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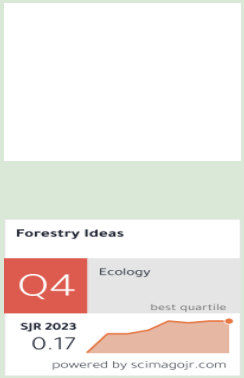

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ISSUES

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ORCHIDS OF BUZULUK PINE FOREST IN SOUTH-EAST OF EUROPEAN RUSSIA: DIVERSITY AND CONSERVATION ISSUES

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Abstract:

The data on orchid diversity of Buzuluk pine forest located in the South-east of European Russia on the border of steppe and forest-steppe zones have been summarised and updated. The occurrence of 12 Orchidaceae species can be reliably confirmed for this territory. This collection of species could be regarded as unique for such climatic and geographical conditions. Such a variety of orchids within the same Anatural site cannot be found anywhere else in Orenburg region, and in Samara region there are only few of similar locations. About half of the orchid species indicated for Orenburg and Samara regions are found in Buzuluk pine forest. Hemipilia cucullata and Hammarbya paludosa on the territory of Orenburg region and Corallorhiza trifida on the territory of Samara region are known only from Buzuluk pine forest. All the orchids found there are included in IUCN Red List. Four species are listed in Red Data Book of Russian Federation. Most of the species (except Epipactis helleborine) are in the regional Red Data Books, making up more than half of all protected species for each region. Orchids occur in localities near residential areas, in places visited by tourists, in the utility zone of the national park (where logging is carried out or may be carried out), in locations with unstable water regime, which may threaten their survival on this territory. All the orchids found in this woodland have at least one locality on the territory of Buzuluk Pine Forest National Park. The problems of the orchid conservation can be attributed to the insufficient knowledge of their populations (number, density, etc.), and the intensive development of oil production, tourism and recreation over the last decade.

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DEVELOPMENT OF COMMUNITY FORESTS AS LOCATIONS FOR HONEY BEE CULTIVATION BASED ON POTENTIAL FEED SOURCES: CASE STUDY OF MATARAM VILLAGE COMMUNITY FORESTS, INDONESIA

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Abstract:

Honey bee cultivation is predominantly practised in community garden areas, although honey bee cultivation in community forest areas, which are typically monocultures, is still uncommon. In order to sustain honey production, it is crucial to assess the availability of food sources for honey bees in community forest regions. This research is aimed at discovering the potential sources of honey bee food in the Mataram Village community forest in order to promote the growth of honey bee cultivation. From July to October 2021, this research was conducted in the community forest of Mataram Village, Gading Rejo, Pringsewu, and Lampung Province, Indonesia. On the study site, vegetation data were collected, and the results were then matched with honey bee feed literature. The density, frequency, and diversity analyses of plant species are utilised. 17 species of plants were identified as food sources for honey bees, including 9 types of nectar-producing plants, 8 types of pollen-producing plants, and 4 types of nectar-pollen-producing plants. Coconut have the highest relative density (RD) and relative frequency (RF) values. H' value is 1.874, the importance of plant diversity as a source of food for honey bees falls within the moderate range. To promote the growth of beekeeping in community forests with low species variety, it is vital to increase the number of plant species, so that bees have a year-round food source.

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Key words: beekeepers, biodiversity, insect visitor, private forests.

