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Sustainable University Engagement and Multi-Stakeholder Collaboration for Development of Kapalo Banda Ecotourism through Stingless Bee Keeping (Apidae: Meliponinae)

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ABSTRACT

The development of ecotourism in Kapalo Banda, Limau Manis, Padang, has potential to be expanded into agro-ecotourism through multi-stakeholder involvement. Key attractions include the scenic of river flows, agricultural cultivation, and stingless bee keeping, which support environmental sustainability and the local economy. With high vegetation diversity, the potential for stingless bee (galo-galo) breeding as a creative economic initiative offers new opportunities. This program aligns with the West Sumatra Provincial Government's efforts to establish the area as a honey production center. However, challenges such as low colony production due to limited knowledge of farming techniques and the availability of flowering feed hinder its development. Through community engagement, empowerment activities were conducted from June to September 2024, including socialization, demonstrations, and training in bee farming techniques, supported by expert teams. Education focused on the potential of galo-galo and marketing strategies for local products. The results of this program indicate improved community skills and knowledge, supporting local economic sustainability and biodiversity conservation. Kapalo Banda partners have the potential to serve as a model for community empowerment based on natural resources, effectively enhancing community welfare. Multi-stakeholder involvement in developing Kapalo Banda Ecotourism has resulted in a series of activities ranging from cultivation preparation, colony propagation techniques, harvest preparation, to downstream processing and product marketing.

Keywords: food plant, honey, meliponiculture, product, stingless bees

INTRODUCTION

Community Empowerment Institutions (Lembaga Pemberdayaan Masyarakat or LPM in Bahasa) plays a crucial role in increasing community income through various programs based on local potential. One of these efforts is providing skills training, such as agricultural product processing training in rural areas, which has been proven to increase product value (Pratama & Sari, 2021). Additionally, these institutions facilitate access to capital

through partnerships with cooperatives and microfinance institutions, helping small businesses grow more rapidly (Sudrajat, 2020). Furthermore, community empowerment institutions encourage the formation of village cooperatives as collective economic platforms to expand market access and enhance production efficiency (Setiawan, 2021). All these programs demonstrate that community empowerment institutions have a strategic role as drivers for the local economy toward sustainable independence (Wibowo, 2022). In line with this role, the Community Empowerment Institution of Limau Manis Urban Village in Padang City, as a community representative body formed by residents, carries out activities to improve human resource capacity and quality. One of the developmental initiatives is the Kapalo Banda Ecotourism area, as it has potential for being ecotourism destination. The site is traversed by a clear river, which artificially formed into pool for water recreation activities. It is also surrounded by rice fields and farms, harboring a variety of plant species that serve as natural food source for insects such as honeybees.

The development of Kapalo Banda Ecotourism in Limau Manis Urban Village requires multi-stakeholder involvement and continuous support from higher education institutions. Multi-stakeholder participation in ecotourism development is strategic for ensuring sustainability, with in accordance contribution of theirs (Priyanto & Nugraha, 2021). Higher education institutions serve as provider of strategic role through research, education, and community service, helping local communities develop ecotourism destinations based on natural and cultural potential (Putri & Suryana, 2020). One form of this contribution is environmental management and conservation training conducted collaboratively with non-governmental organizations (Wardhani & Hidayat, 2021).

Universities can also assist communities in building sustainable ecotourism business models, including financial management and digital marketing, to reach a broader market (Yusuf & Kurniawati, 2022). Additionally, research-based mentoring can help identify local uniqueness, which serves as a key attraction for tourists (Santoso & Rahman, 2020). The involvement of the private sector, government, and universities in ecotourism fosters cross-sector collaboration that supports economic and environmental sustainability (Handayani & Susanto, 2021). With continuous mentoring, ecotourism not only enhances the well-being of local communities but also protects biodiversity as a long-term asset (Widodo & Arifin, 2022). To strengthen the role of higher education institutions in accelerating the development of Kapalo Banda Ecotourism, the main priority issue identified within the Community Empowerment Institution of Limau Manis Sub-district is to improve local knowledge and skills. Additionally, community members are supported in the stingless bee keeping (locally called as *Galo-galo*) as an icon of Kapalo Banda Ecotourism.

