

Stingless Bee Honey Farming and Farmer Empowerment in Sawahlunto City, West Sumatra, Indonesia

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Abstract. Stingless bee honey farming offers a sustainable agricultural practice that provides a natural sweetener and empowers smallholder farmers, especially in developing regions. This study, conducted in Sawahlunto City, West Sumatra, Indonesia, explores the socioeconomic and ecological benefits of stingless bee farming while identifying challenges faced by farmers. Interviews with farmers, local officials, and researchers revealed that honey production significantly enhances farmers' incomes, diversifies agricultural activities, and improves food security. Ecological benefits, such as enhanced pollination and biodiversity conservation, were also acknowledged. However, barriers such as limited technical knowledge, inadequate resources, and weak market linkages constrain broader adoption. The study recommends strengthening extension services, offering financial support, and developing cooperative marketing channels to address these challenges. These measures could help farmers capitalize on the rising demand for sustainable honey while preserving ecological balance. Policymakers and development organizations can harness the transformative potential of stingless bee honey farming to promote sustainable livelihoods and environmental stewardship.

1 INTRODUCTION

Stingless bee honey farming has emerged as a promising avenue for farmer empowerment, particularly in regions where traditional agricultural practices face challenges due to environmental and economic factors. These bees, native to tropical and subtropical areas,

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provide a reliable source of honey and play a crucial role in pollinating diverse crops, thereby enhancing agricultural productivity[5].

In Indonesia, for instance, the country's high species diversity of stingless bees, with an estimated 500-600 species, presents a unique opportunity for smallholder farmers to engage in sustainable beekeeping practices [6]. Stingless bees are known to be active throughout the year, collecting nectar and pollen from various plant species, making them valuable pollinators for multiple crops.

Stingless bee honey farming, known as meliponiculture, has gained traction in Southeast Asia to support sustainable livelihoods. The economic utilization of stingless bees in Asia has been reported for 60 species, providing a diverse range of products such as honey, propolis, and wax. The abundance of resin-secreting trees and the humid tropical climate in regions like Thailand and Malaysia, including Borneo, contribute to the greater prevalence of stingless bees in these areas. Stingless bee colonies are known for their complex social organization and diverse nesting habits, making them well-suited for small-scale, cost-effective beekeeping.[7]

The current status of meliponiculture, or stingless bee farming, in Southeast Asia, is primarily focused on the utilization of these bees for pollination services, and the production of honey and propolis [6][8]. [7] However, the region's transformation in recent decades has significantly impacted both wild and domesticated honey bee populations, posing challenges to the sustainability of these practices.[9]

Farmers in Indonesia, for instance, can leverage the country's high diversity of stingless bee species, estimated at 500-600, to engage in sustainable beekeeping and enhance their livelihoods. These bees are known to be active year-round, collecting nectar and pollen from a wide range of plant species, making them valuable pollinators for various crops. The abundance of resin-secreting trees and the humid tropical climate in regions like Thailand and Malaysia, including Borneo, contribute to the greater prevalence of stingless bees in these areas, further supporting their potential for small-scale, cost-effective beekeeping [8][6].

Stingless bee honey farming can be practiced in West Sumatra, Indonesia's former coal mining areas, where diverse local bee species can be leveraged to establish sustainable livelihoods [8][6]. The complex social organization and diverse nesting habits of stingless bees make them well-suited for meliponiculture, as their colonies can be managed cost-effectively by smallholder farmers [10][7][8]. However, the significant transformations that Southeast Asian societies have undergone in recent decades have severely affected both wild and domesticated honey bee populations, posing challenges to the long-term sustainability of these practices.

However, to address this challenge, farmers in Indonesia can leverage the country's remarkable stingless bee diversity, estimated at between 500 and 600 species, to establish sustainable beekeeping enterprises [6][8]. These stingless bees are active year-round, collecting nectar and pollen from diverse plant species, making them invaluable pollinators for a wide range of crops.

