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Potential of Stingless Beekeeping in Community Empowerment Strategy for Building Sustainable Creative Economy in a Forest Farmer Group of Puncak Labuang, Padang City

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ABSTRACT

The Forest Farmer Group of Puncak Labuang (FFGPL) manages a 194-hectare community forest in Limau Manis, Padang, contributing to the livelihood of community through agriculture and ecotourism. The forest productivity comes as high-value commodities such as durian, mangosteen, and coffee, as well as ecotourism activities like camping and hiking; all of which boost local economy while sustaining the surrounding environmental. Having diverse vegetation, the forest presents an opportunity for farming the stingless bee (galo-galo) as a promising innovative economic initiative. This program aligns with the program of West Sumatra Provincial Government to achieve position as production centre for honey. Some challenges such as low production of bee colonies appear from the lack of knowledge in farming techniques and insufficiency of food sources for colonies which hinder the progress. From June to December 2024, a community service program had been implemented to address these challenges. Activities included socialization, demonstrations, and training in bee farming techniques, supported by a team of experts. The education focused on the potential of galo-galo farming and strategies for marketing local products. Additionally, training sessions for Micro, Small, and Medium Enterprises (MSMEs), along with honey product exhibitions, had successfully raised public awareness and improved the competitiveness of local products. As a result of this program, there was a notable improvement in community skills and knowledge, contributing to the sustainability of local economy and preservation of biodiversity. FFGPL has the potential to become a model for community empowerment based on natural resources, leading to significant improvements in community welfare.

Keywords: education, sustainable economy, stingless bees, community empowerment

INTRODUCTION

The Forest Farmer Group of Puncak Labuang (FFGPL) is a forest farmer group (FFG) that manages a 194-hectare community forest in Limau Manis Village, Pauh District, Padang, based on the Decree of the Ministry of Environment and Forestry of the Republic of Indonesia No. 6256/MENLHK-PSKL/PKPS/PSL.0/7/2022. The forest serves as a source of community income through farming and ecotourism activities, with flagship commodities

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such as durian, mangosteen, and coffee (Putri et al., 2023). In addition, Puncak Labuang offers various ecotourism activities, such as camping and hiking, to support local economy and environmental sustainability. As a lowland tropical rainforest (±240 m elevation), the area harbouring high vegetation diversity of cultivated crops and wild plants. Some wild plant species have been underutilized only as animal feed, neglecting the potential of other parts such as flowers and bark. The plantations in this area are abundance with forage sources hence suitable for bee colonies development. Various plantation species such as coffee, mango, longan, rambutan, and Calliandra bloom in a relatively long period with numerous flowers (Marhiyanto, 1999).

Integrating these potential resources into stingless beekeeping presents an opportunity that potentially increases community income. It means combining farming practices with stingless beekeeping, carried out by farmer groups. Sedana & Astawa (2016) reported that the establishment of farmer groups engaged in beekeeping which generates benefits and added value for the members. Beekeeping contributes variably to household income, such as up to 75% of total household income from stingless beekeeping in Kampar District, with a box of colony could yield more than IDR eight hundred thousand per harvest (Maulana, 2017; Vaulina & Sri, 2019); Apis mellifera beekeeping in Sipatuhu Village generated more than IDR six million per year (Supriyanto, 2017); beekeeping in Tanah Laut District contributed 19.6% for local households (Anggraini et al., 2018); in East Lampung District it contributed 27.71% (Filly, 2018); in Tanah Laut District contributed 37% (Kamaliya et al., 2020); in Bireuen District contributed 41.59% (Riki et al., 2023); in North Lombok District contributed 21.68% (Rahmayanti, 2020); and in Gowa District contributed as low as 8.3% (Febriana, 2021).

Stingless beekeeping (Meliponiculture) is part of creative economy initiatives that currently being developed (Leonhardt, 2017). Stingless bees are known by various local names in Indonesia, such as lanceng (Javanese), teuweul (Sundanese), keledan (Lombok), kelulut (Malay), ketape (Sulawesi), and galo-galo (Minangkabau) (Riendriasari & Krisnawati, 2017; Erniwati, 2013; Herwina et al., 2025). The stingless beekeeping initiative program aligns with the plan of Provincial Government (2021) to establish West Sumatra as center for honey production in Indonesia. The concept of “meliponi-tourism” has recently emerged as effort to attract tourists and enthusiasts to interact within the stingless bee colonies as main attraction (Herwina et al., 2025). This concept not only support ecotourism but also potentially improve the diversity of pollinating insects and agricultural yields at the same time (Herwina et al., 2021).