The stingless bee keeping (Meliponiculture) is an emerging creative economic initiative that widely developed (Leonhardt, 2017). Stingless bees in Indonesia have various regional names, including *kelulut* (Kalimantan), *klanceng* or *lenceng* (Java), and *te'uweul* (Sunda), while in West Sumatra, they are commonly known as *galo-galo* (Inoue et al., 1985; Erniwati, 2013). The stingless bee keeping offers some benefits, such increasing household income through the sale bee products, enhancing agricultural crop production, and supporting the pollination of wild plants (Herwina et al., 2021). Additionally, it serves as an educational medium and a honey-based ecotourism attraction. The primary challenge faced by the Limau Manis Community Empowerment Institution as a partner is how to involve multiple stakeholders and ensure continuous mentoring from higher education institutions in developing stingless bee-farming based ecotourism in Kapalo Banda Ecotourism. Upon identifying key issues related to this challenge, it was then prioritized to implement the breeding of stingless bee through community service activity. This initiative will be supported by multiple stakeholders and higher education institutions in a continuum basis to foster the development of Kapalo Banda Ecotourism.

METHOD

The Community Service activity was in collaboration with LPM UNAND to pioneering the ecotourism based on stingless bee breeding and took place in Puncak Labuang, Padang, West Sumatra. It has been undertaken following the stages of: 1) Local initiation, mainly focus on socialization and education of local partners for holding and maintaining the colonies of stingless bee by promulgating the knowledge on potential feed plants and establishment the stubs for stingless bee colonies; 2) Guidance and planning for positioning the stingless bee colonies; 3) Placement of stingless bee colonies during night time; 4) Introduction of stingless bee species, colony parts, and its general care; 5) Focus group discussion with multiple stake holders including university; 6) Preparation for colony propagation using various types of bee traps; 7) Placement of traps around the ecotourism area; 8) Training on harvesting, safety standards, and hygiene; and 9) Training on post-harvest bee product processing.



Figure 1. Documentation of initial meeting with the Head of the Community Empowerment Institute (LPM), the Village Head of Limau Manis, and the Secretary of Pauh Subdistrict resulted in strong support for establishing a partnership with Universitas Andalas

RESULTS AND DISCUSSION

Community service activity was conducted to assist local partners in Kapalo Banda area, Limau Manis Village, Padang whom mainly consisted of household industry. The activity involved a dedicated team constitute of graduate students and lecturers from Universitas Andalas that provided training and assistance to the local community regarding proper stingless beekeeping techniques. The training covered various aspects, including site selection for stingless bee colonies, hive construction, and post-harvest processing. The initiative was supported through the provision of various essential beekeeping needs, such as procurement of bee hives, acquiring stingless bee colonies, and planting nectar-

producing plants. During the awareness session, two stingless bee species were nominated for meliponiculture in Kapalo Banda area. They are *Geniotrigona thoracica* (galo-galo Rimbo or jungle stingless bee) and *Heteritrigona itama* (Kelu Beruang or bear stingless bee). The awareness team further educated the participants regarding the importance of environmental conservation and the economic benefits of meliponiculture. The summary of community service activity can be seen in Table 1 below.