Furthermore, the favorable environmental conditions in certain regions, such as the abundance of resin-secreting trees and the humid tropical climate in areas like Thailand, Malaysia, and Borneo, contribute to the greater prevalence of stingless bees [8][6]. This regional concentration of stingless bee species presents an opportunity for small-scale, cost-effective beekeeping practices known as meliponiculture [7].

The current status of meliponiculture in Southeast Asia is primarily focused on using stingless bees for pollination services and producing valuable products like honey and propolis. However, the significant societal transformations in the region over the past few decades have severely affected both wild and domesticated honey bee populations, posing challenges to the long-term sustainability of these practices.

We studied the challenges of stingless honey bee farming in the Sawahlunto subdistrict of West Sumatra, Indonesia, which has a coal mining history. This region allows farmers to leverage the country's remarkable stingless bee diversity, estimated at between 500 and 600 species, to establish sustainable beekeeping enterprises.

Stingless honey bee farming technology is considered suited to small farmers and offers a promising avenue for empowerment.[6][8]. However, some issues arose around stingless bee honey farming in West Sumatra's former coal mining areas. For instance, environmental degradation from mining activities has affected the availability of suitable nesting sites and forage plants for stingless bees [8][6][7].

We investigate how stingless bee farming, or meliponiculture, can be implemented as a sustainable livelihood strategy to empower smallholder farmers in Sawahlunto City and what the socioeconomic challenges are.

Our study aims to track the history of stingless bee honey farming in Sawahlunto, identify involved actors, and discuss future challenges in stingless bee farming to empower small farmers.

2 THE METHODOLOGY

This study included desktop research and field visits to stingless bee farming communities in Sawahlunto. We employed qualitative methods such as interviews with local beekeepers, government officials, and NGO representatives to understand the region's socioeconomic and environmental dynamics of stingless bee farming [7][9].

Sawahlunto, a city in West Sumatra, Indonesia, is a former coal mining area that has undergone significant economic and environmental transformations in recent decades [10][8][7][9]. These changes have impacted the livelihoods of local communities, many of whom previously relied on coal mining. In this context, stingless bee farming, or meliponiculture, has emerged as a promising livelihood strategy to empower smallholder farmers and address the challenges of the region's mining history.

The diverse stingless bee species found in Indonesia, estimated between 500-600, offer a unique opportunity for small-scale, cost-effective beekeeping practices [1][11].

These stingless bees are active year-round, collecting nectar and pollen from various plant species, making them valuable pollinators for various crops [1]. After rehabilitation, the former coal mining land can be planted with several flowering species.

3 RESULTS AND DISCUSSION

3.1 History of stingless honey bee farming in Sawahlunto

In 2015, a honey entrepreneur named Heri started his business in Catur District, Sawahlunto. Heri is a graduate of Caltec Polytechnic who was inspired to become an entrepreneur. Previously, Heri had worked at the underground mine training center, but it did not last long. With courage, Heri pursued the honey business and finally switched to becoming a galo galo honey entrepreneur until now. He learned about developing honey from a friend in Pekanbaru. This business started with the difficulty of getting real honey easily, while the demand for honey in the market was relatively high.

Honey is needed, especially during the COVID pandemic. Realizing this, Heri continued to observe and then found out that in his area there are many honeybee hives whose development has not been paid attention to by the community. With the continued increase in market demand, the prospects for the honey business have become very extraordinary. In addition, the anxiety dominated/was taken over by Malaysians, so Heri and his friends began

to focus on producing galo-galo honey with the type of Torasika in the village of Santur Sawahlunto.

At the beginning of its development, namely in 2015-2018, galo-galo honey was considered by the community only as a pest, so it was not uncommon for people to cut down trees and burn these honey nests, then dismantle the nest and damage it. However, a few people have also learned that this honey is beneficial. Galo-galo was initially known as lanceng; many were nested on the walls. Galo-galo honey grew and developed in coconut trees and community gardens. At that time, the community had not tried to develop and preserve the honey they found.

