The Best Practices of Stingless Bee Farming in Kapuas Hulu Regency, West Kalimantan Province, Indonesia

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Abstract. Utilization of non-timber forest products can provide income for the community. Through the Forest and Climate Change Programme – Financial Cooperation Module (FORCLIME - FC), communities in 15 villages in the Kapuas Hulu Regency, West Kalimantan Province began developing stingless beekeeping in 2017. The purpose of this study were to measure the success rate of beekeeping and obtain the best practices for stingless beekeeping. Currently the community is developing 544 boxes of stingless bee colonies (Apidae: Apinae: Trigona) which colonies were obtained from forests in each village. From a number of these colonies, the success rate was 65%. This success depends on the location of cultivation, the technique of extracting and distributing colonies from the forest, and the maintenance process when the colonies have been moved.

1. Introduction
Kapuas Hulu Regency in West Kalimantan covers an area of 2,984,199 Ha, with 72% of it is forest area [1, 2]. Most of the population of 258,984 people [1] inhabits the area around the forest. Therefore the use of forest resources has become part of their daily lives. Generally they use fruits, medicinal plants, unprotected hunted animals, and honey. Generally they use fruits, medicinal plants, unprotected animals, and honey.

Kapuas Hulu is the largest supplier of forest honey in the province of West Kalimantan, especially honey from *Apis dorsata* bees. The development of stingless bee (kelulut) honey in Kapuas Hulu also has good opportunities, although not many people know about it. Naturally, stingless bee colonies can be found making nests on tree trunks in forest or community fields.

The Ministry of Environment and Forestry through the FORCLIME FC program has promoted the cultivation of kelulut honey in Kapuas Hulu Regency in an effort to improve the economy of the communities in the assisted villages and maximize the sustainable use of NTFPs.

In 2017, the kelulut honey NTFP demonstration plot was built in Tanjung Intan Village, Mentebah District, Kapuas Hulu Regency. The development of this demonstration plot was considered successful because it was able to provide additional income for the community. This prompted 14 other villages to start cultivating kelulut in 2018.

Communities in 15 assisted villages of FORCLIME FC have never before cultivated stingless bee. Thus, before starting bee farming practice independently, the community was given training in Selaup Village, Kapuas Hulu Regency and the Padang Tikar Village Forest Management Institute (LPHD) in Kubu Raya Regency. Even though they have been equipped with basic knowledge of stingless bee farming, they have also developed their own knowledge based on the experience they gained in the field.
This brief study aims to inventory the knowledge obtained by the community during stingless bee farming activity and calculate its survival rate.

2. Method

2.1. Location

Stingless bee farming was carried out by 15 villages in the REDD+ Demonstration Activity Area of FORCLIME FC Program in Kapuas Hulu Regency.

| Sub-district     | Village                      | Initial Time  |
|------------------|------------------------------|---------------|
| Embaloh Hulu      | 1. Ulak Pauk                 | August 2018   |
|                  | 2. Saujung Giling Manik     | December 2018 |
|                  | 3. Banua Ujung              | August 2018   |
|                  | 4. Pulau Manak              | December 2018 |
|                  | 5. Banua Martinus           | August 2018   |
|                  | 6. Tamao                    | August 2018   |
|                  | 7. Manua Sadap              | August 2018   |
| Batang Lupar      | 1. Labian                   | August 2018   |
|                  | 2. Mensiau                  | August 2018   |
|                  | 3. Sungai Ajung             | August 2018   |
|                  | 4. Sungai Abau              | December 2018 |
| Mentebah          | 1. Tanjung Intan            | December 2017 |
| Boyan Tanjung     | 1. Nanga Boyan              | August 2018   |
|                  | 2. Teluk Geruguk           | September 2018|
| Bunut Hilir       | 1. Entibab                  | December 2018 |

2.2. Procedure

Data collection was done by conducting interviews. The selection of informants by purposive method with criteria of involvement in the stingless bee farming activities in the village, consisted of farmers and village facilitators of the FC FORCLIME program who accompanied the implementation of the activities.

Questions asked in interviews about the technique of extracting colonies in nature, transporting them to cultivation area, maintenance, and harvesting locations; problems obtained in the field; and efforts to overcome these problems.