The colonies of stingless bees that previously introduced to FFGPL since last six months have not been optimal due to high colony mortality up to 60%. Other problems faced by FFGPL in stingless beekeeping were low productivity and relatively poor knowledge of beekeeping skills. Low productivity and poor community knowledge regarding beekeeping techniques hinder the achievement of optimum benefit from stingless beekeeping. Similarly, opportunity of meliponi-tourism is still unattained. Therefore, this community service program aims to improve the capacity of FFGPL members in stingless beekeeping techniques and to strengthen the integration of beekeeping with the tourism sector to maximize both economic and ecological benefits for the local community.

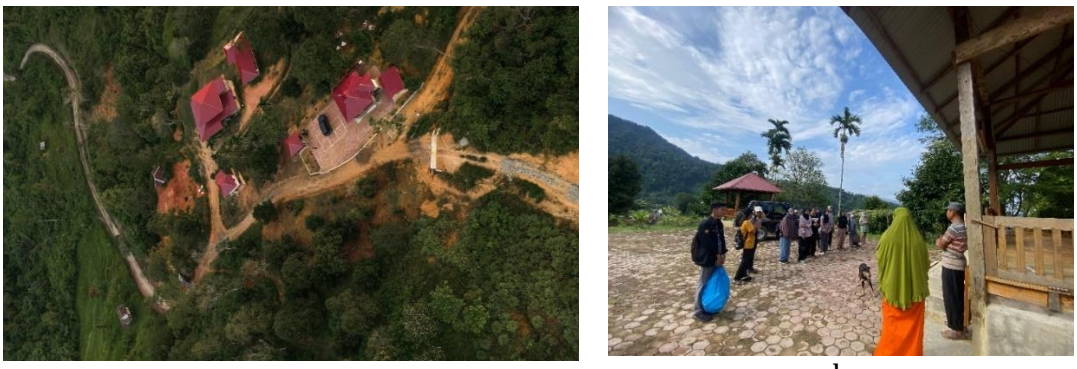
METHOD

The community partnership empowerment through stingless beekeeping activity at FFGPL, Limau Manis Village, Padang City (Figure 1) had been successfully carried out from June to December 2024. It was essentially implemented as an educational program for the

community. The educational program in this activity consisted of counselling, training followed by the application of technology, and mentoring. The method employed was persuasive educative communicative participatory, where the principles of andragogy (adult education) were used as guidelines. Accordingly, the principles developed emphasized value and benefits aligned with experience, practicality, attractiveness, active participation, and partnership (Mutmainnah et al., 2019). In this regard, problem-solving steps were undertaken in the form of awareness-raising and counselling activities based on mutually agreed issues.

Within the framework of developing community partnerships, education aimed to provide learning materials tailored to the needs of the FFGPL community. To understand the site conditions and communal needs of members of FFGPL, a preliminary survey was conducted by the Community Service Team together with students from the Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Andalas (Figure 1b). The survey found that main problem faced by FFGPL members was a lack of knowledge and skills in stingless beekeeping. Based on it, activity curricula were designed to enhance the knowledge and skills capacity of FFGPL members through counselling sessions.

Counselling on the concept of stingless beekeeping was delivered by the Community Service Team from Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Andalas, who possess expertise and competence in stingless beekeeping. The counselling included lectures to explain the principles of beekeeping, i.e. selecting high-quality broodstock for development, identifying forage plants, colony management, honey harvesting and post-harvest processing, as well as financial analysis of stingless beekeeping and honey marketing techniques. The lectures were also followed by discussion sessions between participants and counsellors. FFGPL members were provided with simple and applicable materials during this session.



a b

Figure 1. Forest Farmer Group Puncak Labuang (FFGPL), Limau Manis Village, Pauh Sub-district, Padang, West Sumatra. a = site from aerial view. b = internal briefing between the community service team prior to field survey.

