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Integrated Dairy Goat and Stingless Bee Farming Based on Dual-Purpose Forage Plants to Strengthen Household Food Security in a Women Farmers Group

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ABSTRACT

This community engagement program aimed to strengthen household food security and improve the technical capacity of the Nuhairun Women Farmers Group (WFG), locally known as Kelompok Wanita Tani (KWT) Nuhairun, in Patalangan Village, West Sumatra, through integrated dairy goat and stingless bee farming based on dual-purpose forage plants. The group consisted of 10 active female members who had prior experience in small-scale livestock and stingless bee cultivation, but their management practices remained traditional and less productive. The program focused on improving dairy goat management, stingless bee colony maintenance, hygienic honey harvesting, and the cultivation of dual-purpose forage plants, particularly Calliandra calothyrsus and Clitoria ternatea, which function as both goat feed and nectar sources for the bees. Infrastructure support included improved goat housing, additional hives, and forage planting. Training on farm management and the Business Model Canvas (BMC) was also provided to support product development and household agribusinesses. The program improved members' technical skills, enhanced production consistency, and improved access to nutritious food at the household level. This integrated farming model has strong potential to support sustainable rural food systems and strengthen women's participation in community-based agribusinesses.

Keywords: beekeeping, dairy goat farming, dual-purpose forage plants, food security, zero hunger

INTRODUCTION

The Nuhairun Women Farmers Group (WFG), locally known as Kelompok Wanita Tani (KWT) Nuhairun, was established in 2021 in Patalangan Village, Limau Purut, Padang Pariaman Regency, West Sumatra. The group consists of 10 active women members who manage household farming and livestock activities. This group was initiated to improve the productive use of household land and strengthen family food security using local agricultural resources.

Before implementing this community engagement program, KWT members were already involved in small-scale livestock and stingless bee cultivation (Ratni et al., 2024). Baseline conditions showed that members collectively owned approximately four Peranakan Etawa (PE) goats, one local cattle, native chickens, and more than 50 stingless bee hive boxes, mainly consisting of Tetragonula laeviceps and Heterotrigona itama

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colonies. However, goat feeding practices were still based on naturally available grasses without structured ration formulation, while bee colony management and honey harvesting were conducted conventionally and irregularly, respectively.

Dairy goats are important components of smallholder livestock production systems in tropical countries (Navarrete-Molina et al., 2024), including Indonesia, where they contribute significantly to household income, nutrition, and sustainability (Widyastuti et al., 2023). Among the breeds raised in Indonesia, Peranakan Etawa (PE) goats are a significant dual-purpose breed, valued for both milk and meat production, and are widely maintained in smallholder farming systems (Sujarwanta et al., 2024). PE goats are a crossbreed developed from Jamnapari and local Kacang goats, combining good milk production potential with strong adaptability to tropical environments. Therefore, PE goats are considered one of the most suitable breeds for rural household dairy systems in Indonesia.

Stingless bee cultivation (meliponiculture), locally known as galo-galo in West Sumatra, is an emerging household-based agribusiness with economic and ecological benefits (Leonhardt, 2017). In Indonesia, stingless bees are known by various regional names, including kelulut in Kalimantan, galo-galo in Sumatra, klanceng or lenceng in Java, and te'uweul in Sunda (Inoue et al., 1985; Erniwati, 2013). In addition to producing honey with nutritional and functional value, stingless bees play an important role as tropical pollinators, supporting agricultural productivity and local biodiversity. The cultivation of galo-galo also provides opportunities to improve household income through the sale of honey and other bee products (Herwina et al. 2021). In this program, the integration of dairy goat farming and stingless bee cultivation was based on efficient shared resource use rather than direct biological mutualism. This resource-based integration relies on dual-purpose forage plants, particularly Calliandra calothyrsus (Kaliandra) and Clitoria ternatea (Telang), which function as high-quality goat feed (Sutedi, 2014; Nurjannah et al., 2019) and as nectar sources for stingless bees. This approach supports feed availability, pollinator activity, and the long-term sustainability of household farming systems.

This program aimed to improve household food security by increasing access to fresh goat milk as a source of animal protein and to honey as an energy-rich functional food. In addition, the program was designed to strengthen women's technical skills in goat and stingless bee management, improve farm infrastructure, and support sustainable household-based agribusinesses.

METHOD

This community engagement program was implemented using a participatory and capacity-building approach to strengthen integrated dairy goat and stingless bee farming practices among members of the Nuhairun Women Farmers Group (WFG), locally referred to as KWT Nuhairun. The program was conducted in several structured stages, including baseline assessment, technical training, infrastructure support, practical application, mentoring and evaluation.

Baseline Assessment and Community Engagement

The initial stage involved field observations, group discussions, and interviews with members to identify existing farming practices, available local resources, and key challenges in dairy goat and beehive management. This stage also aimed to build awareness among members regarding the benefits of integrated household-based farming systems and to encourage active participation throughout the program.

