

URBAN ECOLOGY: HOUSE RAT (*RATTUS RATTUS*) MANAGEMENT AND BEE (*TRIGONA* SP.) KEEPING IN RW IX GRIYA BHAYANGKARA, SUKODONO

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Abstract

*Urban environments often grapple with the dual challenges of pest management and sustainable practices, highlighting a crucial research gap in integrating effective and eco-friendly solutions. This activity addresses the issue of house rat (*Rattus rattus*) infestations and the potential for Trigona bee (*Trigona* sp.) keeping in RW IX Griya Bhayangkara, Sukodono. The primary objective was to develop and implement a training program for constructing environmentally friendly rat traps and establishing Trigona bee colonies. Utilizing a hands-on approach, the methodology included the design of simple, water gallons-based rat traps and the setup of bee bamboo-hives tailored for urban settings. The expected outcome where the introduction of simple rat traps could reduce house-rat populations, while Trigona beekeeping offered additional economic benefits and environmental sustainability. This activity underscores the importance of community engagement in adopting these methods, demonstrating that local resource utilization and practical training can effectively address urban ecological challenges. The implications of this activities extend to enhancing urban pest management strategies and promoting sustainable urban agriculture practices, contributing to overall community well-being, ecological resilience, and the achievement of SDGs.*

Keywords: bamboo hive, community empowerment, food-bait, pest management, SDGs

Abstrak

Lingkungan perkotaan sering menghadapi tantangan ganda dalam manajemen hama dan praktik berkelanjutan, yang menimbulkan celah penelitian menarik dalam mengintegrasikan solusi yang efektif dan ramah lingkungan. Kegiatan ini menangani masalah infestasi tikus rumah (*Rattus rattus*) dan potensi budidaya lebah Trigona (*Trigona* sp.) di RW IX Griya Bhayangkara, Sukodono. Tujuan utama adalah mengembangkan dan menerapkan program pelatihan untuk membuat perangkap tikus ramah lingkungan dan budidaya koloni lebah Trigona. Dengan pendekatan praktis, metodologi mencakup desain perangkap tikus berbasis galon air mineral yang sederhana dan pemasangan sarang lebah dari ruas bambu yang disesuaikan untuk pengaturan perkotaan. Hasil kegiatan yang diharapkan bahwa pengenalan perangkap tikus sederhana dapat mengurangi populasi tikus rumah, sementara budidaya lebah Trigona menawarkan manfaat ekonomi tambahan dan keberlanjutan lingkungan. Kegiatan ini menekankan pentingnya keterlibatan komunitas dalam mengadopsi metode ini, menunjukkan bahwa pemanfaatan sumber daya lokal dan pelatihan praktis dapat secara efektif mengatasi tantangan ekologis perkotaan. Implikasi dari rangkaian kegiatan ini meliputi peningkatan strategi manajemen hama perkotaan dan promosi praktik pertanian perkotaan yang berkelanjutan, berkontribusi pada kesejahteraan komunitas secara keseluruhan, ketahanan ekologis, dan pencapaian SDGs.

Kata kunci: pakan umpan, pemberdayaan komunitas, pengelolaan hama, SDGs, setup bambu,

INTRODUCTION

The necessity for the empowerment of PKK (Pemberdayaan Kesejahteraan Keluarga) groups in urban settings is underscored by the unique challenges faced by communities in densely populated areas (Halik et al., 2023; Hamidah & Redjosari, 2022). PKK, as a community-based organization focused on family welfare, play a pivotal role in addressing these challenges by fostering inclusive growth and empowerment across various strata of society (Amal et al., 2021). The rural community members of PKK RW IX Bhayangkara in Sidoarjo were confronted with a pressing issue, as the menace of rat infestations that has become a significant threat to household gardens and overall residential life. The pervasive damage caused by rodent attacks not only undermines local food security but also poses risks to their property and health (Supriadi et al., 2023).