Table 1. Activity series of the community service in the Kapalo Banda area

No.	Activity	Result	Remark
1	Preparation for the placement of stingless bee colonies	The activity was carried out successfully	The activity coordinated with the local community
2	Relocation of stingless bee colonies to Kapalo Banda area	It went smoothly	The relocating process was commenced during night
3	FGD, education, and planting of various plants for food sources, in cooperation with the government officials (Head of Subdistrict and Village Chief)	The activity was full with enthusiasm where many new of knowledge and insights presented	Presented knowledge and skills were perceived useful for the program
4	Inspecting the condition of stingless bee colonies during the adjustment period	The activity was performed successfully	This process was needed to ensure the adaptability of stingless bee to new environment
5	Exhibiting of stingless bee products at Universitas Andalas Auditorium	It was attended by visitors from academicians, students, and others	The activity purposed to highlight stingless bee honey as health supplement to boost immunity
6	Coordination with the Secretary of Pauh Subdistrict and local youth leader to conduct education and socialization activities on meliponiculture in Kapalo Banda area	Coordination with relevant parties was established	It was part of the preparation for education and socialization activity
7	The implementation of community service activity at the meliponiculture site in Kapalo Banda area, Limau Manis, Padang, West Sumatra	It went well	The activity was attended by the officials of Pauh Subdistrict, local community, academicians, local and international (Pakistan) students of Universitas Andalas

Government Stakeholders

The government authority plays important role in developing Kapalo Banda agro-ecotourism. Some key roles and contributions of the government in this activity include: Legal Formal for Activity Permits, Active Participation and Principle of Sustainability. For Legal Formal for Activity Permits, the awareness activity should be approved and permitted by governmental authorities. Since the location for awareness activity was near

river basin (daerah aliran sungai or DAS in Bahasa) which classified as disaster-prone area, a legal formal administrative approval is required for sustaining of community-based activity in long-term).

Active participation from government officials in community awareness activity is crucial for the success of program, which in this program started since the program initiation and socialization of stingless bee cultivation. The active involvement of government was evident through the presence of their representative in awareness activities held in Kapalo Banda area, where the head of subdistrict, village chief, neighborhood and community leaders (Rukun Warga or RW and Rukun Tetangga, respectively in Bahasa). The presence of a member of Padang City Council that represent Limau Manis electoral area, also strengthen this purpose (Figure 2).

Principle of Sustainability was dealing with the importance of maintaining healthy, green, and beautiful environment. Meliponiculture contributes to environmental preservation by ensuring a clean habitat for stingless bees, replanting barren lands with various plant species as food sources which making the surroundings greener. It means a rich food source for stingless bees that improve the productivity of its colonies. The Subdistrict Head expressed her commitment to facilitate the downstream process of stingless bee products. A representative of Limau Manis electoral area in Padang City Council, who also attended, expressed his hopes that this activity would achieve the improvement of productive and heighten the economy of local community. He emphasized that the initiative should be formally institutionalized so that it holds accountable to involved stakeholders. As well that a partner group should be formed and officially registered for securing a decree from Village Office, ensuring its legal status. Legal recognition of the group is essential, as prerequisite for proposing various of governmental assistance.



Figure 2. Documentation of Initiation and Socialization of Program with Various Potential Stakeholders for the Development of Kapalo Banda Ecotourism

University's Community Service Team

Community service team from Universitas Andalas take important part in the development of Kapalo Banda ecotourism by providing training and assistance for the local community partner in handling stingless bee-keeping. Some activities have been done to improve knowledge and skills of local community in meliponiculture, which consisted of several stages: 1) Feasibility Assessment for Stingless Bee-keeping Site; 2) Bee Colonies Arrival and Placement and 3) Training for Hive Construction to Propagate Colonies. The 1th,

for Feasibility Assessment for Stingless Bee-keeping Site, the community service team has previously surveyed Kapalo Banda area to assess its feasibility for meliponiculture and decided that it meets the requirements for this purpose. Some supporting factors identified therein (Figure 3), including the diverse array of flowering plants and food sources (either cultivated plants or wild ones), abundant clean water sources, road access for transporting colonies into location, availability of site for colony placement, and the willingness to cooperate in partnership from the landowner.