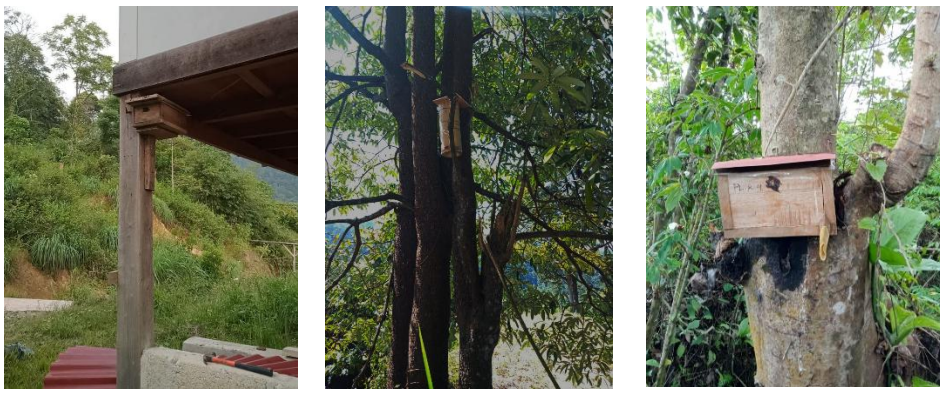
To further the comprehension of counselling materials, FFGPL members were involved in practical stingless beekeeping activities. The activities included the construction of colony hives (Figure 2), installation of traps (Figure 3), preparation of log/hive stands for bee colonies (Figure 4), harvesting process (Figure 5), and post-harvest honey packaging (Figure 6). The direct practice was implemented to ensure that the taught knowledge and skills observable and practicable. To support this, FFGPL members were provided with equipment and materials, including stingless bee colony logs that were ready for harvest. Harvesting techniques and colony monitoring were the mentoring activities that lasted the longest until the completion of community service program.



a b c

Figure 2. Practical preparation for stingless beekeeping training at FFGPL site. a = outlining hive construction and colony log stands. b = practice of constructing stingless bee hives from wood boards. c = practice of constructing stingless bee hives from bamboo.

The trapping practice and installation were conducted at FFGPL site (Figure 3). Trap placement was governed by nesting habits of stingless bees, mostly in cavities of tree and building. Traps were then installed by the building walls (Figure 3a) or on tree branches (Figure 3b–c). Trap installation was intended as artificial cavities so natural or introduced stingless bee colonies able to divide their colonies.



a b c

Figure 3. Hive structures were installed at several locations in FFGPL site. a = wooden structure on house wall, b = bamboo structure on tree branch, c = wooden structure installed on tree branch that already occupied by stingless bee colony.

Practical activities for constructing log/colony stands were carried out at the FFGPL site (Figure 4). This activity was independently implemented by FFGPL members upon receiving technical guidance from the community service team. The colony stands were constructed from river stones in accordance to the available colonies. These colony log stands will accommodate the introduced stingless bee colonies. The stingless bee species introduced were Geniotrigona thoracica and Heterotrigona itama.



a b c

Figure 4. Practicing of constructing colony structure at FFGPL site. a = log/colony stand constructed by FFGPL members, b&c = sample of stingless bee colony stand with H. itama colony log placed atop.

Practical training on honey harvesting process was carried out on stingless bee colonies at the FFGPL site (Figure 5). The harvesting activity began with tutoring session on identifying colony conditions suitable for harvesting (Figure 5a), recognizing the types and functions of pots within the topping cavity (Figure 5b), and understanding the requirements of harvestable honey pots as well as honey harvesting techniques (Figure 5c).



a b c

Figure 5. Guidance on monitoring and honey harvesting techniques on stingless bee colonies FFGPL site. a = Monitoring stingless bee colonies suitable for harvesting, b = Condition of honey pots (mature, immature, and empty) within the topping cavity, c = Harvesting mature honey pots.

The practical activity on post-harvest honey processing was carried out on stingless bee colonies at the FFGPL site (Figure 6). The activities included education on honey filtering (Figure 6a) and packaging into bottles (Figure 6b). In addition, participants were also introduced to the process of designing a brand for FFGPL, which would be used to label the honey packaging (Figure 6c).



a b c

Figure 6. Practical activity on post-harvest honey processing at FFGPL site. a = tutoring on honey filtering, b = stingless bee honey packaged into bottles, and c = brand design for FFGPL products.