Rat infestations in urban settings are a multifaceted problem that goes beyond merely damaging crops. These rodents are notorious for destroying ornamental plants, undermining the aesthetic value of green spaces, and creating unsanitary conditions that affect the quality of life (Burke et al., 2021; Balčiauskas & Balčiauskienė, 2020). Inside homes, rats can cause extensive damage by gnawing on furniture, wires, and insulation, which not only leads to costly repairs but also increases the risk of electrical fires (Ayyad et al., 2023). The contamination of food supplies by these pests further exacerbates food security concerns, particularly in a community that relies heavily on its gardens for fresh produce (Dossou et al., 2020). In response to these challenges, the local PKK group has identified an innovative solution that leverages the natural environment: the cultivation of *Trigona* honey bees. This initiative provides a dual benefit. First, it introduces a sustainable method for managing rat populations by promoting a natural ecosystem balance. Second, it offers an alternative economic opportunity for residents through the production of *Trigona* honey, which is valued for its medicinal properties and can be a source of supplementary income (Kusuma et al., 2022; Zalilova et al., 2021). Beekeeping not only supports biodiversity but also enhances pollination for home gardens, potentially increasing crop yields and improving food security within the community. Moreover, the health benefits associated with the consumption of *Trigona* honey, known for its medicinal properties, further amplify the potential positive impact on community well-being (Rozman et al., 2022). However, amidst these challenges lies a potential avenue for empowerment. The

community possesses a valuable resource in the form of the PKK group, which, with strategic guidance, can be instrumental in cultivating Trigona honey bees. This dual-purpose initiative not only addresses the pressing issue of rodent attacks but also holds promise for sustainable economic development and the promotion of environmental sustainability through beekeeping (Kusuma et al., 2023).

This community service project, therefore, aims to empower the residents of RW IX Griya Bhayangkara by harnessing the collective resources and skills within the PKK group. Through the Asset-Based Community Development (ABCD) approach, the project focuses on identifying and mobilizing existing assets—such as local knowledge, skills in gardening and beekeeping, and social networks—to create sustainable solutions for community problems. The ABCD approach emphasizes the importance of building on the community's strengths rather than focusing solely on its needs or deficiencies. By engaging community members in every stage of the project, from planning to implementation, this approach fosters a sense of ownership and ensures that the interventions are tailored to local conditions and sustainable in the long run. Furthermore, this initiative aligns with the broader goals of the Sustainable Development Goals (SDGs), particularly SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 11 (Sustainable Cities and Communities). By developing skills in eco-friendly pest management and sustainable beekeeping, the community addresses immediate issues like rat infestations while also contributing to long-term food security and economic stability. Moreover, the project promotes SDG 11 by enhancing the living environment and resilience of urban areas through sustainable practices that protect biodiversity and foster community well-being. By integrating SDGs into this initiative, the project not only focuses on resolving immediate local challenges but also contributes to global efforts aimed at creating a more sustainable and equitable world. The knowledge and practices developed through this project can be shared with neighboring communities, creating a ripple effect that amplifies its impact and further aligns with SDG 17 (Partnerships for the Goals), which emphasizes the importance of collaboration in achieving sustainable development.

METHODS

The initiative's activities are centered around the community hall (balai) of RW IX Griya Bhayangkara (Figure 1), which serves as the hub for participatory assessment phases, planning meetings, and training sessions. This community service project employs the Asset-Based Community Development (ABCD) methodology as described by (Nel, 2020), focusing on the utilization of rat traps and the cultivation of Trigona bees as innovative solutions to the challenges faced by the community in RW IX Griya Bhayangkara. The ABCD approach underscores the importance of identifying and leveraging existing community assets, including human skills, knowledge, and social networks, to foster sustainable development. In the context of this initiative, the methodology involves a participatory assessment phase where community members, particularly from the PKK group, are actively engaged in identifying local assets, challenges, such as rat infestations and limited land use, and potential opportunities for the cultivation of Trigona bees and the effective utilization of rat traps.

