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Collaborative Pentahelix in Supporting Community-based Maggotization through the Climate Village Program in Bandung City

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Abstract
The problem of organic waste management in Bandung City, which accounts for 60% of the 1,600 tons of daily waste, requires innovative solutions through cross-sectoral collaboration. This study analyzes the implementation of the collaborative penthahelix model in a maggotization program using Black Soldier Fly (BSF) larvae in RW 14, Cipadung Village, Bandung City. Using qualitative methods including in-depth interviews, observations, and literature reviews, this study analyzes the dynamics of interaction among the five penthahelix factors: academia, business, community, government, and media. The results show that the maggot program successfully processed 80% of daily organic waste and benefited 65% of RW 14 residents. Academics played a role in education and technical assistance, the government provided regulations and facilities, the community actively optimized the integrated program, and the media played a role in publicity. However, the business sector has not yet optimized the economic value of maggot products. The study concludes that the collaborative pentahelix model in maggotization shows significant potential for sustainable organic waste management, but requires strengthening the role of the business sector to create sustainable community self-reliance.

Keywords: *Collaborative Pentahelix, Waste Sorting, Maggotization, Black Soldier Fly (BSF).*

1. INTRODUCTION

The complexity of problems in Indonesia, especially in big cities such as Bandung, requires an integrated strategy. Based on data from the Bandung City Environment and Sanitation Agency, of the 1,600 tons of waste produced every day, 60 percent is organic waste. This issue has several adverse effects, ranging from environmental pollution to public health emergencies (Maharani & Aryanta, 2023). The low rate of processing household organic waste as a new raw material that can be used to produce new economically valuable products is one of the environmental issues frequently encountered recently (Maryuni, 2024).

Through the Climate Village Program (PROKLim), a strategic program from the Ministry of Environment (KLH) or the Environmental Management Agency (BPLH), a concrete solution is being implemented to address climate change. The global challenge today is climate change, whose impacts are already being felt at the local level. Climate change begins with changes in temperature, rainfall patterns, and natural disasters such as floods and droughts, requiring communities across Indonesia to prepare for its impacts. The Climate Village Program is a national initiative aimed at enhancing community and local government involvement in sustainable adaptation and mitigation efforts for greenhouse gas (GHG) emissions. The Climate Village Program encourages communities to take concrete, community-based actions starting at the grassroots level (villages, neighborhoods, or RW/RT communities) to strengthen community resilience to climate change. The program is designed to create synergy between national policies and local implementation, as well as to strengthen collaboration among stakeholders, including communities, governments, the private sector, and civil society organizations.

In addressing the challenging issue of waste management, particularly in the city of Bandung, the government and the Bandung City Environmental Agency are actively implementing a maggot cultivation program. The current lack of organic waste processing in Bandung remains one of the issues that has not been optimally resolved. The maggotization program, or the use of Black Soldier Fly (BSF) larvae as agents for decomposing organic waste, appears to be a viable alternative in this situation. Up to 80% of organic waste can be decomposed by BSF, which also produces valuable byproducts. However, effective waste sorting at the source is necessary for maggotization to be implemented, and this remains a significant challenge in Indonesia (Nur Hidayah Fitria, 2022). Magotization activities carried out at the neighborhood level in Rukun Warga 14, Cipadung Village, Cibiru District, Bandung City, were selected as the location by the researchers. The aim was to understand how collaborative governance is implemented using a penthahelix approach consisting of five actors: academia, the private sector, the community, the government, and the media.

2. METHOD

This study uses a qualitative approach with a case study design to analyze collaboration through the pentahelix role in a household waste sorting program or organic waste through maggotization in RW 14, Cipadung Village, Cibiru District, Bandung City. A qualitative approach was chosen because of its ability to reveal social processes and the dynamics of interactions between interests. According to Sugiyono (in Sahab 2022), descriptive qualitative methods involve collecting data in the form of words or images, so they do not rely on numbers. The collected data is then analyzed and described to make it easy for others to understand. In this study, the main objective is to describe, explain, and interpret the conditions related to the case study conducted.

