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Rubber plant agroforestry management by Dayak meratus Community as beeforage source of *Apis dorsata*

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Abstract

This research aims to analyze how agroforestry takes part significantly to preserve the availability sustainability of beeforage. The research is carried out in Ulang Village, Loksado Sub-district, Hulu Sungai Selatan Regency. The observation is held on toward some rubber plants cultivated in the agroforestry area where many beehives of *Apis dorsata* found there. The sampling data collected are all kinds of flowerous plants, flowering period, and types of plants. As a result, researcher found there were 13 kinds of flowerous trees which become beeforage. Beeforage is obtained from cultivated and natural plants. September, October, and November are the periods when almost plants are flowering. However, there will be a famine of flower in March, April and May.

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Introduction

Forest is a very beneficial natural resource. Human beings' behaviours in preserving and maintaining it become one of prime determinant for forest productivity. As we find generally in custom societies' life, Meratus Dayakese is one of many tribes who depends most of their livings on forest sources. For them, forest is really valuable not only economically, but also socio-culturally and religically. Moreover, forest is considered as a natural space where not merely various plants and animals live there, but the Dayakeses themselves also become inseparable part of the forest itself (Widjono, 1998). Local culture and tradition play important roles in forest preservation (Asante *et al.*, 2017).

The rubber plants cultivation has been developed by the dayakeses hereditarily. The planting of rubber plants and many kinds of fruity plants are advanced in no madden farming system two years later. (Fahriannoor *et al.*, 2013). Yet, some big trees remain growing as well. In some countries in Asia, the big tall trees remain existing (Laurance, 2007), especially those which become places for bees live.

The custom society of Dayak Meratus cultivates the rubber plants farming field with an agroforestry pattern. Besides the rubber plants as the major plants, the Dayakeses also cultivate some crops. When the rubber plants are still too young to be harvested, they plant some seasonal plants such as rice and vegetables. In accordance with Razak *et al.* (2016), the vary of plants grown together with rubber plants aims to increase the people's income without opening a new farming field.

The wild trees with wide size in diametre grow well and become the natural resources which give important benefits for Dayak Meratus society. One sample of the trees is Gala-gala tree (*Kompassia malaccensis)*. The tree grows strongly and very highly among the rubber plants in agroforestry cultivation and makes some bees of *apis dorsata* nest there. Many beehives are easily to find along the years. The villagers will take some advantages by harvesting the honey anually for self-consumptions or being marketed.

Bees may find the agroforestry plants to be the source of their food source. Bees can come to the flowers thousands times to gather nectar and pollen. During the process, bees will come in handy in plant's pollination process that results in increasing fruits of the plant (Dukku, 2013). To identify the plants which provide beeforage is primarily prerequisited in honeybees proliferation. (Abou-Shaara, 2014). The declining amount of vary of plants gives negative impacts to the amount of honey production. (El-Nebir *et al.*, 2013). Every region has particular period of bees' maintenance in accordance with the beeforage availability. The knowledge about plants that produce food for honeybees will have been valuable in working on bees' colony efectively during this period. (Bhalchandra *et al.*, 2014).

Therefore, the objective of this research is to identify the cultivation management system of rubber plants agroforestry grown the custom society of Dayak Meratus as the source of bees' foodstock. The plants grown in the agroforestry field are observed for their flowering period together with the availability of nectar and pollen so that the researcher can easily predict the period of honey exsistance in a year. The honey production obtained will be a recommendation for rubber plant agroforestry development in promoting honeybee cultivation.

Materials and methods

Time and Place

Field observation has been done since 2018. It is located in Ulang Village, the Sub-District of Loksado, Hulu Sungai Selatan Regency, Indonesia. The hive trees stretch on 2°47'14,95"S and 115°28'25,86"E. This location is a rubber plants agroforestry area.