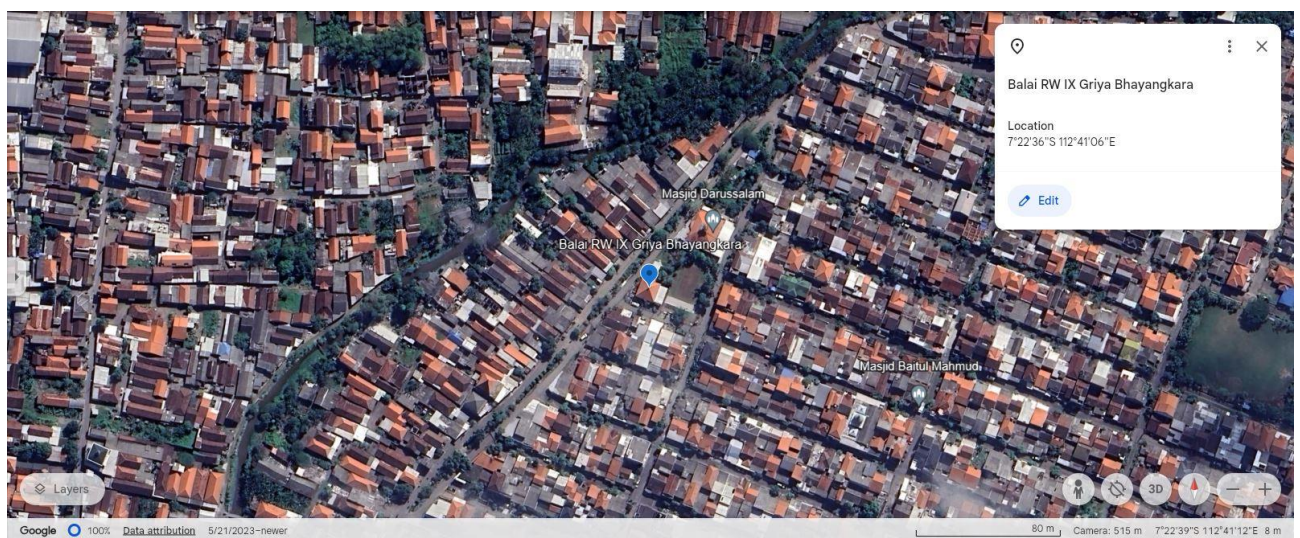


Figure 1. Geographical Location of Community Engagement. Coordinates 7°22'36"S 112°41'06"E. Source: Google Earth.

The project methodology is structured around collaborative planning sessions that are designed to map out community assets that can be harnessed for the construction of simple rat traps and Trigona beekeeping cultivation. These sessions serve as a platform for knowledge exchange, where community members can share insights on local materials that can be repurposed for rat traps and techniques for sustainable beekeeping. Implementation of the identified solutions entails a series of capacity-building workshops and hands-on

training sessions, aimed at enhancing the community's skills in constructing and deploying effective rat traps and managing Trigona bee hives.

Stage 1: Community Asset Mapping. The initial phase of the project adopts an Asset-Based Community Development (ABCD) approach, commencing with a comprehensive mapping of community assets. This involves the systematic identification of tangible and intangible resources within RW IX Griya Bhayangkara, including land-use, public facilities, local knowledge, social networks, and physical assets that can be leveraged for rat trap utilization and Trigona beekeeping. Community meetings and workshops were organized to facilitate the participation of local residents, especially members of the PKK, in identifying assets and challenges.

Stage 2: Skill Enhancement. Following the asset mapping, the second stage focuses on skill enhancement among community members. Tailored training sessions and workshops were developed to address identified gaps and to strengthen the community's ability to manage rat infestations and engage in Trigona beekeeping effectively. This stage included practical demonstrations on constructing environmentally friendly rat traps from locally sourced materials and hands-on training in sustainable beekeeping practices.

Stage 3: Implementation and Monitoring. With enhanced capacities, the community proceeded to the implementation phase, where rat traps were deployed, and Trigona bee hives were established. This phase involved the practical application of skills acquired during the training sessions, with a focus on utilizing local resources and adapting techniques to the specific environmental and social context of RW IX Griya Bhayangkara. Monitoring mechanisms were established to track the progress of the initiatives, identify challenges, and assess the impact of rat trap utilization and beekeeping on the community's well-being and local ecosystem. Regular feedback sessions were conducted to facilitate the exchange of experiences and to foster continuous learning and adaptation of strategies.