Assistance and monitoring activities were carried out continuously to observe the successes and challenges of the implemented programs. These activities were conducted by the Service Team and students through direct colony monitoring as well as using internet for interactions and discussions. Several monitored aspects included the number of beehives completed and installed as attractants for bees to nest, volume of honey harvested, post-harvest honey processing, and marketing techniques of stingless bee honey.

Success indicators of the program were measured by assessing the knowledge and skills gained by group members. The measurable parameters included the number of active FFGPL members who participated in the activities, the number of log colony stands constructed members, the number of beehives completed, and the number of trap hives installed during the program. Eventually, success indicators also reflected in the volume of honey harvested and packaged, as well as the marketing methods implemented by the group.

RESULTS AND DISCUSSION

This Site Suitability for Meliponiculture

The preliminary survey conducted at the Forest Farmer Group Puncak Labuang (FFGPL) actively involved lecturers and students, who simultaneously conducted the fieldwork sessions for “Honey Beekeeping” and “Soil Biology” courses. The activity was held on 12 June 2024, aside from introducing beekeeping practices to students, it was also crucial in building firm relationships with FFGPL members. Through this arrangement, students were expected to have first-hand experience in networking and comprehending more on local social and economic conditions, as well as the conditions of habitat used for stingless beekeeping (Figure 1 and 2).

The initial survey identified various environmental aspects relevant to beekeeping and colony condition within the FFGPL site. The physical conditions included potential food sources for stingless bees, canopy coverage, and other challenges faced by FFGPL members. The survey resulted in data and information (Table 1) as a baseline for further developing a sustainable stingless beekeeping program that relevant to the respective community. From Table 1, the FFGPL site in Limau Manis area meets most of the requirements for stingless beekeeping. According to Rompas et al. (2023), a good honey beekeeping site should meet requirements such as 1) flowering plants within 0.5-0.7 km range as food sources, 2) environmental temperature ranging between 26-34oC with 70-80% humidity, 3) sufficient clean water source, 4) lack of disturbances (odor, smoke, noise, pests and diseases, and

strong gale), and 5) in considerable distance from agricultural area with frequent chemical use.

Table 1. Environmental aspects inspected for stingless beekeeping requirement at Forest Farmer Group Puncak Labuang (FFGPL) Limau Manis, Padang City

No	Parameter	Observed Condition	Recommendation for stingless beekeeping
1	Area size	194 hectares	Suitable
2	Number of flowering plant species	>50 species	Suitable
3	Variation in tree height	Diverse	Suitable
4	Availability of resin-producing plants	Present	Suitable
5	Average daily temperature	>25 °C	Suitable
6	Availability of clean water in the surrounding area	Present	Suitable
7	Presence of natural nesting site	Observed	Suitable
8	Distance from intensive pesticide application	Pesticide-free	Suitable
9	Distance from disturbances/noise	Free from disturbance	Suitable
10	Availability of human resources	Available	Suitable
11	Accessibility	Concrete road to the site	Suitable
12	Governmental support	Present	Suitable

Educational Activities

The next phase of this program aimed to evaluate the pre-existing stingless bee colonies in the area and to determine the optimal condition for new colonies procurement. It was conducted between 26 August to 5 September 2024, which included in-depth analysis on the health and productivity of existing stingless bee colonies to identify any factor influencing colony performance. It involved systematic observation on the presence and diversity of flowering plants serve as food sources for stingless bees. A comprehensive analysis on forage plants was crucial, as high-quality floral resources directly contributes to the growth and long-term success of colonies, ensuring sustainable honey production. Furthermore, Setiad et al. (2023) reported that area size becomes the key factor for the development of stingless beekeeping. In addition, internal and external characteristics of farmers in agricultural practice may directly affect the stingless beekeeping activity (Dewi et al., 2021).

Practice of Constructing Colony Log Stands

Theoretical lecture on colony log stand construction then practiced by directly building log stands from river stones collected from surrounding (Figure 4a). The FFGPL members were trained in its construction practice, with emphasis given on the fulfilment of criteria such as shade or protection by trees. The practice deepened the understanding on essential preparatory stage, which involves material preparation (stone, sand, cement, and water) and building process of stands by constructing a foundation specifically designed to accommodate colony logs of stingless bees. This process was crucial in creating a stable and secure infrastructure for stingless bee colonies, therefore various technical aspects, like material selection, site location, and the precise design of the log stands should be

considered. Robust and well-structured log stands was critical for guarantying colony safety, comfort, and health. It also helps sustaining beekeeping activities for long-term, where conducive environment for colony growth and for beekeeping personals to conduct colony monitoring (Figure 4).