Technical Training and Capacity Building

A series of training sessions and workshops were conducted to improve the members' technical knowledge and practical skills in integrated dairy goat and stingless bee farming. Dairy goat management training covered goat husbandry at different physiological stages, including kids, growers, pregnant, lactating, and dry goats, with an emphasis on feeding strategies, health monitoring, milking hygiene, and simple silage preparation using locally available forage. In addition, stingless bee cultivation training focuses on colony transfer and multiplication, hive maintenance, pest prevention, and hygienic honey harvesting and handling (Herwina et al., 2024). To support household-based agribusiness development, members also received business management training through the introduction of the Business Model Canvas (BMC), which helped them identify value-added product opportunities, customer segments, marketing channels, and simple business strategies (Ratni et al., 2022).

Technology and Infrastructure Support

To improve production efficiency and overall farm management, the program provided technological and infrastructure support tailored to the needs of the Nuhairun Women Farmers Group. This support included the improvement of dairy goat housing facilities to enhance animal comfort, ventilation, hygiene, and manure management. In stingless bee cultivation, improved hive boxes have been installed to support better colony stability, facilitate routine maintenance, and improve the efficiency of honey harvesting. In addition, dual-purpose forage plants, particularly Calliandra calothyrsus (kaliandra) and Clitoria ternatea (telang), were introduced and planted in the farming area. These plants were selected because they function as both nutritious goat feed and nectar sources for stingless bees, thereby supporting a more sustainable and integrated farming system.

Practical Application and Mentoring

Following the training sessions, the members directly applied the introduced technologies and improved management practices within their household farming systems. Practical activities included the preparation of balanced goat rations using locally available forage, silage production as a feed reserve for the dry season, improved milking hygiene and handling practices, routine hive maintenance, and hygienic honey harvesting. To ensure the effective adoption of the introduced practices, continuous mentoring and regular field visits were conducted throughout the program. These activities aimed to monitor implementation progress, identify technical constraints faced by members, and provide on-site guidance to support the sustainability of integrated farming systems.

Monitoring and Evaluation

Program monitoring and evaluation were conducted through regular field observations, group discussions, and participant feedback throughout the implementation period. The evaluation focused on changes in members' technical knowledge and practical skills, adoption of improved goat and stingless bee management practices, utilization of infrastructure support, and perceived benefits related to household food access and farming sustainability. This participatory monitoring approach allowed for the timely identification of challenges and supported continuous improvement during program implementation. Overall, the approach was expected to strengthen the long-term sustainability of integrated dairy goat and stingless bee farming among the members of the Women Farmers Group.

RESULTS AND DISCUSSION

Before the intervention, KWT Nuhairun members had already been involved in small-scale goat farming and stingless bee cultivation; however, their management practices were still conventional and less productive. Goats were mainly fed naturally available grasses without balanced ration formulation, and bee colonies were maintained in traditional hive boxes with irregular monitoring and harvesting. These limitations affect the consistency of both milk and honey production.

The program improved technical capacity through structured training and ongoing mentoring. Members were trained in dairy goat management across different physiological stages, including the kid, grower, pregnant, lactating, and dry periods. The training included feeding management, health monitoring, milking hygiene, and silage preparation using locally available forages. These activities improved the members' knowledge and confidence in managing dairy goats.

In stingless bee cultivation, the members received practical training in colony transfer, hive maintenance, pest prevention, and hygienic honey harvesting (Figure 1). This improved the consistency of colony management and reduced losses caused by poor hive conditions. The use of improved hive boxes also supported better colony stability and facilitated honey extraction (Herwina et al., 2024).



Figure 1. Training to members

To strengthen the sustainability of the integrated farming program, members of the Nuhairun Women Farmers Group were introduced to a Business Model Canvas (BMC) as a simple business planning tool (Figure 2). The BMC helped members identify key partners, including extension officers, local government, input suppliers, and resellers, while clarifying their value propositions, such as fresh goat milk, natural stingless bee honey, and healthy household products (Ratni et al., 2022). It also guided the members in mapping customer segments, marketing channels, production activities, cost structures, and potential revenue streams. Through this activity, members gained a better understanding of how to manage their farming activities, not only from a technical perspective but also as a more organized household-based agribusiness system. The BMC also highlighted the broader social and economic benefits of the program, including improved household nutrition, women's empowerment, additional income opportunities, and diversification of business.