In addition to the interviews, observations were also made of the cultivation sites and the bee hive. This observation is important to clearly describe the conditions and cultivation practices that have been carried out.

3. Result and discussion

The implementation of the FORCLIME FC program aims to reduce greenhouse gas emissions from the forestry sector while increasing the livelihoods of Indonesia's poor rural communities. One form of its activities in Kapuas Hulu Regency is to encourage people living around the forest to develop non-timber forest products as their new livelihood. The potential of NTFPs is explored by the community through forest patrol activities that are routinely carried out by the assisted village community. Stingless bee is considered capable of being developed because the communities often find their nests.
Table 2. The number of beehives found in the forest during community patrol

| Village              | Patrol path length (km) | 2016 | 2017 | 2018 | 2019 | Total |
|----------------------|-------------------------|------|------|------|------|-------|
| Ulak Pauk            | 18.8                    | 0    | 2    | 1    | 4    | 7     |
| Saujung Giling Manik | 11.2                    | 0    | 0    | 0    | 0    | 0     |
| Banua Ujung          | 21.6                    | 0    | 0    | 0    | 2    | 2     |
| Pulau Manak          | 9.2                     | 0    | 0    | 1    | 0    | 1     |
| Banua Martinus       | 16.1                    | 0    | 0    | 6    | 0    | 6     |
| Tamao                | 69.2                    | 0    | 0    | 2    | 1    | 3     |
| Manua Sadap          | 43.8                    | 0    | 0    | 4    | 1    | 5     |
| Labian               | 18.1                    | 0    | 0    | 0    | 0    | 0     |
| Mensiau              | 17.23                   | 2    | 1    | 3    | 0    | 6     |
| Sungai Ajung         | 20.73                   | 0    | 0    | 6    | 3    | 9     |
| Sungai Abau          | 13.32                   | 0    | 0    | 0    | 4    | 4     |
| Tanjung Intan        | 15.1                    | 0    | 1    | 1    | 0    | 2     |
| Nanga Boyan          | 5.49                    | 0    | 0    | 8    | 3    | 11    |
| Teluk Geruguk        | 10.98                   | 2    | 0    | 5    | 0    | 7     |
| Entibab              | 5                       | 0    | 0    | 0    | 0    | 0     |
| **Total**            | **295.85**              | **4**| **4**| **37**| **18**| **63**|

All cultivated stingless bee come from forest areas. The results of this patrol showed only a small part of the general stingless bee hives they encountered because villagers often find the stingless bee hives outside the patrol path, but the location is not recorded.

The FORCLIME FC program facilitates this stingless bee farming activity by providing grant funds for the supply of tools and materials such as the cost for collecting stingless bee colony from the forest, wooden hives and harvesting equipment. The program targets 600 nests in 15 villages.

3.1. Bee Farming Process

Bee farming activities carried out by the farmer consist of a series of processes, including survey of stingless bee hives in forest, beehive extraction, transportation to the cultivation location, maintenance, and harvesting.

The first activity is survey stingless bee hives in forest and fields. The hives can be found on the trunks or branches of any tree species, both living and dead [3]. Some species also live in the soil. There are at least 29 types of kelulut bees on Kalimantan Island [4], but they only cultivate three three species: *Geniotrigona thoracica* (kelulut menyan), *Heterotrigona itama*, and *Tetragonula laeviceps* (kelulut damar) for these species are easier to find in the forest.

**Figure 1.** Nest entrance of *Geniotrigona thoracica* (A), *Heterotrigona itama* (B), and *Tetragonula laeviceps* (C)
Extraction of the stingless bee nest by first cutting down the nesting tree. Next, the part of the nesting tree is broken down to take only the nest and then moved to the hive box (transfer system) or simply cut the base and the end of the nesting stem or branch about 30 cm from the nest entrance (log system). In the log system, the end of the log will be cutted to the edge of the brood section so that the bee immediately builds a new honey pot in the hive box. The box or log is then transported to the cultivation site in the afternoon or evening of the same day or the next day. The active time of the stingless bee is generally at 7:00 to 18:00 [5], so that when it is transported at night all the bee have returned to the nest.

Beefarming practice is located in the garden or in the house yard of the community. The hive boxes are grouped in one shed or placed under a tree stand. The box is made of boards with various box sizes. In the log system, the bottom of the box is equipped with a hole measuring 15 cm x 15 cm as a link between the log and the box. Especially for boxes that are placed under stands, the cover is equipped with a tin roof or a board wrapped in flexy or vinyl (used banner). Beehives shed are made of wooden blocks with a tin roof.