The FFGPL members were assisted in placing newly arrived stingless bee colony logs at the site which conducted during night time. The new colonies, still in their packing materials, were transported to the designated stands. The colony logs were positioned so that the nest entrance faced towards the abundant food source (Figure 4b). Once the log colonies were firmly placed on stable position, the packing materials removed. Knowledge regarding colony placement and nest entrance orientation was essential, as it facilitated adaptation and successive foraging activities of worker bees. The nest entrance and path toward it must remain unobstructed to smooth flight traffic among workers departing from or returning to the nest. Comprehending these measures can significantly assist the growth and productivity of colonies. Furthermore, the placement process of colony logs on the stands not only served as skill enhancement for FFGPL members but also educational matter which attract the ecotourism enthusiasts.

Upon commencing this activity, some indicators were measured: 1) number of colony log stands that ready to host colonies, and 2) the properness of placement of all newly arrived colonies onto the designated stands. Knowledge and skills transfer among FFGPL members were observed to occur during this activity, presumably as result of community empowerment, rooted local social values and possibly as it was regarding their actual needs. According to Abbeduto (2004), the value of solidarity, sincerity, cooperation, honesty, and hard work must be cultivated within the community to drive change towards greater empowerment. In relation to empowerment concept, the knowledge aspect within community must be strongly built from within. Hardiansyah et al. (2023) also reported that empowerment programs through training have proven effective, as indicated by differences in knowledge levels measured before and after training.

Practice of Constructing and Installing Hive Traps

The measured indicator of this practice is the number of hive traps completed by FFGPL members. This activity produced 20 wooden hive traps and 20 bamboo hive traps, accomplished in less than a month. All these hives were then used as traps and installed across buildings and trees with thought to be potentially utilized as nesting sites by stingless bees (Figure 3). During the construction process of hive traps, the inner space was coated with raw propolis collected from stingless bee colonies at the surrounding of FFGPL site. Within next two-month period, 10% of the installed hive traps has been successfully colonized by stingless bees. The trapped species was identified as Tetragonulla sp, while the inhibited hive traps were characterized by the presence of nest entrance tube built on its wall (Figure 7a). When the trap lid opened, internal nest structure becomes visible (Figure 7b).



a b

Figure 7. Observation on hive traps after 3 months' instalment at FFGPL site. a = nest entrance tube of has been built on hive wall. b = brood cells dominated internal nest structure which indicates optimum productivity of the queen.

Independent Business Training

The training activity for Micro, Small, and Medium Enterprises (MSMEs) attended by representatives of FFGPL on 14 September 2024. The training was designed as crucial initial step to initiate stingless bee farming businesses, as well as to understand post-harvest processes and marketing aspects. It provided fundamental insights into effective and efficient farming techniques, where participants got introduced to various methods of sustainable colony management and maintenance. Participants also received education on marketing strategies applicable to maximize economic value of bee products (Figure 8), such as brand development and community-based marketing approaches.

Measured indicator for this activity is the comprehension of trainees toward the importance of trademarks in business (Figure 6c). A success key in running MSMEs was the brand, which engage the belief of consumers toward the quality and trustworthiness of products advertised by a brand (Santoso, 2003). A brand (trademark) is a marketing concept consists of a sign or mark and consumer associations with that mark. A brand becomes one of consumers' considerations in purchasing a product, either goods or services (Kotler & Keller, 2019). A brand functions as a differentiator of goods and services produced by a person or other legal entities. For producers, a brand is a warranty for value of their products, particularly regarding quality; while for sellers, brands are used to promote their merchandise items in order to seek and expand the market (Usman, 2003).

Through independent training, participants were expected to acquire practical skills necessary to independently manage businesses, increase confidence in utilizing local resources, and encourage local economic development. By focusing on the sustainable use of natural resources, this training not only provides technical knowledge but also raises awareness of the importance of environmental sustainability in farming practices. Community education built on community development emphasizes that trust in the community through education is based on the strengths, skills, and abilities, knowledge, and experiences possessed by the community (Andika & Azizah, 2020; Purnama, 2018).