Figure 3. Site visitation and survey at Kapalo Banda Ecotourism. Local partner (in green shirt) is the landowners who accommodated the establishment of meliponiculture therein

Second, Bee Colonies Arrival and Placement. During the survey, local partners were educated regarding the arrival procedure of stingless bee colony, which typically conducted at night. The members of partner community were advised to assist the transporter of stingless bee colonies to reach the placement site which previously designated to. The predesignated placement site has been surveyed for its feasibility for colony placement and taught to local partner, i.e., the percentage of sunlight penetration, degree of shading, inter colony distance, the direction of the nest entrance when the hive erected, and materials used for constructing the colony stands. Upon knowing survey results, the local partners were guided to build colony stands by using in site material, such as river stones and rocks (Figure 4).

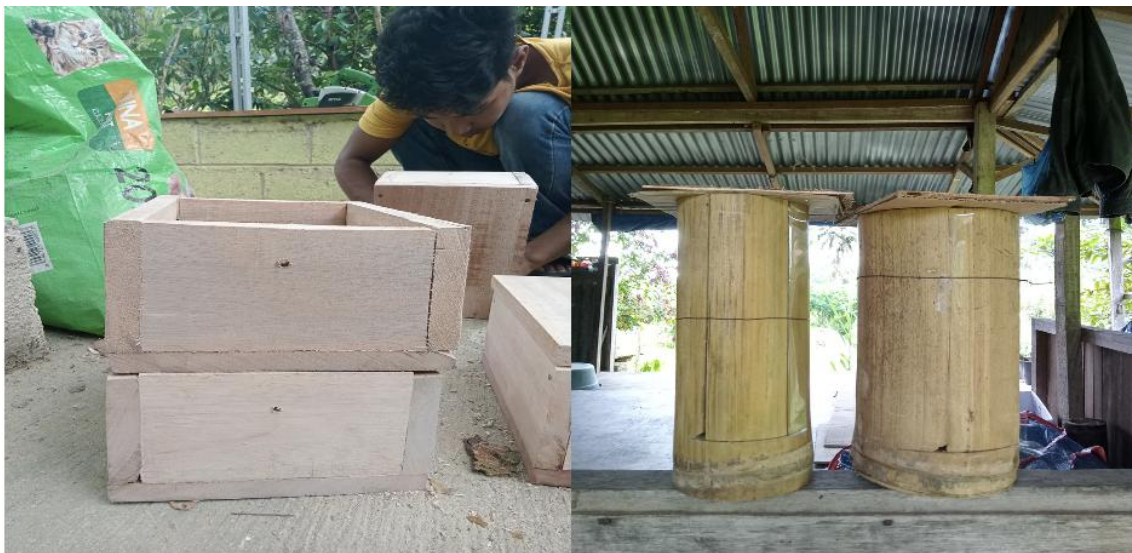
Third, the Training for Hive Construction to Propagate Colonies. There were four activities conducted during the stage of stingless bee colony propagation at Kapalo Banda area: 1) Hive Construction (trap); (2) Trap Installation; (3) Monitoring of Trap Installation and Results; and 4) Honey Harvesting Practice.

Training Stage for Hive Construction to Propagate Colonies

First, Hive Construction (Trap). Practical training on hive construction was conducted to improve the skills of partner members. The hives were designed to trap natural colonies from the wild as well as to anticipate the splitting colonies from those already established on site. Two types of materials were used to construct the hives: wood (for square-shaped hives) and bamboo (for cylindrical-shaped hives). Despite the bamboo is locally abundant, partner members were still trained to build both wood and bamboo hives. The outcome of this practical stage was square hives made from wood and cylindrical hives made from bamboo (Figure 5a and 5b respectively).