Stage 4: Evaluation. The final stage entailed a comprehensive evaluation of the project's outcomes, focusing on the effectiveness of the ABCD approach in addressing rat infestations and enhancing land use through Trigona beekeeping. Successes,

challenges, and lessons learned were documented to inform future community development efforts.

RESULTS AND DISCUSSIONS

Need Assessment Result

The needs assessment conducted within PKK RW IX Griya Bhayangkara revealed several critical challenges that require immediate attention to enhance community well-being and resilience as shown in Table 1. Firstly, the prevalence of a high rat infestation emerged as a significant concern, with the rodents causing substantial damage to household gardens and posing potential health risks to the residents. The assessment highlighted that these infestations have not only compromised local food production but also created an unsanitary living environment, exacerbating the community's vulnerabilities. Secondly, the limited availability of land for gardening and agricultural purposes due to urbanization and dense population has restricted the community's ability to engage in sustainable food production activities. This limitation underscores the necessity for innovative solutions to optimize space for gardening and other productive uses. Additionally, there is a notable lack of awareness and knowledge regarding effective pest management practices among the residents, which has led to the persistence of pest-related problems, including rat infestations. This knowledge gap suggests a critical need for education and capacity-building initiatives focused on sustainable pest control methods. Lastly, the underutilization of local resources, particularly in beekeeping, was identified as an area of missed opportunity. Despite the community's potential to benefit from beekeeping, including the cultivation of Trigona honey bees, there has been a lack of strategic initiatives to harness this opportunity, which could provide both environmental and economic benefits. Addressing these challenges requires a comprehensive approach that leverages community assets and promotes sustainable practices to foster a resilient and thriving environment in RW IX Griya Bhayangkara.

Table 1. The matrix of problems encountered, problems descriptions, and solutions

Problems Encountered	Problem Descriptions	Proposed Solutions

High rat infestation	The community faces a severe issue with a high population of rats, which damages household gardens and poses health risks.	Develop environmentally friendly rat traps using locally sourced materials to control the rat population effectively.
Limited land availability	Due to urbanization, there is limited space for gardening and agricultural activities, restricting the community's capacity to grow food.	Promote vertical gardening techniques and optimize available space for small-scale agriculture and beekeeping.
Lack of awareness in environmental-friendly pest management	Many residents lack knowledge of sustainable pest control methods, resulting in ineffective management of household pests.	Organize workshops and training sessions on sustainable pest management, including the use of natural repellents and traps.
Underutilization of local resources	The community has not fully utilized the potential of beekeeping, despite the availability of resources and interest.	Implement a Trigona honey bee cultivation program, providing training and resources to empower the community in beekeeping.

Development of Simple Rat Traps

The identification phase revealed a significant challenge faced by the residents of RW IX Griya Bhayangkara Sukodono: a high population of rats infesting residential areas, posing a threat to both outdoor gardens and indoor spaces, while also causing property damage. To address this issue, a simple rat trap was developed, utilizing discarded a 19-liter plastic mineral water gallon. The process of designing and constructing these rat traps aimed to provide an accessible and affordable solution to the rat infestation problem, utilizing locally available materials and requiring minimal technical expertise. The first step in the

development process involved collecting discarded mineral water gallons from the community. These gallons were then cleaned and prepared for transformation into rat traps. By repurposing these gallons, the project aimed to reduce plastic waste while simultaneously addressing the rat infestation issue. The gallons were carefully cut and modified to create an entrance for the rats while ensuring that they could not escape once inside the trap. The design also incorporated mechanisms to hold bait securely within the trap, enhancing its effectiveness in attracting and capturing rats. Community members were provided with guidance on how to set up and use the traps effectively. Figure 2. illustrates the design and construction process of the environmentally friendly rat traps. This simple yet effective technology demonstrates the potential for community-driven solutions to address local environmental challenges while promoting sustainability and resource efficiency.