Figure 8. MSME Training of West Sumatra Province attended by representatives of FFGPL.

Independent training activities also play an important role in raising awareness of potential local products and in strengthening collaborative networks between entrepreneurs within the FFGPL community and other business actors. With the establishment of this collaborative network, it is expected that synergy will emerge that can support business growth and enhance the competitiveness of local products in wider markets, while simultaneously providing a positive contribution to the economy of local community.

Entrepreneurship Practice through Product Exhibition Activities

Entrepreneurial practice requires a series of initial steps to be prepared, one of which is branding the product. The creation of labels for stingless bee products (Figure 9), particularly honey, was a strategic step in building brand identity before the product was commercially marketed. This process aims mainly to create a positive image that attracts consumer attention by providing clear information regarding the quality and uniqueness of product. The carefully designed label will be submitted for Intellectual Property Rights (IPR) registry and patent processing to protect the innovation and distinctiveness of the product from possible imitation and plagiarism. This initiative was carried out by students and in discussion with FFGPL members, thereby creating a synergistic collaboration between the academic sphere and field practices.



Figure 9. Brand and packaging of stingless beekeeping products of FFGPL displayed together along with other products during UNAND Expo 2025

The downstream development of stingless beekeeping products, particularly honey, has reached the stage of market introduction. For the introduction of FFGPL's products to consumers, exhibition activities were carried out (Figure 10). The FFGPL members participated in their first exhibition held at the Convention Hall of Universitas Andalas to introduce their stingless beekeeping products. This activity coincided with the celebration of the Anniversary of Universitas Andalas and attended by wide audience, including students, lecturers, and public. Visitors showed high interest in offered products. Their enthusiasm was clearly visible, shown through various questions asked regarding the aspects of cultivation, benefits, and the uniqueness of stingless bees and meliponiculture. It demonstrated the interest and attention of community toward high-quality local products from beekeeping. According to Ekinci (2009), one's interest toward product or service can be judged from one's willingness to seek information about a product or service. Consumers with interest tend to seek more detailed information about product or service, with purpose to precisely know the specifications of product or service before deciding to buy it.



Figure 10. The situation from first exhibition activity where stingless beekeeping products from FFGPL displayed in UNAND EXPO 2025

At the first exhibition displaying stingless beekeeping products of FFGPL, audiences and potential consumers were given the opportunity to taste stingless bee honey through a testing session. Subsequent interviews with tester audience revealed positive responses, expressing their satisfaction with honey flavour. Some of them even proceeded to place orders or even purchased the honey product. It hinted a good market potential as well as community willingness to support local products. The exhibition activity was expected not only to raise public awareness about the importance of stingless bees but also to contribute to the development of the community economy through the promotion of fine beekeeping products from FFGPL. Through the synergy between education, innovation, and field practice, this program has the potential to bring significant impacts to local community. Organized product exhibitions is a common method used by many companies to effectively promote their product (Utomo & Salsabila, 2021). The success of an exhibition is measured by the enthusiasm and number of attending audience.

CONCLUSION

The Community Empowerment Partnership activities carried out in coordination with the Forest Farmer Group Puncak Labuang (FFGPL) to establish stingless beekeeping have shown positive results. The application of technology and innovation in this program, through systematic training and the implementation of best practices, not only increased colony productivity, and quality of products (honey, propolis, and bee pollen) but has also

expanded market access through more effective marketing strategies. Through active collaboration with the community, the program has built necessary skills and knowledge to support local economic sustainability while also raising awareness on the importance of environmental conservation. Community participation in every stage of program, from training in farming techniques to marketing trial activities (exhibitions), has created strong synergy and strengthened the commitment to sustainability. By utilizing biodiversity, FFGPL has shown their potential to achieve successful model of community empowerment based on natural resources. The outcomes of these activities can improve communal welfare and drive broader local economic growth, while also positioning stingless bee farming as an integral part of sustainable community development. Based on the results of these activities, it is recommended that stingless beekeeping to be integrated with plantation crops with the primary objective of enhancing the mutualistic relationship between plants and bee colonies.

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