involvement of multiple actors will enrich innovation, expand the range, and speed up the achievement of the reduction targets for waste and carbon emissions in Bogor Regency.

REFERENCES

- [1] S. R. Arnstein, "A ladder of citizen participation," *J. Am. Inst. Plann.*, vol. 35, no. 4, pp. 216–224, 1969.
- [2] D. Ayuningtyas, R. Y. Pratama, and A. Hanifah, "Bank sampah digital sebagai inovasi sosial di era digitalisasi pengelolaan sampah," *J. Ilmu Sos. dan Ilmu Polit.*, vol. 24, no. 2, pp. 134–147, 2021.
- [3] Bappenas, *Rencana Pembangunan Jangka Menengah Nasional 2020–2024*. Jakarta: Kementerian PPN/Bappenas, 2020.
- [4] J. W. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 5th ed. Thousand Oaks, CA: SAGE, 2018.
- [5] R. Damayanti and D. Prasetyo, "Peran komunitas dalam pengurangan emisi rumah tangga berbasis gaya hidup zero waste," *J. Pembangunan Berkelanjutan*, vol. 10, no. 1, pp. 23–35, 2022.
- [6] K. Dewi and N. Suryani, "Pengelolaan sampah berbasis masyarakat di Bali," *J. Ilmu Lingkungan*, vol. 15, no. 3, pp. 105–115, 2017.
- [7] S. Dovers and A. A. Hezri, "Institutions and policy processes: The means to the ends of adaptation," *Wiley Interdiscip. Rev. Clim. Change*, vol. 1, no. 2, pp. 212–231, 2017.
- [8] K. Emerson, T. Nabatchi, and S. Balogh, "An integrative framework for collaborative governance," *J. Public Adm. Res. Theory*, vol. 22, no. 1, pp. 1–29, 2012.
- [9] R. Firdaus, Nurlela, and D. Yuliana, "Tantangan pengelolaan sampah di Indonesia: Perspektif kebijakan dan masyarakat," *J. Adm. Publik*, vol. 8, no. 1, pp. 21–31, 2021.
- [10] R. Fitriyani and M. Ardiansyah, "Kolaborasi pemerintah dan LSM dalam pengelolaan sampah desa," *J. Bina Desa*, vol. 5, no. 2, pp. 98–108, 2020.
- [11] IPCC, *Climate Change 2022: Mitigation of Climate Change*. Geneva: Intergovernmental Panel on Climate Change, 2022.
- [12] C. Kennedy et al., "Greenhouse gas emissions from global cities," *Environ. Sci. Technol.*, vol. 43, no. 19, pp. 7297–7302, 2015.
- [13] E. H. Klijn and J. F. M. Koppenjan, *Governance Networks in the Public Sector*. London: Routledge, 2016.
- [14] A. Kurniawan, R. Putri, and H. Santoso, "Strategi pengelolaan sampah berbasis 3R," *J. Rekayasa Lingkungan*, vol. 14, no. 2, pp. 90–98, 2019.
- [15] M. B. Miles, A. M. Huberman, and J. Saldaña, *Qualitative Data Analysis: A Methods Sourcebook*, 4th ed. Thousand Oaks, CA: SAGE, 2024.
- [16] D. Novitasari, S. Wahyuni, and F. Ramadhani, "Kegagalan program low carbon city akibat tidak terlibatnya komunitas lokal," *J. Urban dan Lingkungan*, vol. 12, no. 3, pp. 145–158, 2023.
- [17] S. Nugroho and S. H. Wijayanti, "Inovasi sosial dalam pengelolaan sampah: Studi kasus e-sampah di Yogyakarta," *J. Teknol. Lingkungan*, vol. 18, no. 1, pp. 67–76, 2022.
- [18] R. E. Prabowo and R. Munandar, "Efektivitas teknologi informasi dalam pengelolaan sampah komunitas," *J. Tata Kelola Lingkungan*, vol. 6, no. 1, pp. 44–55, 2022.
- [19] K. G. Provan and P. Kenis, "Modes of network governance: Structure, management, and effectiveness," *J. Public Adm. Res. Theory*, vol. 18, no. 2, pp. 229–252, 2008.
- [20] Y. Purwaningsih and S. Syafrudin, "Efektivitas pengelolaan sampah rumah tangga berbasis komunitas di Sleman," *J. Lingkungan dan Pembangunan*, vol. 3, no. 2, pp. 114–123, 2020.
- [21] R. Rochman and I. Lestari, "Peran tokoh masyarakat dalam pembentukan budaya lingkungan," *J. Pemberdayaan Masyarakat*, vol. 7, no. 1, pp. 65–73, 2022.
- [22] D. P. Sari and A. Wibowo, "Tata kelola kebijakan lingkungan: Studi kasus implementasi Perda Pengelolaan Sampah," *J. Kebijakan Publik*, vol. 15, no. 2, pp. 88–101, 2020.
- [23] M. Santosa, R. D. Lazuardi, and T. Widodo, "Digitalisasi pengelolaan sampah melalui aplikasi

- ‘Gringgo’ di Bali,” *J. Inov. Publik*, vol. 9, no. 1, pp. 34–43, 2021.
- [24] J. Schot and W. E. Steinmueller, “Three frames for innovation policy: R&D, systems of innovation and transformative change,” *Res. Policy*, vol. 47, no. 9, pp. 1554–1567, 2018.
- [25] Y. Setyawan, “Strategi Low Carbon City di kota-kota berkembang Indonesia,” *J. Pembangunan Daerah*, vol. 6, no. 2, pp. 78–89, 2019.
- [26] T. Suharno, A. Prabowo, and W. Widodo, “Public-private-community collaboration for sustainable urban development,” *Sustainability*, vol. 15, no. 8, p. 6512, 2023.
- [27] E. Tjahjono, T. Raharjo, and S. Hidayat, “Efisiensi anggaran pengelolaan sampah berbasis komunitas,” *J. Ekon. Lingkungan*, vol. 5, no. 1, pp. 50–62, 2020.
- [28] R. Trisyani and A. Zaman, “Dampak pelibatan warga dalam pengelolaan sampah rumah tangga,” *J. Sosial Masyarakat*, vol. 9, no. 3, pp. 200–212, 2019.
- [29] N. Ulhasanah and N. Goto, “Environmental behavior toward solid waste management in Indonesia: Padang City case,” *J. Mater. Cycles Waste Manag.*, vol. 20, no. 2, pp. 1257–1272, 2017.
- [30] World Bank, *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. Washington, DC: World Bank, 2018.
- [31] R. K. Yin, *Case Study Research and Applications: Design and Methods*, 6th ed. Thousand Oaks, CA: SAGE, 2016.
- [32] R. Yulianti and D. Winarni, “Strategi masyarakat dalam pengelolaan sampah rumah tangga,” *J. Ilmu Sosial dan Lingkungan*, vol. 10, no. 2, pp. 154–165, 2021.