Sampling and data collection technics

The trees where honeybees make their hives are observed from the radius of 1 kilometre. The route area of observation follows the points of compass, namely north, east, south, and west. The width of observation area is 20 metres The data collected are those from the vary of plants related to flowerous plant, flowering phase, and type of plants. Nectar and pollen sustainability is observed based on the

literature. Later on, the observation result will be used as a source in making flowering phase calender.

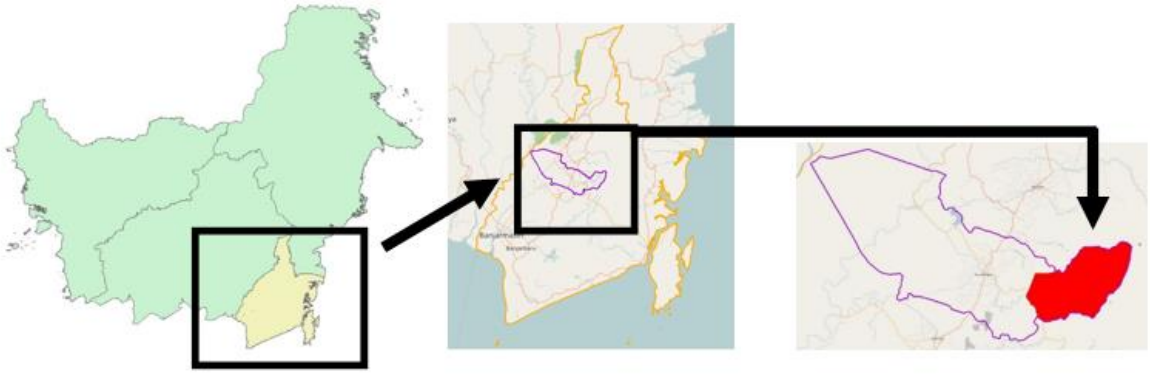

Fig. 1. Research Location Map.

Data analysis

The collected data are analyzed descriptively then presented in forms of graphs and tables.

Result and discussion

Variety of beeforage

Honeybees make use of surrounding plants as the source of beeforage. The trees with beehives are located in the area of rubber plants agroforestry cultivated by the dayakese society. The result of vegetative analysis shows that there are 13 varieties of plants providing beeforage. The plant varieties found at the plot area of observation are presented in Table 1.

Table 1. Plant varieties of plotted observation area.

No	Species	Family	Type
1	*Vitex pubescens*	*Verbenaceae*	Natural
2	*Elaeocarpus stipularis*	*Elaeocarpaceae*	Natural
3	*Artocarpus integer*	*Moraceae*	Cultivated
4	*Durio zibethinus*	*Bombacaceae*	Cultivated
5	*Baccaurea macrocarpa*	*Euphorbiaceae*	Cultivated
6	*Hevea brasiliensis*	*Euphorbiaceae*	Cultivated
7	*Lansium domesticum*	*Meliaceae*	Cultivated
8	*Ficus glomerata*	Moraceae	Natural
9	*Garcinia mangostana*	*Clusiaceae*	Cultivated
10	*Litsea sp*	*Lauraceae*	Cultivated
11	*Baccaurea motleyana*	*Euphorbiaceae*	Natural
12	*Peronema canescens*	*Verbenaceae*	Natural
13	*Eusideroxylon zwageri*	*Lauraceae*	Natural

The plant types found from the plotted observation area consist of 9 (nine) families. The plants type from Euphorbiaceae family is the largest amount with 23.08% findings, then followed by Lauraceae, Moraceae and Verbenaceae with 15.38% for each. Whereas the other families such as Bombaceae, Clusiaceae, Elaeocarpaceae, and Meliaceae are the smallest ones with only 7.69% for each. The description of precentage amounts of beeforage source providability Family is presented in Fig 2.