3. RESULT AND DISCUSSION

The maggot house serves as a maggotization site in RW 14, Cipadung Village, Cibiru District, Bandung City, officially established by the Village Head of Cipadung through Decision Letter No. TN/54/SK/Kel.Cpd/XII/2022 regarding the formation of the Sae Hunting Group and Maggot Group in RW 14, Cipadung Village, Cibiru District, Bandung City. The Saung Magot maggot farming group, which operates under an integrated farming system based on the "zero waste to food" concept, utilizes organic waste and food scraps to process and utilize them in agriculture and maggot farming on a plot of land measuring 4 x 15 meters. The Saung Magot collaborates with the Sae Hunting Group, which focuses on agriculture and livestock farming. In addition to maggot farming, Buruan Sae Saung Magot also cultivates vegetables such as eggplant, chili peppers, and tomatoes, and operates a poultry farm for egg-laying chickens and catfish farming.

The maggot shelter has the potential to build a self-reliant community in terms of household waste management. They utilize their backyard to set up the maggot shelter and plant various vegetables and raise egg-laying chickens. The maggot shelter collects wet waste daily from several neighborhoods, which can be turned into compost, used as maggot feed, and the resulting maggot waste can be used as organic fertilizer. This maggot shed initiative is considered an appropriate approach for managing household wet waste in RW 14, Cipadung Village, and is also seen as a potential source of new job opportunities. Therefore, the pentahelix model is necessary to optimize the role of the maggot shed in household waste management. In its implementation, the pentahelix model is based on (Academicians, Business Community, Government, and Media). This pentahelix model is a collaborative approach involving five main parties to achieve a common goal. In the maggotization program in RW 14, Cipadung Village, Bandung, these five parties collaborate to address organic waste issues. Below is an explanation of the roles of each element:

1. Academicians

Academics play a crucial role in development, particularly in driving the creation of knowledge-based policies and practices (Suherman, Suprayogi Sugandi, et al., 2021). As a group with an academic background, academics are trusted as concept designers, strategic thinkers, and generators of innovative ideas that can be implemented across various aspects of community life. In the context of the maggotization program in Bandung City, the presence of academics holds strategic value that is not only theoretical but also practical and directly impacts society.

Generally, the role of academics in environmental development can be divided into several main aspects. First, academics function as providers of policy recommendations through research findings and scientific studies. With comprehensive data and analysis, academics can offer objective input to the government, ensuring that every decision made is based on strong, measurable, and scientific grounds. This is crucial during the policy formulation stage, so that the policies developed are not only responsive to existing issues but also sustainable. Second, in the policy implementation stage, academics can act as strategic partners in assisting the implementation process in the field. The involvement of academics in direct practice in the community provides added value, as they can test and adapt scientific theories and approaches to local social, cultural, and economic conditions. The presence of academics also strengthens the validity of every program implemented, including in terms of assistance, counseling, and technical training. Third, in the evaluation phase, academics have the capacity to assess the effectiveness, efficiency, and impact of policies or programs. Through an evaluative approach based on scientific methods, academics can provide an objective picture of program achievements and recommendations for future improvements. Thus, program sustainability is better ensured because there is a process of reflection that is carried out regularly and systematically.

In addition to being involved in the policy realm, academics also have an important role in strengthening community capacity. Through activities such as community service, seminars, training, focus group discussions (FGDs), and mentoring, academics can transfer knowledge and skills to the community directly (Suherman, Sugandi, et al., 2021). This process not only educates the community intellectually but also builds collective awareness and the ability of residents to address environmental issues in a smarter and more sustainable manner.

In the maggot farming activities in RW 14, Cipadung Village, the role of academics has been clearly identified. Based on interviews with the RW Head and the Head of Saung Maggot, it is known that there is active involvement from academics from Padjadjaran University (Unpad) Bandung. This involvement includes technical assistance, providing education on maggot farming, and strengthening the institutional capacity of the community. Academics from Unpad also offer strategic advice on program development and encourage increased collaboration between the local community and external parties, including the government and private sector.

The presence of academics in the maggotization program demonstrates that the synergy between scientific knowledge and social practice is key to achieving sustainable environmental management. When academic knowledge is bridged with community needs, relevant, practical, and long-term impactful innovations are created. The maggotization program is no longer merely a technical solution to waste issues but also serves as a medium for comprehensive community education and empowerment. Through the Merdeka Belajar Kampus Merdeka (MBKM) program and the Merdeka Student Exchange Program (PMM) in 2024, a role was assigned through direct community service activities, particularly at the Maggot Shelter in RW 14 Cipadung. During the PPM MBKM program, this role involved providing social education on waste management, marking an important first step. In this role, students educate the community about the dangers of unmanaged waste and the importance of sorting and processing waste from an early stage. This education is presented in an easy-to-understand manner, enabling the community to apply this knowledge in their daily lives. This creates sustainable behavioral changes in the community.