Figure 2. Bee farming locations: under the canopy stand (A) and in the artificial shade (B)

The next step is to maintain the beehives from pests such as ants, lizards, spiders, birds, and frogs. The pest will eat the bees, except the ants that are targeting the brood cells. To avoid ant attack, a cloth soaked in lubricating oil is tied up on wood that supports logs and shed. On general, the farmers do not make a specific schedule for treatment, but they often visit the farming location and check the hive boxes at least once a week.

The stingless bees are generally foraging in the forest or fields around the farming location. The species of forage plants in the forest are not fully known by the community, but some species that are often visited by bees such as durian flowers, mangoes, and rubber tree. Farmers also enrich feed plants by planting various flowering plants around the cultivation area such as caliandra, coral vine, and sunflower.

Harvesting can be done 6 months after the colonies nest in the nest box, yet farmers usually harvest in the flowering season which generally occurs at the beginning of the rainy season. Harvesting is done by tearing the honey pots and sucking the honey contained in it with a honey suction pump. The honey is then filtered and packaged in 100 ml and 250 ml volume bottles.

3.2. The Best Practices of Stingless Bee Farming in Kapuas Hulu
F ORCLIME FC program targets the cultivation of 600 hive boxes, unfortunately this number is not met. Farmers have actually collected the stingless bee nests from the forest as many as 740 colonies, gradually. However, only 65% of these colonies survived in the hive boxes (Tabel 3). There are several factors that are suspected to cause the colony left the box, which is improper extraction technique and the time of transporting the nest from the forest to the farming site, the farming location is not suitable and lack of maintenance (Figure 3).
Table 3. Survival rate of stingless bee colonies in 15 villages in Kapuas Hulu Regency

| Villages               | Number of colonies | Target | Collected from forest | Survive | Survival Rate (%) |
|------------------------|--------------------|--------|-----------------------|---------|-------------------|
| Ulak Pauk              | 35                 | 35     | 25                    | 71.43   |
| Saujung Giling Manik   | 35                 | 35     | 33                    | 94.29   |
| Banua Ujung            | 35                 | 45     | 34                    | 75.56   |
| Pulau Manak            | 35                 | 44     | 38                    | 86.36   |
| Banua Martinus         | 35                 | 44     | 37                    | 84.09   |
| Tamoa                  | 60                 | 103    | 57                    | 55.34   |
| Menua Sadap            | 60                 | 60     | 30                    | 50.00   |
| Labian                 | 35                 | 40     | 28                    | 70.00   |
| Mensiau                | 60                 | 92     | 52                    | 56.52   |
| Sungai Ajung           | 35                 | 35     | 7                     | 20.00   |
| Sungai Abau            | 35                 | 47     | 35                    | 74.47   |
| Tanjung Intan          | 35                 | 51     | 20                    | 39.22   |
| Nanga Boyan            | 35                 | 39     | 25                    | 64.10   |
| Teluk Geruguk          | 35                 | 35     | 31                    | 88.57   |
| Entibab                | 35                 | 35     | 29                    | 82.86   |
| Total                  | 600                | 740    | 481                   | 65.00   |

![Figure 3. Factors that cause colonies do not survive in the beehive boxes](image)

Through the training of stingless bee farming in Kubu Raya regency, farmers in Kapuas Hulu began to implement the transfer system as was done by LPHD Padang tikar. However, after the application of transfer system by farmers in Kapuas Hulu, this system was considered not suitable because many colonies left the box hives. When logs are broken down, the brood section is often damaged and will gradually rot or the queen is left behind while the nest is moved to the hive box. Furthermore, the most fatal mistake is to break one nest and moved it to several boxes. The practice of breaking up the colony was carried out by farmers in the Mensiau Village, as a result the colony was not formed in the kelulut box. In addition, this system is also more difficult because the stem needs to be broken again to get a nest in it. At present all farmers switch to the log system, even though they still apply the transfer system when extracting the stingless bee nest on decayed wood.