Before 2018, Heri and his friend had not received financial support from any government or private sector party. Even so, with the number of hives/stuks of approximately 20 to 30 stuks, Heri proved that his honey harvest was successfully marketed. With low capital, honey can be sold at a reasonably high price. According to Heri, compared to the shallot business, which requires a longer harvest time (3 months), and the selling price is still low and fluctuating, it is more profitable to try galo-galo honey. This then encouraged Heri to continue to study and develop Torasika-type galo-galo honey in the area where he was located. Honey colony stalks must be maintained and protected from predatory disturbances such as lizards, ants, or exposed plastics so that honey develops appropriately.

Some areas where galo-galo honey is developed include Cialang village, which received assistance from Walghi, Kubu Tarok village, and Pematang Panjang, with a group program by the Provincial Government. In the village of Santur, 72 colonies also developed with the help of village funds. Then, in Kajai Village, in the fragrant lemongrass group, there were 30 stuks. Furthermore, three villages have been contacted and developed: Kubang and Taratak Bancah villages and Balai Batu Sandaran (BBS). According to Heri, of the many types of galo-galo, the one that produces more is the Torasita type, which develops a lot in Sawahlunto. From 1 hive/stub, it can be harvested after two months and produce a harvest of 3 liters of honey/harvest.

Torasika can also grow on jengkol and hazelnut plants. Two pecan-producing villages, Tabancah Village and Kajai Village, can be mixed with propolis to make hair oil. In Balai Batu Sandaran (BBS) village or Kajai Village, there are 30 colonies. During the durian season, honey also develops well. Meanwhile, the demand for colonies continues to increase, with as much as 3000- 3500 kg of colonies for honey-seeking companies/CVs in various regions. To be sent to Medan and Lampung alone, more than 1000 colonies from the Sijunjung area. Honey entrepreneurs successfully met the market demand in Sawahlunto, Itama, and torasika honey. So far, business actors are trying to find a natural colony, where torasika nest and live on hollow trees. However, if people are allowed to continuously cut down trees overgrown with honeycombs, they are afraid of putting pressure on nature to interfere with its preservation. To overcome this, honey was tried to be cultivated with the help of humans or breeding and used in an incubator. Unfortunately, this effort has not been successful.

In 2018, the local government became interested in Heri's crops. Cooperation with the local government began when Heri was asked to provide material at the agriculture office. Furthermore, in March 2020, the Head of the Agriculture Office and the local government offered cooperation (MOU) for 5 years. Heri and the local government agreed to work together to develop an orchard, a former coal mine land. Heri is obliged to bring guests related to galo galo to visit the orchard.

Furthermore, Heri is required to deposit 5 percent into the APBD. At the beginning of the opening, this land was only planted with dragon fruit; now it has developed a variety of fruit and vegetable plants, as well as several galo-galo Torasika honey stuck as an educational tourism vehicle in Sawahlunto. All of Heri's obligations were fulfilled, succeeded in bringing in visitors and even received an offer of assistance from the forestry service to develop other

types of stinging honey, but have not been fulfilled at this time for fear of disturbing the comfort of visitors to the orchard. The emergence of various offers of assistance while production costs were relatively low at that time made Heri think about downstreaming honey products.

In 2020, PTBA offered assistance in developing Heri's honey business. Heri's science continues to develop; by observing the condition of the honey products produced, it is known that the product has several weaknesses, such as the quality of the product is somewhat dilute, with a high moisture content of 28- 32 percent, foamy, so it is difficult to send it outside the province. Then, by learning various techniques to reduce moisture content, Heri finally founded The Home, an engine room and vacuum cylinder used to reduce the moisture content of honey by evaporation. The cost of making the home amounted to 7 million rupiah, which came from PTBA. Homemade honey reduced its moisture content by about 20 percent; from 28-30 percent to 19-20 percent, with an evaporation process lasting for 3 days.

The homemade process also reduces weight by 20 percent. Initially, the market suspected homemade honey to be a mixed honey product. The selling price of homemade honey and natural honey remains the same. The market price of Rp 400 thousand has resulted in very high profits. Meanwhile, the demand for honey continues to increase, and home honey is increasingly in demand because of its high quality. The beneficiaries of assistance for processing homemade honey, are around 45 people. The use of the home uses a queue system. The results obtained reached 10 liters/day and were processed for 3 days. The high honey production has successfully distributed 10 thousand monthly colonies to the community. Then the Head of the Service tried to inform this honey abroad, but different honey flavours in community groups constrained the export problem. The price of honey in the community continues to decline to 150 thousand / kg. All of this is because the quality of honey in the community is not maintained.