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Figure 1. Direct Community Service Activities, Particularly At The RW 14 Cipadung Community Center

Source: Direct Documentation By The RW 14 Cipadung Chairman, 2024

Based on available information and documentation, other universities that have visited and conducted research related to maggot cultivation in RW 14 Cipadung include the State Islamic University of Bandung and the Bandung Institute of Technology. From the role of academics, it is evident that their role is crucial in a fundamental capacity in strengthening community roles through collaborative thinking and the application of scientific knowledge, which serves as a manifestation of social responsibility. Through research, education, and direct field applications, academics assist communities in becoming more empowered and self-reliant in addressing challenges, particularly in managing organic waste through maggot farming.

2. Business

The business sector plays an important role in social participation and responsibility toward society, as well as contributing to the improvement of the community's economy. When the business sector fulfills its economic role effectively and is accompanied by strong social responsibility, a positive synergy is created that drives sustainable development. Companies that demonstrate concern for society and the environment tend to have a good reputation, gain the trust of consumers and investors, which ultimately supports the sustainability of the business itself. Thus, the business sector is not merely an accessory but a vital pillar that, alongside academia, government, and other community elements, helps build a strong foundation for the progress of a region. However, field findings have not yet identified the role of the business sector in collaborating with maggot farming. Maggots have not yet reached the entrepreneurial sector stage; maggot farming still primarily serves as a decomposer of wet waste, capable of decomposing 80% of waste daily.

The business sector is crucial and poses a challenge in transforming this significant potential into a sustainable economy. The maggot farm in RW 14 Cipadung has produced significant output and provided exceptional environmental benefits as a waste decomposer. However, there is a lack of buyers or business sectors willing to absorb the output of BSF (Black Soldier Fly) maggot cultivation.

3. Community

The role of the Buruan Sae community as a supporting agent in optimizing a program that is currently being implemented. Buruan Sae plays a crucial role in optimizing the maggot program that is being implemented. This optimization ensures that the maggot program runs smoothly, more efficiently, and more effectively in achieving its objectives. The community does not merely execute the program; both programs strive to maximize and ensure the maggot program runs smoothly and delivers optimal results. The implementation of the maggot program involves utilizing backyard

spaces with an integrated farming system, where livestock is raised on small plots of land, serving as an example of synergy in turning limitations into opportunities rather than obstacles.

Additionally, existing issues can be addressed through the role of maggots in decomposing waste daily. Nearly 65% of residents in RW 14 can experience the benefits of maggot farming in the daily disposal of wet household waste and the managed livestock. The eggs from the chicken farm are part of a collaboration between the maggot farm and the Posyandu team in the stunting prevention program. When additional feeding (PMT) is needed for children, the Posyandu provides a regular source of high-protein food, directly contributing to improved child nutrition. Addressing stunting is not only about physical health but also the future of the younger generation, as stunting can impact children's productivity development. Based on these findings, the Buruan Sae Saung Magot program has assisted the government in addressing community issues, particularly in Bandung City, related to organic waste management and stunting mitigation.

This has created an extraordinary social impact, demonstrating smart cross-sector collaboration where the maggot house is integrated with egg-laying chicken farms, the Buruan Sae community, and, no less importantly, assists health posts in addressing stunting in Bandung City, showing how various initiatives can synergize to solve complex problems. This community support demonstrates the multifunctional impact of a single program.

4. Government

The government plays a crucial role in every environmental management initiative, including the maggotization program. As a policy maker, the government not only functions as a regulator but also as a facilitator, executor, and evaluator in activities involving the community. The government has the authority to formulate policies that prioritize the interests of the broader community and the future of the environment, and is responsible for creating conditions that support the development of environmentally friendly innovations, one of which is through the organic waste processing program using maggots or black soldier fly (BSF) larvae.

In the city of Bandung, the government is committed to environmental conservation and management, which is concretely manifested in the form of regulations, namely through the Bandung City Regional Regulation (PerDa) No. 1 of 2023 on the Implementation of environmental Protection and Management. This regulation serves as the legal basis for environmental programs in the city of Bandung, including efforts to address the increasing volume of household waste each year. Waste issues, particularly organic waste from households, have become a serious challenge. If not addressed promptly, this will lead to various negative impacts, including on public health, environmental aesthetics, and ecosystem sustainability. Therefore, the Bandung City Government does not stop at the regulatory level but also takes concrete steps through the implementation of community-based programs focused on innovative and sustainable waste management.