Figure 2. Simple Rat Trap Constructed from a 19-Liter Mineral Water Gallon

Research indicates that community-driven pest control measures, such as those developed in PKK RW IX, can be highly effective in managing local pest populations when properly implemented and maintained (Carrick-Hagenbarth, 2021). The traps operate on a basic mechanical principle, leveraging food-bait to attract the rats and a simple mechanism

to capture them (Takács et al., 2018). Additionally, by engaging the community in the design and deployment of these traps, the initiative fostered a sense of ownership and responsibility among residents, enhancing the likelihood of sustained use and maintenance over time. Furthermore, the emphasis on using recycled materials aligns with broader environmental sustainability goals and addresses waste management issues within the community (Vadakkepatt et al., 2021; Zimon et al., 2020). This strategy not only helps to mitigate the immediate problem of rat infestations but also contributes to broader environmental conservation efforts, as it encourages the reuse of materials that would otherwise contribute to local waste (Raiden & King, 2021). Overall, the development and implementation of these simple rat traps represent a proactive, community-centered approach to pest management that balances effectiveness, cost-efficiency, and sustainability. Future studies could explore the long-term impacts of these traps on rat populations and the potential for scaling up similar initiatives in other urban communities facing comparable challenges.

Training on Trigona Beekeeping Using Simple Bamboo Setup

The training on Trigona beekeeping incorporated the use of a simple bamboo setup, reflecting a practical and cost-effective approach to initiating beekeeping activities in the PKK RW IX Griya Bhayangkara community (Figure 3). The use of bamboo, a readily available and environmentally friendly material, was chosen to construct beehives due to its structural advantages and affordability (Al Awwally et al., 2023). The bamboo setup was designed to be easy to assemble and maintain, making it accessible for community members with varying levels of experience. This design not only aligns with the principles of sustainability but also leverages local resources to enhance the practicality of beekeeping (Qu et al., 2022).



Figure 3. Demonstration of Trigona Beekeeping by Lecturers, Engaging Enthusiastic PKK RW IX Griya Bhayangkara Community Members

The training sessions demonstrated how to create and use bamboo hives for Trigona bees, focusing on the key aspects of hive construction, colony management, and honey harvesting (Figure 4). The bamboo hives were constructed to provide an optimal environment for Trigona bees, considering their unique nesting preferences and environmental needs (Prastiyo & Nuraeni, 2023). The use of bamboo was highlighted as beneficial due to its natural insulating properties, which help regulate temperature and humidity within the hive, creating a stable environment for bee colonies. This setup also facilitated ease of maintenance and monitoring, crucial for ensuring the health and productivity of the beekeeping operation. The training emphasized the importance of proper hive management techniques to ensure successful beekeeping outcomes. This included instructions on positioning the hives in suitable locations, managing bee populations, and harvesting honey in a way that maximizes yield while minimizing stress on the colonies. The incorporation of bamboo setups not only provided a sustainable solution to the community's beekeeping needs but also served as an educational tool to demonstrate the feasibility of low-cost, environmentally friendly practices in apiculture. The success of this training highlights the potential for expanding similar initiatives to other

communities, promoting sustainable agriculture and contributing to local economic development (Harianja et al., 2023).



Figure 4. Trigona Bee Colonies, Propolis, Honey, and Nectar in Bamboo Segment Growing Medium Setup

Workshop and Education Sessions on Simple Rat Trap and Beekeeping by Lecturers

The training and education sessions on simple rat traps and beekeeping, conducted by expert lecturers, were designed to enhance the knowledge and skills of the community members in PKK RW IX Griya Bhayangkara (Figure 5). These sessions were crucial in equipping residents with practical and theoretical knowledge, enabling them to effectively address the rat infestation problems and explore sustainable beekeeping practices. The training on rat traps focused on understanding the different types of rats commonly found in urban and rural areas, including house rats (*Rattus rattus diardii*), Rice-field rats (*Rattus argentiventer*), and wood rats (*Rattus tiomanicus*.) (Hoque et al., 2018; Lim, 2015). The lecturers provided in-depth insights into the bioecology of house rats, highlighting their breeding patterns, feeding habits, and preferred habitats. This information was essential for helping residents identify potential rat infestations early and understand the behaviors that contribute to their proliferation. Moreover, the training covered the signs and symptoms of

rat infestations, such as droppings, gnawed materials, and greasy rub marks along walls and pathways. Understanding these indicators is critical for early detection and effective control of rat populations.