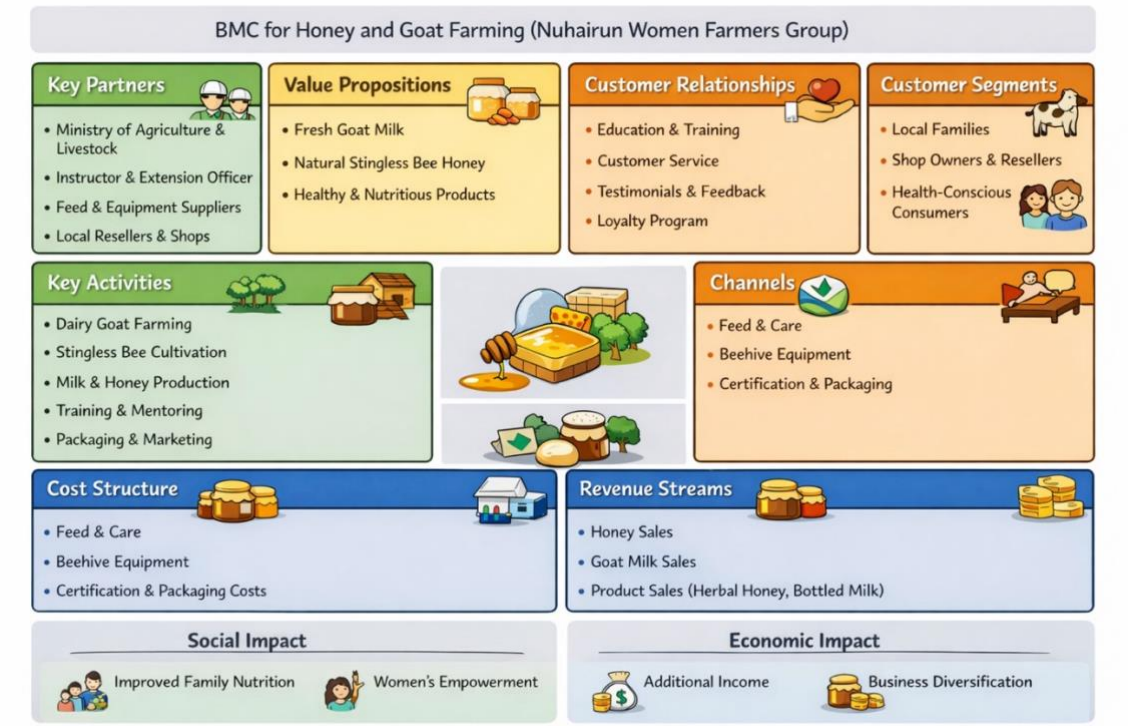


Figure 2. Business Model Canvas (BMC) developed for the Nuhairun Women Farmers Group to support integrated dairy goat and stingless bee farming.

Infrastructure support included the construction and improvement of goat housing facilities, installation of additional hive boxes, and planting dual-purpose forage species around the farming area. The goat housing facilities were designed to improve ventilation, cleanliness, manure management and animal comfort. Forage planting has helped improve year-round feed availability while supporting the nectar supply for bees. This integrated approach strengthens the sustainability of farming systems (Figure 3).



Figure 3. The dual-purpose forage as nectar supply for bees

Following the implementation of the program, members of the Nuhairun Women Farmers Group demonstrated an improved capacity to manage diverse household farming resources through the integrated dairy goat and stingless bee system. At the time of post-intervention monitoring, the group collectively maintained dairy goats, Peranakan Etawa (PE) goats, along with more than 200 stingless bee hive boxes consisting mainly of

Tetragonula laeviceps and several Heterotrigona itama colonies. In addition, members had access to household and communal land ranging from approximately 1,500 m^2 to 2 ha per person, which supported livestock raising, forage cultivation, and the future expansion of bee colonies. As part of the intervention, approximately 1,000 Calliandra calothyrsus and 1,000 Clitoria ternatea plants were established to improve year-round forage availability for goats and provide nectar sources for stingless bees. These results indicate that the program successfully strengthened the household farming asset base and improved members' readiness to sustain and gradually expand their integrated agribusiness activities over time. Although household income data have not yet been systematically recorded, members have reported improved access to nutritious food and increased motivation to maintain the integrated farming system. Similar community-based interventions have also been reported to improve household economic opportunities and strengthen rural livelihoods through better farm resource management and value-added product development (Herwina et al., 2025a, 2025b).

In addition to technical outcomes, the program strengthened women's participation in household agribusiness and collective decision-making. The program encouraged peer learning among members and increased awareness of the sustainable use of local resources. This integrated farming model demonstrates strong potential for replication in other rural communities with similar agroecological conditions, as shown in Figure 4.



Figure 4. The Integrated Farming Model

Impact and Sustainability

This community engagement program contributed to improved household food access and strengthened women's participation in household farming activities. Through improved dairy goat and stingless bee management, members gained better technical skills in livestock feeding, milking hygiene, honey harvesting, product handling and simple business planning. The use of dual-purpose forage plants also supports environmental sustainability by improving local feed availability and providing nectar sources for stingless bees. In addition to strengthening household resilience, this integrated farming model shows good potential for wider adoption in rural communities with similar agroecological conditions. The program also supports broader sustainable development efforts related to poverty reduction (SDG 1), household food security (SDG 2), and community welfare (SDG 3) (Kemendesa, 2021).

CONCLUSION

The integrated dairy goat and stingless bee farming program improved the technical capacity of the members of the Nuhairun Women Farmers Group in livestock and bee management, product handling, and simple agribusiness planning. The use of dual-purpose forage plants supported better feed availability for goats while also providing nectar sources for stingless bees, thereby contributing to a more sustainable household-based farming system. The program also helped improve household access to nutritious food through fresh goat milk and honey while strengthening women's participation in productive farming activities. Overall, this integrated farming approach shows strong potential to support household food security and sustainable rural livelihoods and may serve as a practical model for similar communities with comparable local resources and agroecological conditions.

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Conflict of Interest

The authors declare no conflicts of interest regarding the publication of this article.

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