Heri himself has succeeded in sending honey of around 100 liters/2 months, where the weight of 1 liter

= 1.2 kg, and sells it diluted. To be sent to the agent is at least 10 kg, and the market always absorbs the harvested honey. The wage spent on harvesting 1 liter of honey is 20 thousand rupiahs, but the bookkeeping does not exist yet. The demand for honey continues to grow, and Singapore is a regular buyer. The obstacle is that it must meet the amount of 1 ton to be shipped to Singapore, continuously. That amount is rather difficult to meet continuously because the yield of honey depends on nature. In addition to the demand for honey, the demand for colonies continued to increase, so production became the focus of the business at that time. The demand for colonies is relatively high for the market in Lampung and Bengkalis, reaching 1000 kg. Although it is still sold at retail and depends on demand, all honey production products are successfully marketed.

Some of the assistance provided by PTBA includes exhibitions held 2 to 3 times a year. Other aid is in the form of training and partnerships. In 2021, Heri received PTBA's assistance to train in Tanjung Enim, with 2 of his friends. Furthermore, he participated in training in Jakarta. PTBA also finances travel expenses and pocket money. In the same year, Heri became acquainted with one of the honey processors into derivative products, named Ika.

Furthermore, Heri collaborated with Ika to downstream honey into honey soap, propolish, and honey coffee. Initially, this product was branded Cupiang, but then it changed its brand to Bee Awak. In 2023 the 'Minang Honey' brand, from the provincial government, changed to the 'Bee Awak' brand. The local government does not cover honey with the brand 'Mining Honey'. With a lot of demand from outside, but if you can't maintain quality, it is worried that it will damage the Minang brand. This brand is under the authority of Koperindag. The lack of guidance from the local government, problems between agencies, and lack of coordination made the Minang honey brand unclear and floating, and finally, the 'Bee Awak' brand appeared, under the guidance of PTBA. Meanwhile, the Provincial Government's

target program of 3000 kg of honey markets must go through the Head of the Head of the Head of the Head of the Regional Office, so that the Regional Government does not feel underestimated.

PTBA assistance is also given in the form of exhibition activity facilitation, PTBA provides 1 stand/outlet measuring 3x4 meters which is mainly filled with honey products with the product brand 'Bee Awak'. So, various downstream product packaging is made for 50 products each. PTBA asked to remove the forestry service cooperation brand, so there was a misunderstanding about the forestry service. Then, PTBA brought its guests to the exhibition so that all the products could be sold out. The effect of the exhibition is that all honey in West Sumatra can be accommodated. 4 MSMEs from Sawahlunto were successfully selected from 90 MSMEs that were contested.

In 2022, PTBA again provided assistance amounting to 5 million rupiah. The assistance was used to buy printers and barcodes. Since the export demand is for organic products, Heri must also immediately take care of the organic certificate of his product so that it is suitable for export. The sale of honey is not only in person, by sending it to the market, but also online, by packaging the product.

PTBA also often facilitates Heri in taking part in various trainings. Then Heri held 2 Field Schools by bringing a team as a resource person companion. Finally, Heri's knowledge spread widely. Here's fostered honey business actors, who are more than 20 people. According to Heri, the mindset of people who want to sell quickly without improving quality must be changed immediately. Heri has disseminated Heri's knowledge and experience as a honey entrepreneur to the surrounding community inside and outside Sawahlunto. Heri has conducted quite a lot of coaching, especially with members of farmer groups in Sawahlunto, totaling 14 and 11 members of farmer groups outside the city.