Figure 5. Engaging Training and Demonstration on Simple Rat Trap Construction and Trigona Beekeeping Conducted by Lecturers

The sessions also included a comprehensive overview of various rat control methods, focusing on mechanical, biological, and chemical control strategies (De Ruyver et al., 2023). Mechanical control methods, such as the use of traps and barriers, were emphasized for their effectiveness and minimal environmental impact (Bogardus & Shiels, 2020; Schlötelburg et al., 2021). Biological control methods, which involve the use of natural predators or pathogens to manage rat populations, were also discussed as a sustainable alternative to chemical controls (Abidin et al., 2021; Wood & Fee, 2003). The lecturers further elaborated on chemical control methods, including the use of rodenticides, and stressed the importance of careful and responsible use to prevent harmful impacts on non-target species and the environment (Syahputri & Priyambodo, 2020). A significant portion of the training was dedicated to discussing the environmental and health impacts of chemical pesticides (Pertile et al., 2022). The lecturers highlighted the potential risks associated with

pesticide use, such as contamination of soil and water resources, harm to beneficial insects and wildlife, and the development of pesticide resistance in rat populations (Ali et al., 2021). They underscored the importance of adopting integrated pest management (IPM) practices that combine multiple control strategies to minimize reliance on chemical pesticides (Alprilia et al., 2024). This approach not only reduces environmental risks but also promotes long-term sustainability in pest management (Smith & Meyer, 2015).

In addition to rat control, the training sessions provided valuable insights into the practice of beekeeping, particularly focusing on the cultivation of *Trigona* honey bees, which are stingless bees known for their docile nature and high productivity (Windriyanti et al., 2022). The lecturers introduced various species of honey bees, including *Apis mellifera*, *Apis cerana*, and *Trigona* spp., and explained the unique characteristics and benefits of stingless bees (Kusnaedi et al., 2022). The training covered the products derived from beekeeping, such as honey, propolis, and bee bread, and highlighted their nutritional and medicinal benefits. The focus was particularly on the production and benefits of *Trigona* honey, known locally as klanceng honey, which is highly valued for its antioxidant and antimicrobial properties (Okińczyc et al., 2020). The lecturers emphasized the economic potential of beekeeping as a supplementary income source for the community, particularly in the sale of high-value bee products. The educational sessions were well-received by the participants, who expressed a keen interest in applying the knowledge gained to their daily lives. By providing hands-on demonstrations and interactive discussions, the lecturers effectively engaged the community members and encouraged them to actively participate in the learning process. The training not only enhanced the technical skills of the residents but also fostered a deeper understanding of sustainable practices in pest management and beekeeping. This holistic approach to education and training is essential for empowering communities to become more resilient and self-reliant, contributing to both environmental sustainability and economic development.

CONCLUSION

The comprehensive training and education on *Trigona* beekeeping and simple rat trap construction have proven to be pivotal in addressing the challenges faced by the PKK RW IX

Griya Bhayangkara community. By employing a bamboo-based setup for Trigona beekeeping, the initiative has demonstrated a sustainable and cost-effective approach to apiculture, which aligns with local resource availability and environmental considerations. This training not only equipped community members with practical skills in managing bee colonies and constructing rat traps but also fostered a deeper understanding of the ecological and economic benefits associated with these practices. The integration of these techniques underscores the potential for community-driven solutions to enhance local resilience, improve food security, and promote sustainable livelihoods. Overall, the success of this initiative highlights the value of targeted education and hands-on training in empowering communities to tackle environmental and economic challenges effectively, thereby contributing to broader goals of sustainability and self-reliance.

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