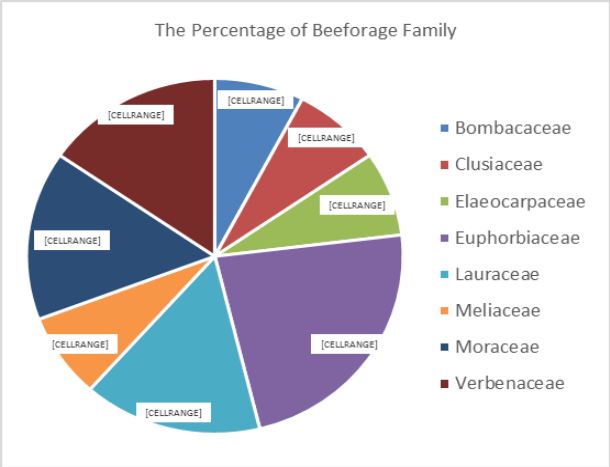

Fig. 2. The percentage of beeforage Family in Ulang Village.

The custom society of Dayak Meratus' living in Ulang Village deeply depends on the natural resources. The major livelihood of the people there is farmer/cultivator. Their faming fields are cultivated for some kinds of productive and beneficial plants to fulfil their daily needs both for commercial or traded and selfconsumption. From the survey of vegetative analysis, it is known that from 13 sorts of plants in observation plot, there are 53.85% of plants which are cultivated plants. While, the other 46.15% are plants that grow naturally (Fig. 3). The plants growing

naturally in the forest are not spontaneously diminished but preserved by the customs to maintain the forest function and the woods might be useful for any kinds of needs sometimes.

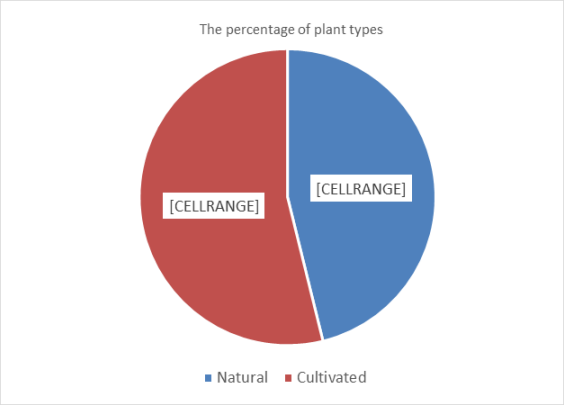

Fig. 3. The percentage of plant types with beeforage in Ulang Village.

The types of plants are selected based on the interest toward one particular plant type and the width of farming area provided. The interest toward a particular plant type is selected in relation to the beneficial aspects both after its harvesting such as its productivity and high rate of selling cost, and before harvesting such the easiness for preservation. In rubber plants cultivation, the writer finds any other types of flora besides rubber plants. This variants of plants, consisting of fruity plants are intended that before the rubber plants can be produced, the other kinds of plants can be worthy for the villagers to be harvested (Aryadi and Effendi, 2014). According to Anglaaere *et al.* (2011), the consideration of altered availability gives any related consequences on selected various types' value, means that the more benefits obtained the larger amount of the variants. On the other hand, the type characteristic is determined based on the easiness and simplicity of its preservation.

The trees where beehives grow located at the rubber plants farming field. In the cultivation area, there grows some fruity plants so that it forms a preservation system of rubber plants agroforestry. Having been stated by Aryadi and Effendi (2014), the Dayak customs create an agroforestry system at the rubber plants cultivation by combining rubber plants with any other kinds of productive flora such as durians and other fruity plants. The rubber plants cultivation is created by reopening unused farming field after around 2-3 years abandoned and considered not to be productive anymore. This rubber plants cultivation has been advanced approximately for 10 years.

Flowering calender

Bees needs source of nourishment deriving from flowers for their nectar and pollen. It is necessary to recognize the times when plants are flowering to keep the feeding source provided. Flowering phase for plants is known as flowering calender. It is the significant data providing any informations on the sustainability of bees' food source that in 12 months it is stated as flowering phase. From the observation, it is obtained that some potential plants to be the sources of beeforage have various flowering phase (Table 2).