One of the flagship programs currently being developed is the maggotization program, which utilizes Black Soldier Fly larvae to process organic waste into more beneficial products, such as animal feed and organic fertilizer. In this context, the role of the government through the Environmental Agency (DLH) is crucial. The DLH acts as a driving force and bridge between the community as field implementers and the government as a provider of resources and policies. The support provided by the government through the Environmental Agency includes aspects such as: 1) Provision of facilities and infrastructure, 2) Training and education, 3) Continuous mentoring, 4) Strengthening institutional and community capacity, 5) Monitoring and evaluation.

Through this collaborative approach between the government and the community, the maggotization program is not only a technical solution to reduce the volume of organic waste but also a social movement that fosters collective awareness among the community about the importance of preserving the environment. When the government actively participates not only as a regulator but also as a facilitator, public trust will increase. This can strengthen community

participation and encourage broader behavioral change.

The researchers concluded that the government's role in the maggotization program in Bandung City is comprehensive, encompassing regulatory, facilitative, educational, and evaluative aspects. The government does not merely establish rules but also ensures that the program operates effectively at the grassroots level. With this strategic and sustainable role, it is hoped that the maggotization program can become an alternative solution to address waste issues, improve the quality of the environment, and empower the community economically and socially.

5. Media

Media plays a strategic role in the process of disseminating information (Suparto & Habibullah, 2021), public education, and shaping public opinion on social and environmental issues. In environmental management, particularly the maggotization program in Bandung City, media serves as a bridge between program implementers and the broader community. Through media, information about the objectives, benefits, and impacts of maggotization activities can be communicated more widely and systematically (Widhiandono, et al., 2025).

The role of the media in such activities encompasses several key aspects: 1) as a means of public education, 2) as a promotional tool for the program, 3) as a catalyst for public participation, and 4) as a tool for building a positive image of the community driving environmental change. However, field observations indicate that the utilization of media in the Saung Maggot RW 14 program in Cipadung Village remains very limited. To date, the publication of maggotization activities has only been carried out by the Cipadung Village social media account. The members of the maggot hut do not yet have their own social media accounts that are actively and structurally managed. This is due to the limited knowledge and skills in the use of information technology, as most members still experience difficulties in operating digital devices and managing social media independently (technological illiteracy).

These limitations pose a significant challenge in expanding the reach of information to a broader audience. However, digital media is now the primary tool for shaping perceptions and increasing community engagement in social programs. If social media management is optimized, the potential that can be maximized is not only in terms of promotion but also in building partnership networks, attracting the attention of other stakeholders, and expanding the social impact of maggot-based waste management activities.

Despite its limitations, the role of neighborhood social media has already yielded tangible results. Many parties have visited the Maggot Pavilion, including schoolchildren, university students from various institutions, and council members. These visits are conducted for various purposes, such as purchasing maggots as livestock feed, conducting academic research, field studies, and official visits from government agencies. This indicates that the information disseminated through the media, despite its limitations, is still capable of attracting attention and sparking public curiosity about the maggotization program in RW 14 of Cipadung Village.

Based on field observations, the media used to publish activities at the maggot house relies solely on the Cipadung Village social media platform, as members of the maggot house do not yet have their own social media accounts and, on average, are still technologically illiterate. The arrival of these visitors also serves as an important opportunity to shape public opinion on the importance of preserving the environment and managing waste responsibly. The community began to realize that maggot farming not only has a positive impact on the environment but also holds significant economic and social potential. In this context, media serves as a bridge connecting on-the-ground actions with community interaction or other stakeholders. Technical training on social media management, digital communication strategies, and environmental community branding is needed to enable them to independently convey information.

CONCLUSION

This study shows that the maggotization program in Bandung is a promising innovation for addressing organic waste issues. Through a collaborative pentahelix approach, this program has successfully reduced waste by up to 80% and provided direct benefits to the community. However, not all elements of the pentahelix are functioning perfectly. The business sector is a weak point that needs to be strengthened to ensure the program is not only environmentally friendly but also economically sustainable for the community. The maggot processing facility in RW 14, Cipadung Village, Cibiru District, Bandung City, serves as a concrete example of how the community, government, and academia can collaborate to address environmental issues at the local level. With improvements in business and media aspects, this model has the potential to become a solution for other cities in Indonesia.

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