Introduction

Nowadays, the use of forest products is no longer limited to wood but has expanded to Non-Timber Forest Products (NTFPs). NTFPs were utilised for a variety of uses, including food, animal feed, traditional fiber medicine, agricultural facilities, household products, and construction materials (Talukdar et al. 2021)these products are used by a variety of purposes like food, fodder, fiber traditional medicine, agricultural amenities, domestic materials, construction materials, and the likes. Many traditional beliefs and cultures are also associated with these products. The present study was carried out in Patharia Hills Reserve Forest (PHRF. Honey is one of the NTFPs that is currently expanding and in demand among forest farmers, particularly on community forest holdings. Because to the present COVID-19 epidemic, honey

is one of the leading contenders for those seeking natural remedies that can maintain health and boost the immune system (Agus et al. 2021, Agussalim et al. 2021). Moreover, honey in high demand internationally and utilised globally (Hinton et al. 2020). Diverse honey beekeepers took advantage of this possibility, and community forest farmers cultivate honey bees in forest regions. Apiculture seen to be more advantageous, particularly for community forest farmers. The cultivations was not based on land, thus it will not compete with other forest plants. Moreover, honey bees serves as pollinators for many plants (Rachersberger et al. 2019).

The Omah Tawon Mataram (OTM) farmer group is one of communal forest farmers groups that pursued for honey bee apiculture. Initially, the OTM group has just kept honey bees on their backyard. OTM relocated honey bee cultivation to community forest land due to restricted space and food supplies. The objective was moving the position of cultivation, in order to given broad access of higher quality and quantity of food sources, resulting in increased honey production. Honey bee cultivation necessitates that the quality and quantity of honey bee feed were met. Absence of feed sources in honey beekeeping might lead to a decline in honey production, which will affected in negative influence on beekeepers' income (Agussalim et al. 2017).

Bees require nectar or pollen from a variety of woodland or beehive-area plants in order to survive (Nicolson 2011, Hermita 2013). The proximity of honey bee nests to nectar sources has a positive effect on the growth of honey bee colonies. Colony populations will expand and procreate more rapidly and will not relocate in search of food. The availability of alternative food sources, such as pollen, will enhance the quality of life of bee colonies and extend their lifespan (Ferdyan et al. 2021). Thus, beekeepers and managers must position honey bee colonies near food sources. Also, the availability of feed sources must be considered at all times. Plants that provide bee food must be able to produce nectar or pollen in a single year, thus the location of honey bee cultivation must also take into account the types of vegetation present. This study seeks to identify possible honey bee feed sources in the community forest of Mataram Village, Gading Rejo District, Pringsewu Regency, Indonesia, in order to assist the development of honey bee farming.

Object and Methods

This investigation was conducted in the OTM group's honey bee cultivation region in Mataram Village, Gading Rejo District, Pringsewu Regency, Indonesia (Fig. 1). The farming location is adjacent to a protected forest and the Way Sekampung River. This study was conducted between July and November of 2021.

This study was utilized both primary and secondary data sources. At the location of the cultivation of plants that have the potential to be a source of honey bee food, primary research data were collected. Using a 20-by-20-meter square area, plant species data was collected. The obtained plant data was later recognised using community-specific identities and plant determination keys. The results of the plant inventory were then compared to the list of bee food source plants that had been identified through a previous literature review. The acquired data were evaluated by calculating the density (D), relative density (RD), frequency (F), and relative frequency (RF), as well as the