The result of the observation on plants' flowering phase which becomes the food source for bee forest as presented on Table 1 shows that from 13 plants on the list have various periods or flowering phase. *V. pubescens* flower can be found at the season during January to December and this kind of flower produces nectar and pollen. *E. stipularis* can produce nectar and pollen during flowering phase from August to November. Another plant which produces nectar and pollen is *P. canescens,* whose its flowering phase takes place two times, namely in December-February and June-August. For cultivated plants, the varieties which produce nectar and pollen are *B. macrocarpa, H. brasiliensis* and *G. mangostana*. *B. macrocarpa* experiences flowering phase between September-November. On the other hand, *H.brasiliensis*' flowering phase will start between June-December. In addition, *G. mangostana*'s flower can be found between September-January.

Related to the result of observation, there have found 5 kinds of plants which only produce nectar, where 3 of them are produced by some wild plants growing naturally while the other 2 are by cultivated plants. The Wild plants producing nectar in this area are *F. glomerata*, *B. motleyana* and *E. zwageri*. The flower of *F. glomerata* variety can be found from November

to February. While, *B. motleyana* has a particular flowering period between September – January. On contrary, The flowering phase for *E. zwageri* tree is between September – December. Whereas, some cultivated plants that only produce nectar can be found on *D. zibhetinus* and *L. domesticum*. Durians' flowering phase happen between July – November. Moreover, *L. domesticum* produces flower in October – December.

Table 2. Flowering period of beeforage.

No	Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Source Type	Ref.
1	*V. pubescens*													NP	8
2	*E. stipularis*													NP	1,2
3	*A. integer*													P	8
4	*D. zibethinus*													N	9
5	*B. macrocarpa*													NP	10
6	*H. brasiliensis*													NP	13
7	*L. domesticum*													N	11, 13
8	*F. glomerata*													N	3, 8
9	*G. mangostana*													NP	14, 15
10	*Litsea sp*													N	4,5,11
11	*B. motleyana*													NP	12
12	*P. canescens*													NP	13
13	*E. zwageri*													N	6,7

Note: N= Nectar, P = Pollen, 1) Adhikari & Ranabhat. 2011, 2) PROSEA Timbers, 3)efloraofgandhinagar, 4) Ngernsaengsaruay, *et al*, 2005, 5) Rosmarlinasiah *et al*, 2015, 6) Wahjono & Imanuddin, 2011, 7) Fijridiyanto, et, al, 2011, 8) Rijal, *et al*, 2018, 9) Agussalim, *et al*, 2017, 10) Akhmadi & Sumarmiyati, 2015, 11) Muehleisen, 2011, 12) Khadijah, *et al*, 2018, 13) Jasmi, 2017, 14) Yanto, *et al*, 2016, 15) Sarwono, 2007

In the observation area, researcher finds there is a plant variety which only produces pollen, that is *A. integer*. It's flower can be arisen between September – October. The variation of nectar and pollen production by bees' foodstuff plants is shown at Fig. 4.

Fig. 4 shows that beeforage provided varies along the year and the amount availability from one month to another month does too. Some plants producing both nectar and pollen can be found along the year by 7 varieties of plants. The most period is from September to November produced by 6 plants. Then, there will be declining amount in December that there are only 4 varieties, while in January is only by 3 kinds of plants and February by 2 plants. In sequence, during March until May, the variety which produces nectar and pollen are only 1 plant. Increasingly on June, flowers which result in nectar and pollen lift up produced by 4 varieties of plants, so does in July, then rise up anymore in August by 5 plants.

Moreover, the varieties of plants which only produce nectar are sustainably provided from September that is only produced by 3 plants, whereas in October there is an increasing amounts becoming 4 plants and the top production will happen in November by 5 varieties of plants. Additionally, in December, flowering phase of plants producing nectar experiences a declining that is only produced by 3 kinds of plants. Different from December, in January and February remain only 1 plant whose flower produces nectar. Ironically in March, April and May, there is no single flower producing nectar found.