Around 30 to 60 participants also attended the training that Heri has given. Imran is one of his assisted farmers who won the honey competition. Even though it is priced at 150 thousand/kg at the farmer level, it is very profitable from the capital spent. With the training provided by Heri, many honey farmer entrepreneurs in Sawahlunto have developed. Heri teaches about honey cultivation and the marketing strategy of galo-galo honey. So that in the future, they can produce their brand and create jobs.

Another training that Heri participated in was organized by the Province of West Sumatra, where Heri was asked to be a resource person. In Bangka Blitung, honey has been successfully produced as much as 3-4 tons per month. This is also supported by the quality of honey products in Tanjung Enim, which tends to be uniform. Meanwhile, in West Sumatra, honey products vary in product quality. Nevertheless, Torasika Honey is a well-loved honey, with good quality and a high market. Heri managed to send products to West Java and joined the Honey Association. For propolis products, 20 to 40 kg can be produced from Sawahlunto. Honey products use very minimal chemicals because the surrounding area is also an organic plant. However, the party from Singapore reported that there are still high levels of terpenoid chemicals. In response, the Head of the Forestry Service asked to search for the plants that caused this.

In 2023, PTBA will continue supporting product marketing exhibitions, even facilitating exhibitions at Sarinah malls in Jakarta. The visit of guests from various countries, such as Spain and Singapore, makes the honey market even more wide open. Demand is increasing, and honey must be available consistently. Seeing the development of the market and high demand, PTBA plans to expand this honey production class, with several conditions that must be met, namely the existence of a production house and BPOM standardization.

Furthermore, Heri has been very active in sharing his knowledge and experience as a honey entrepreneur with the surrounding community. He has conducted coaching for more than 20 people, including members of farmer groups in Sawahlunto and outside the city [12][13].

The training provided by Heri has significantly impacted the development of honey farmer entrepreneurs in Sawahlunto.[14][15][16][15] He teaches about honey cultivation and marketing strategies, enabling the farmers to produce their own branded products and create jobs.

Heri's knowledge and experience as a successful honey entrepreneur have been in high demand.[15]He has been invited as a resource person for various training programs, including one organized by the West Sumatra Province.

Heri's efforts have also gained recognition beyond Sawahlunto. He was invited as a resource person for a training organized by the West Sumatra Province, showcasing his expertise. Furthermore, Heri's honey products have found their way to markets in West Java, and he has even joined the Honey Association. Torasika Honey, a product from Heri's region, has gained popularity for its high quality and strong market demand [14].

While the honey produced in Sawahlunto varies in quality, Heri's diligence in improving his products has paid off. On the other hand, the honey from Tanjung Enim tends to be more uniform in quality, with production reaching 3-4 tons per month in Bangka Belitung [17].

3.2 Involved Actors and Their Roles

As previous efforts have shown, the stingless bee honey industry in Sawahlunto has seen significant progress through the collaborative efforts of various stakeholders [14][17]. PT Bukit Asam (PTBA), a state-owned coal mining company, has played a pivotal role in supporting and empowering the local honey farmers. PTBA, as the company is known, has consistently provided financial assistance and capacity-building opportunities to the Micro, Small, and Medium Enterprises (MSMEs) engaged in stingless bee honey production.

Through PTBA's facilitation, farmers like Heri have been able to upgrade their operations, investing in essential equipment like printers and barcode scanners to ensure their products meet export standards. PTBA has also organized training sessions and field schools, equipping Heri and his fellow honey entrepreneurs with crucial knowledge and skills in honey cultivation, processing, and marketing strategies.

Heri, in turn, has emerged as a champion for the local honey industry, leveraging the support he received to scale up his own business and, crucially, share his expertise with fellow farmers.

Through the Forestry Service, West Sumatra Provincial Government is also actively involved along the way, lending their expertise and oversight, working closely with the honey producers to investigate the elevated terpenoid levels found in the honey and devise strategies to mitigate this challenge.

The increasing demand for Torasika Honey, a well-regarded local brand, and the growing interest from international markets have further fueled the momentum behind the stingless bee honey sector in Sawahlunto. Honey farmers like Heri have seized these opportunities, expanding their production and diversifying into complementary products like propolis, which can yield 20 to 40 kilos.