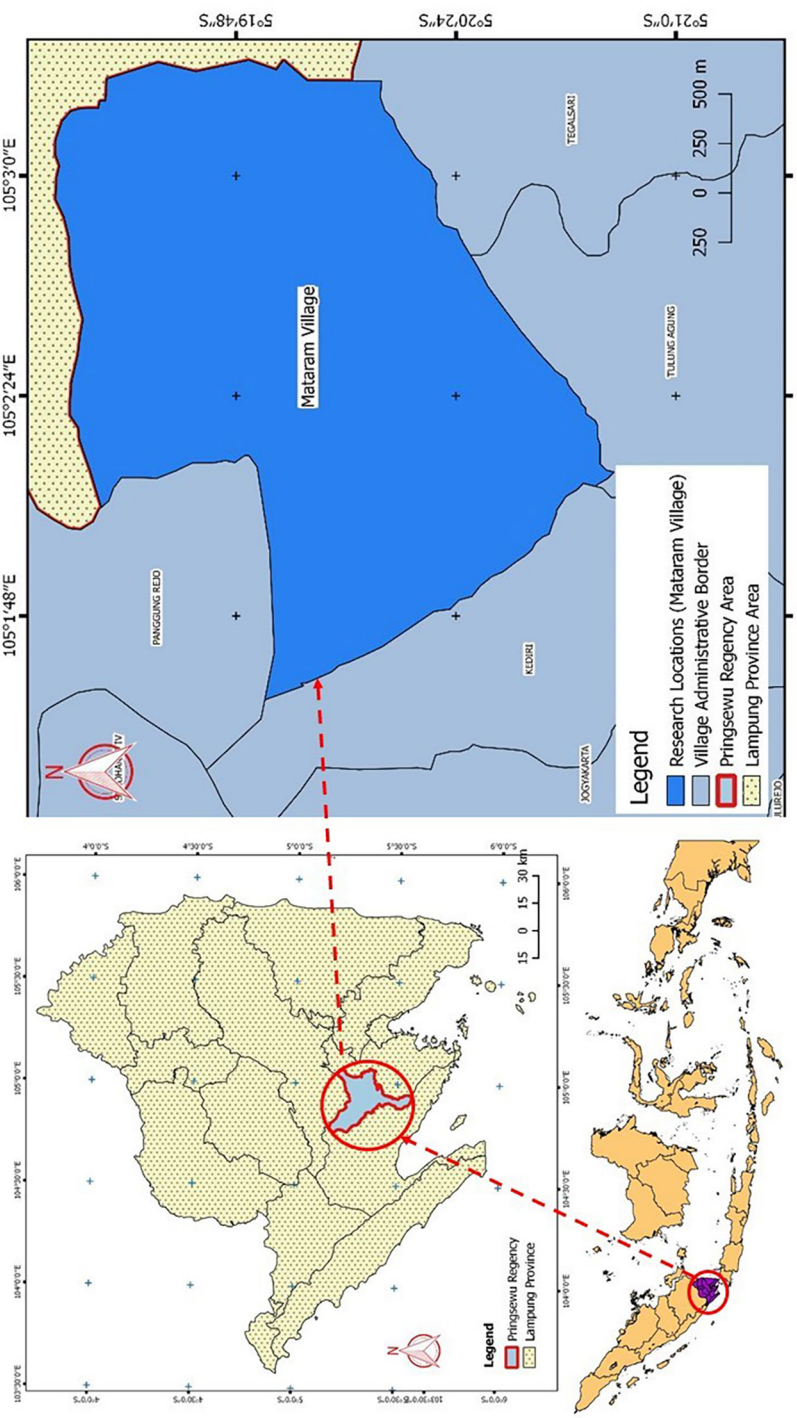

Fig. 1. Map showing the study area.

Shannon-Wiener diversity index (H'), in order to determine which plants have the potential to serve as a food source for honey bees.

Results and Discussions

Types of pollen and nectar-producing plants

According to field identification results, 22 tree species were discovered, with 170 individual trees making up the forest. Unfortunately, not all plants are honey bee food sources. Honey bees have dietary preferences, namely on the sorts of flowering plants from which nectar or pollen can be extracted. Diverse flowering plants provide as a food supply for honey bees, however certain flowering plants release secondary metabolites that serve as a defence for the plant but are harmful to some flower visitors. This also applies to honey bees, hence honey bees have a preference for nectar and pollen sources (Villalona et al. 2020, Seshadri and Bernklau 2021).