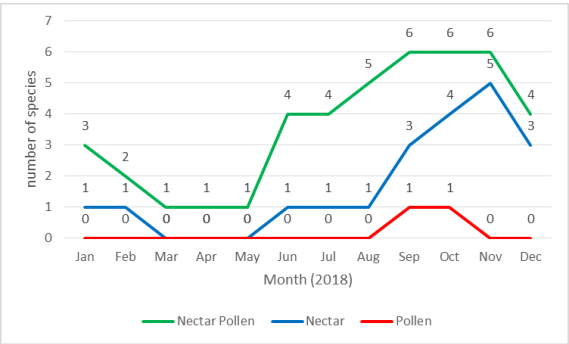

Fig. 4. The availability of beeforage based on period of months.

In this observation area, there are also some plants found that only produce pollen, but those plants belong to one kind of variety, namely *Artocarpus integer*. *A. integer* flowers between September to October. On trhe other sides, there are no pollen producer plants can be found from November to August in this location.

The observation result (Fig. 4) also shows that there is a famine phase where there is a single flower availabled to produce both nectar and pollen. From March to May is identified as a famine season of flowering phase. Whereas, January and February are the periods in which flowers grow decreasingly. The lack of flowers in this periods can give impact to the honey production declining and this will make the bees migrate to other places since the previous spot cannot provide the beeforage for them. However, bees will remigrate to the previous hives when their new migration area experiences a beeforage famine (Woyke *et al.*, 2012).

According to the available flowering calender, it can be identified that wild honey management needs a typical attention. In the season of flower famine taken place from March to May needs a worthy anticipation by planting any alternative plants which are able to produce flowers in the season. This planting program had better be done from the radii of 1 kilometre from the beehives' trees.

The alternative plants which are valuable to grow to provide any additional source of beeforage are Kaliandra (*Callyandra callothyrsus*) (NP), Coconut (*Cocos nucifera*) (NP), Lamtoro (*Leucaena glauca*) (P), Sugar Palm (*Arenga pinata*) (NP). These plants produces flowers along the years (Soemarno *et al.*, 2000). Kaliandra produces nectar and is well-known much to be cultivated for honeybees farming. The bright colour and aromatic smell of the honey produced by the Kaliandra become the reason why the consumers favor Kaliandra honey (Minarti *et al.*, 2016). Another source such as Lamtoro, can be found in the wet and dry highland circumstance. Moreover, Lamtoro is expectedly an alternative to provide some pollen for honeybees (Agussalim *et al.*, 2017). On the other hand, Coconut and Sugar Palm are eventually easy to be found in most Ulang Village area, but they grow to closely in the village area and far from the radii of beehives trees. Both kinds of plants can produce nectar and pollen along the years (Soemarno *et al.*, 2000).

The way to vary the plant types for the availability of bee forage for a year may cause the change of agroforestry patterns having been applied by the people. However, the plants can beneficially produce fruits, leaves, and other parts of plants. Moreover, it is recommended for people to cultivate other sorts of honey bee such as *A. cerana* and *Trigona* sp. which can be harvested monthly. The optimum utilization of plants production and the development of honey bee cultivation will give profitable impact for the villagers about the alternative source of their income.

Conclusion

Rubber plants agroforestry cultivated by the people of Ulang Village can promote the growth of *A. dorsata*, eventhough there happens a famine season of flowers. There are 13 kinds of trees which provide some beeforage which consist of 7 cultivated plants and 6 wild ones. Those kinds of plants can produce nectar and pollen for beeforage. The top periods of flowering season takes place in September, October, and November, while in March, April and May are the famine season of flowers. In the different months, flowering phase still can be found although in a very limited amount. Based on this research, it is considered to be important to have an enrichment or additions of flower types to reduce the risk of bees' migration at famine season.

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