Figure 4. Preparation for stingless bee colony arrival and placement. a. Colony stand is made from river stones as recommended from the initial survey made at Kapalo Banda area. b. The placement of stingless bee colony atop the constructed stand



(a)

(b)

Figure 5. Practical training on making hive/traps using bamboo and wood with local partners during the community service activity at Kapalo Banda area. (a) Square hive made from wood, (b) Cylindrical hive made from bamboo

Second, Trap Installation. This stage constituted of two steps, i.e., (a) Location selection, (b) Selection of trap installation points. For the first step, partners were provided knowledge on how consider the best site putting trap, such as the presence of worker bees visiting plants at the site. If worker bees were around, the installed traps were likely to attract colonies. The training was also given on how to install trap at safe points, ensuring they were free from disturbances, protected from weather conditions, and located in areas with abundant nectar and pollen sources. The practice on this stage was conducted by partner members resulting in the improved community skills and knowledge, which in turn contributing to local economic sustainability and the conservation of biodiversity at places, such as on residential houses (Figure 6a) and on trees (Figure 6b). The installed traps can be seen on a house or on a tree (Figure 6c and 6d, respectively).



Figure 6. Trap installation at several locations in Kapalo Banda area: (a) On a partner's house, (b) On a tree, (c) Trap installed on a residential house, (d) Trap installed on a tree.

Third, Monitoring the Results of Trap Installation. During monitoring phase, the installed traps were inspected regularly at onterval of every 15 days. The number of traps with stingless bee colonies was recorded. Within 30 days of istallation, two traps were found to contain *H. itama* colonies. For another month, the two traps were fully inhabited by *H. itama*: one colony had established itself and suffice, while the other one was still an early-stage colony and quite unstable (Figure 7a and 7b respectively). This situation signals the need to keep monitoring the colony condition while giving education and training for local partners so the colonies can be successfully maintained.



Figure 7. Results of trap installation at the partner location which inhabited with *Heterotrigona itama* colonies: (a) Trap with robust colony; (b) Trap with underdeveloped and early-stage colony

Fourth, Honey Harvesting Practice. This stage introduced the local partners with harvesting tools and hygiene standards that require the cleanliness of equipment used which affects honey quality. The harvesting should be better conducted in the morning (before 10 AM) and in the afternoon (between 4:00 PM and 6:00 PM). During practice sessions, local partners were introduced to the types of pots found in the topping cavity of stingless bee hives, different types of honey pots, and how to select riped honey pots for harvesting. The use of a vacuum harvesting tool was demonstrated and directly practiced by the members of local partner (Figure 8).



Figure 8. Harvesting practice for stingless bee honey using the vacuum method

Honey harvesting is a critical stage in apiculture that affects the quantity and quality of the honey produced and plays a significant role in the sustainability of bee populations and the overall health of ecosystems. The practices employed in honey harvesting, particularly for stingless bees, necessitate an emphasis on proper hygiene, technique, and timing. Hygiene is paramount in the apiculture industry, directly influencing the quality of honey produced (Jones, 2005). Contaminated harvesting tools can introduce bacteria or fungi, which affects honey's flavor, texture, and storage life. The importance of these hygiene practices can be referenced from the work of human health standards established by the World Health Organization (WHO), which emphasizes the necessity of clean equipment in food production.

The community service activity also involved student volunteers from Student Executive Board of the Faculty of Mathematics and Natural Sciences at Universitas Andalas (FMIPA UNAND). Their participation was due to the resemblance of their awareness program (i.e., eco-enzyme) with this community service activity. Hence, they take part in the downstream processing of stingless bee products which have potential for accelerating the processing of organic waste at Kapalo Banda area into eco-enzyme products.

CONCLUSION

It can be concluded that the continuous guidance is essential to ensure the local community to use and maximize their local potential. The development of stingless bee keeping (meliponiculture) in Kapalo Banda area possesses great opportunity for success if carried out in collaboration with respective stake holders, including in achieving the production and downstream processing of meliponiculture products. Furthermore, greater collaboration with micro, small and medium enterprises (MSMEs) and other institutions is needed to expand the downstream processing of products.

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