The study result showed that from total of 22 tree species were discovered in OTM cultivation area, 17 species are honey bee food source. 17 species belonging to forest commodities, plantation commodities and fruit crop commodities. Forest commodities are bungur (*Lagerstroemia speciosa* (L.) Pers.), waru (*Hibiscus tiliaceus* L.), jati (*Tectona grandis* L. f.), pulai (*Alstonia scholaris* (L.) R.Br.), sengon (*Albizia chinensis* (Osbeck) Merr.), laban (*Vitex pubescens* Vahl.), petai (*Parkia speciosa* Hassk.), jengkol (*Archidendron pauciflorum* (Benth.) I.C.Nielsen), petai cina (*Leucaena leucocephala* (Lam.) de Wit), sonokeling (*Dalbergia latifolia* Roxb.) and suren (*Toona sureni* (Blume) Merr.). The plantation commodities are kelapa (*Cocos nucifera* L.), kakao (*Theobroma cacao* L.) and karet (*Hevea brasiliensis* Mull.Arg.). The fruit crop commodities are pisang (*Musa acuminata* Colla), durians (*Durio zibethinus* L.) and mangga (*Mangifera indica* L.). Bees can receive nourishment from a variety of flowering plants (forest, agricultural, plantation, horticultural, and wild species), which produce nectar as honey, pollen, and propolis ingredients. Honey bees gather pollen and nectar from flowers to sustain their colonies (Hermita 2013, Oguntuase et al. 2020).

The study revealed that honey bees consumed only a portion of the nectar and pollen from 17 tree species. Many species of these plants have been reported (Table 1) (Agussalim et al. 2017, Irwansyah 2018, De Lima et al. 2019, Priambudi et al. 2021) as a food source for honey bees. Nectar is the primary source of nutrition for honey bees, in addition to their own energy requirements, as well as an important portion of their larvae's diet. In the meantime, pollen is required to give the proteins, lipids, vitamins, and minerals necessary for larval development (Nicolson 2011, Portman et al. 2021). This feed was essential for the survival of honey bee colonies (Njurumana et al. 2021). This helped honey bee cultivation and productivity. Honeybees gather nectar and pollen from flowers. The flower's base, stamens, ovules, stylus, crown, and other organs contain nectar (Batoro et al. 2022). Meanwhile, pollen was a single cell containing the microgametophytes of seed plants, which produce the male gametes (sperm cells) (Stephen 2014).

Table 1 shown that some of the plants taken from nectar and pollen are kelapa, bungur, pisang, and manga. While waru, jati, pulai, sengon, petai, durian, karet, sonokeling, and suren are taken for nectar.

Table 1. Tree species as a source of pollen and nectar.

No	Local name	Scientific name	Pollen	Nectar
1	Kelapa	*Cocos nucifera*	v	v
2	Bungur	*Lagerstroemia speciosa*	v	v
3	Waru	*Hibiscus tiliaceus*		v
4	Jati	*Tectona grandis*		v
5	Pulai	*ALSTONIA SCHOLARIS*		v
6	Pisang	*Musa acuminata*	v	v
7	Sengon	*Albizia chinensis*		v
8	Laban	*Vitex pubescens*	v	
9	Petai	*Parkia speciosa*		v
10	Kakao	*Theobroma cacao*	v	
11	Durian	*Durio zibethinus*		v
12	Jengkol	*Archidendron pauciflorum*	v	
13	Karet	*Hevea brasiliensis*		v
14	Petai cina	*Leucaena leucocephala*	v	
15	Sonokeling	*Dalbergia latifolia*		v
16	Mangga	*Mangifera indica*	v	v
17	Suren	*Toona sureni*		v

Laban, jengkol, kakao and petai cina only taken for pollen.

Kelapa has the most potential source of pollen and a source of nectar (Jasmi et al. 2021). Kelapa inflorescence was monoecious, with male and female flowers in each spadix. Kelapa spadix is 1–2 m long, with 30 or more rachillae about 30–55 cm long, and has 200–300 male flowers from top to bottom (Regi and Rajkumar 2013). The high potential for male flowers in one tree produces a lot of pollen, which means that the feed source in the form of pollen was well available. Besides being the source of pollen, kelapa was also known as the source of nectar. Nectar containing 9–12 % sucrose was produced from the receptive flowers (Jay 1974). Nectar was produced from septal nectaries and hydathodes and it is secreted the stigmatic surface (Narayana 1937). The use of coconut as main food source for bees was carried out by beekeepers in Papak Hamlet, Genggelang Village, North Lombok Regency, West Nusa Tenggara Province, Indonesia (Agussalim et al. 2017).