3.3 Opportunity and Weakness

While the honey from Tanjung Enim has a more uniform quality, reaching up to 3-4 tons per month in Bangka Belitung, the honey produced in Sawahlunto varies in quality. Nevertheless, Torasika Honey, a local brand, has gained a strong reputation for its high quality and market demand [18][19]. This creates an opportunity for the Sawahlunto honey producers to capitalize on the growing popularity of their products and expand their reach.

Heri reveals there are weaknesses and opportunities for capturing a larger market. There is a considerable demand for honey from foreign countries, and they are willing to pay

premium prices for high-quality products [20]. The local honey has received positive feedback from Singaporean buyers, but the elevated terpenoid levels detected in some batches must be addressed. The West Sumatra Provincial Government has stepped in to help investigate the issue and work with farmers to find solutions [16]. The current problem is that the quality may not meet the international standard, being from smallholders and being accumulated into single export-ready batches consistently. To capture the lucrative international honey market, local producers must focus on improving their products' overall quality and consistency through better production practices, storage, and processing methods [1].

Despite the challenges, the stingless bee honey industry in Sawahlunto presents significant opportunities for farmer empowerment and economic development. The increasing demand for high-quality, locally sourced honey domestically and internationally provides a strong market incentive for producers to invest in upgrading their operations [21][14].

4 Conclusion and Recommendations

The development of stingless bee farming in Sawahlunto city in post-coal mining time represents a significant opportunity for farmer empowerment and livelihood diversification in the region. The pioneering efforts of entrepreneurs like Heri have demonstrated the potential of this industry to create jobs, generate income, and foster sustainable rural development.

Through the support and facilitation of entities like PT Bukit Asam (PTBA) and the West Sumatra Provincial Government, honey producers in Sawahlunto have been able to access the resources, knowledge, and tools necessary to grow their businesses. Heri's journey, in particular, showcases the transformative impact of targeted interventions as he has transitioned from a small-scale beekeeper to a respected industry leader, sharing his expertise with fellow farmers and expanding his product reach to markets beyond his local region.

The popularity of Torasika Honey, a locally sourced brand that has gained recognition for its high quality, further underscores the growing demand for authentic, artisanal honey products. This domestic and international demand presents a compelling opportunity for the Sawahlunto honey producers to scale up their operations and capture a larger share of the lucrative honey market.[22][23]

However, the varying quality of honey from the Sawahlunto region remains a challenge that must be addressed. The elevated terpenoid levels detected in some batches have raised concerns about meeting international standards, and the local producers must focus on improving overall quality and consistency through better production practices, storage, and processing methods.

The West Sumatra Provincial Government's involvement in investigating the terpenoid issue and working closely with the honey farmers to find solutions is a positive step towards ensuring the long-term sustainability and competitiveness of the local honey industry [24]. Strengthening quality control measures, implementing standardized processing protocols, and providing additional training and support to the honey producers will be crucial in overcoming this hurdle and positioning the Sawahlunto honey as a sought-after product in both domestic and global markets [14][1].

The diversification into complementary products like propolis presents another avenue for honey farmers to expand their revenue streams and further capitalize on the rising demand for natural, health-conscious alternatives [25][14]. As the stingless bee honey industry continues to grow, the Sawahlunto honey producers must also explore strategies to ensure the traceability and authenticity of their products, bolstering consumer confidence and brand loyalty.

With the right interventions and support, the stingless bee honey farming in Sawahlunto can serve as a model for farmer empowerment and sustainable rural development, showcasing how traditional agricultural practices can be elevated and integrated into the modern economy[9][7]. Partnerships with research institutions and government agencies will be crucial in developing best practices, improving quality control, and identifying new market opportunities [26][14][24][1].

Ultimately, the success of the Sawahlunto honey industry will depend on the honey producers' ability to consistently deliver high-quality, traceable products that meet the evolving preferences of both domestic and international consumers. By investing in research, technology, and capacity building, local honey farmers can position themselves as leaders in the emerging stingless bee honey market, driving economic growth and creating a more sustainable future for their communities [7][9].

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