The location of cultivation also determines the success of stingless bee farming. The colony box needs to be shaded, both natural shade under the canopy of trees or artificial shade. This is important to prevent the nest from overheating. Generally the chosen location is shady and close to the garden or forest. Between the nest boxes need to be given a considerable distance. In boxes placed in artificial
shade, generally distance between boxes are less than 1 m apart, while under stands are 1.5 - 3 m apart. Some villages which their hive boxes were placed in shade such as Ulak Pauk, Pulau Manak, Banua Ujung, Labian, Tamao and Mensiau experienced failures because their stingless bees attacked each other due to the close distance. Each colony has its own scents, however the distance between the boxes that are too close can make bees lose their way and enter other colonies. This unexpected visitor may also be a robber which will take the store from other colony, this causes the robbed colony move to another place [6]. Some stingless bee species even called nest parasites because the queens are laying eggs in other bee’s nest (They are now moving most of their hive boxes under canopy. The boxes that are still in the shade are given enough distance from each other and the position of the boxes is adjusted so that the entrance between the boxes are not facing each other.

Some villages are often flooded in the rainy season that the farming area needs to be elevated. High mortality rates were obtained by farmers in Sungai Ajung Village because they did not consider putting the hive boxes in a flood-free area, resulting in 80% of the colony leaving behind the boxes and died submerged by flood. In Saujung Giling Manik Village, the colony box is placed at a high location (1.5 - 2 m from the ground) so that the colony can survive even when floods hit. In addition, farmers also need to really close the box tightly to avoid the nest being flooded when it rains.

Maintenance activities are important to prevent the colony from being attacked by pests. The most dangerous pest is the ant because it can make the colony leave the box if many brood cells are damaged due to its attack. Ant attacks generally occur in the initial phase after removal of the colony because the nest is still exposed. After the colony is able to adapt to the nest box, they will cover the brood section with layers of wax and resin so that the ant cannot enter. This layer is called involucrum which functions to protect the brood section and insulate it [7]. On the outside of this involucrum, they build soft wax pots for pollen and honey [8].

Even though many colonies left the hive boxes due to mismanagement in the beginning, farmers eventually were able to learn from mistakes and start producing honey with the remaining colonies. At least seven villages have now been able to harvest the honey. During 2018 until July 2019, honey production in the seven villages had reached 85 L (Figure 4), which was usually sold in bottles of 100 ml and 250 ml. Honey produced by stingless bee colony approximately 200 – 5000 grams per year [8]. The demand for kelulut honey at the regional level of Kapuas Hulu is quite high so that the honey produced by farmers already has its own market, in fact its production should be increased to meet all these demands.

![Figure 4. Honey production in seven villages](image)

The stingless bee cultivation in Tanjung Intan Village has a small survival rate (Table 3), but that does not mean they fail. This village is the first to cultivate the stingless bee and has gone through
various challenges so that they can produce lessons learned and best practices from it. Currently Tanjung Intan village has become a training location for other stingless bee farmers and students.

The next challenge of bee farming activity in these villages is the multiplication of colonies. Tanjung Intan pilot demonstration plot has already tried to create a new colony by tried by stacking the hive box with a new one and separating it after the boxes are full. Unfortunately this attempt failed, the colony was leaved the hive box after separation. All this time the multiplication of the colony was carried out by searching and collecting nesting from the forest, but this was quite risky considering the excessive use could cause the colony to run out in the wild. Because the source of the colony is obtained from nature, the community strives to protect the forest from damage to ensure the availability of colonies and forage in the future. Nevertheless, they still hoped and tried to master the multiplication technique of the colony so that they would no longer need to cut down trees to collect stingless bee nests.

4. Conclusion
Stingless bee farming is carried out in 15 villages in Kapuas Hulu Regency. The number of colonies targeted by the FORCLIME FC program to be cultivates is 600 colonies. The community has collected as many as 740 colonies with a survival rate of 65%. Many colonies left the hive box due to improper extraction technique and the nest transporting time from the forest to the farming site, the farming location is not suitable and lack of maintenance. From this mistakes, the lessons learned by farmers is better to use log system when extracting nests, transporting nest from forest to farming site is carried out at night when all the colonies have returned to it nest, and farming site needs to be from floodingin a place that is free from flooding and shaded with a distance between the boxes at least 1.5 m. A total of seven villages have succeeded in harvesting their honey with a total production of 85 L.

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