Bungur has beautiful flowers that was able to attract insects to visit. Crescent flowers were purple and arranged in panicles with the length range of 10–15 cm. Usually, crepe flowers were located in the armpits of the leaves or the ends of the branches. Bungur can flower two times a year, from late November to December and from May to June (Rahmah et al. 2021). Crescent flowers have flower nectar and pollen, which honey bees use as a food source.

Pisang inflorescences at the end of the stem, protruding from the end of the stem, were pseudo, drooping, semi-curtained or even erect. The flowers of this plant will fall because the bracts are not deeply indented, twisted together or pinnately erect. Pisang have nectar and pollen, which were taken by honey bees for food sources. Another plant used as a source of nectar by honey bees was sengon. Sengon plants contain blooming flowers that produced seasonal nectar, which honey bees used as a source of nutrition (Agussalim et al. 2017). During the rejuvenation of fallen leaves during the dry season, this flowering process began in March and April.

Petai has the potential of a bee food, but only when it blooms. This was due to the Petai flowering season, which lasts from June to October. There were flower in some nodules, each nodule has *bracts* that form whorls and join to form a cup like

structure called the cupula. Another plant used as a food source was durian. Climatic conditions influence the flowering season for durian plants. The flowers of this plant was arranged in a bowl-like arrangement on a stalk. Also, it has flowers of the same sex that bloom in clusters right off the stem or branches at the base.

Another feed source in the field was kakao. Kakao become one of the food source for honey bees in Salut Village, Kayangan District, North Lombok Regency, West Nusa Tenggara Province, Indonesia (Erwan et al. 2022). Kakao plants have cauliflory-type flowers, namely the growth of flowers from the axillary tufts of leaves on stems and branches. Kakao flowers are hermaphrodite flowers, having two sexes (pistils and stamens) in one flower. This kakao plant is associated and symbiotic with insects that help pollinate (Nugroho et al. 2019).

Another food source plant was karet. Karet flowers consist of male and female flowers, which were found in sparse additional umbrella panicles. The base of the flower tent in bell-shaped. Flower tent length 4–8 mm. The female flowers were slightly larger than the males and contain three bear ovaries. The male flowers have ten stamens arranged into a pole. The anther was divided into two bouquets, one higher than the other. This karet flower was the source of nectar for honey bees.

As a source of pollen, Laban has an inflorescence arrangement at the end of the stem or in the leaf axils (terminal). The blooms were blue on the outside and slightly purplish and androgynous on the inside. The base of the petals are joined to form a tiny bowl, while the base of the corolla's irregular five lobes are joined. The crown was purplish-white, the stalk and anthers were within the crown's cavity, and the ovary was located above the flower's base (Alimah 2020). Pulai was another plant encountered as a source of feed. Pulai had been a type of flower that was reported as being bisexual. The flowers will form clusters on the leaf tips. Inside, the blossoms of this plant are greenish-white with rounded margins.

Mangga is a honeybee-pollinated fruit. Terminal branches produce thousands of panicle-shaped mangga blooms. Compound interest mango blooms have thousands of flower buds. Golden mango flowers with white crowns. Male mango blooms outnumber hermaphrodite ones. Insects helped pollinate mango blooms, which have male and hermaphrodite flowers. The honey bee, a helpful insect, takes mangga nectar and pollen.

Potential sources of honey bee feed

Mataram Village, Gading Rejo, Pringsewu, has a vast forest with many of resources. Agroforestry combines forestry, plantation, and crops to manage forests. Honey bee agriculture has been developed in Mataram Village, Gading Rejo, Pringsewu's communal forest over the previous year. Forest flora feed these bees.A total of 22 species from 170 trees in the forest were identified in the study area. However, not all of these trees are food source for honey bees. Ninety-three percent or 159 trees, representing 17 species, become food source for honey bees. Each species has different frequency and density values. RD and RF from 17 species are presented in Table 2.

Table 2 reveals that kelapa has the highest RD (45.28) and crepe, jati, island, sengon, laban, and sonokeling the lowest (0.63). Kelapa has a 17.65 RF value, while bungur, jati, island, pisang, sengon, petai, laban, kakao, durian, and sonokeling have 2.94. Kelapa plants have high

Table 2. Potential sources of honey bee feed.

No	Local name	Scientific name	RD	FD
1	Kelapa	*Cocos nucifera*	45.28	17.65
2	Bungur	*Lagerstroemia speciosa*	0.63	2.94
3	Waru	*Hibiscus tiliaceus*	4.40	5.88
4	Jati	*Tectona grandis*	0.63	2.94
5	Pulai	*Alstonia scholaris*	0.63	2.94
6	Pisang	*Musa acuminata*	15.09	2.94
7	Sengon	*Albizia chinensis*	0.63	2.94
8	Laban	*Vitex pubescens*	0.63	2.94
9	Petai	*Parkia speciosa*	1.26	2.94
10	Kakao	*Theobroma cacao*	5.03	2.94
11	Durian	*Durio zibethinus*	3.14	11.76
12	Jengkol	*Archidendron pauciflorum*	1.89	8.82
13	Karet	*Hevea brasiliensis*	13.84	8.82
14	Petai cina	*Leucaena leucocephala*	1.26	5.88
15	Sonokeling	*Dalbergia latifolia*	0.63	2.94
16	Mangga	*Mangifera indica*	3.14	8.82
17	Suren	*Toona sureni*	1.89	5.88
		Total	100	100

RD and RF. Some plants have quite different RD and RF values than kelapa plants.

The field used for honey bee cultivation is directly opposite the protected forest area when viewed from the location of the investigation. This will indirectly alter the sorts of vegetation on community-owned land. On community land, stands of woodland, agricultural, and plantation crops provide honey bees with sustenance. Kelapa predominates on community land since this plant is the primary crop farmed by the community. Its sap is used for palm wine and kelapa sugar production. This processed product is a source of income from community land and is sold by the community. The introduction of honey bees into this region is anticipated to generate additional money while preserving the land's biological qualities and being environmentally benign. The collection of Kelapa sap and the cultivation of honeybees can continue as usual. Kelapa sap consists of 85 percent water, 14 percent sugar, and trace amounts of aminoacids, organic acids, proteins, minerals, lipids, and colors (Iskandar and Darusalam 2020). This sugar content has been the principal source of food for honey-producing bees, therefore the prevalence of kelapa makes the potential source of food for honey bees more than adequate.

The presence or dominance of plant species with small RF and RD values was not uniformly distributed across all plots. Due to the agriculture location's proximity to a protected forest region, forestry plant seeds can transfer from the protected forest area to the cultivation area. Thus that certain forest plants are found in community-owned places; environmentally, this was a positive thing, as a variety of plants prevented monoculture stands and reduced the ecological value of property maintained by the community. In addition to woodland species, there were also fruit plants and plantation crops discovered. Although the value of RD and FP was not as high as that of kelapa, the existence of these plants benefited farmers by allowing them to cultivate crops other than kelapa sap, which is their primary output.

Diversity of food sources for honey bees

The diversity of flora kinds on the land of Mataram Village might be relatively significant. This was complemented by a di-

versity index result of moderate species diversity for the honey bee food supply plants. Table 3 displays the Shannon-Wiener (H') diversity index used to calculate the value of the plant diversity in Mataram Village as food sources for honey bees.

In Mataram Village, the value of plant diversity as a source of honey bee food was 1.874. This result shows that the community's land contains a medium diversity of plant species serving as a food source for honey bees. The variety value of honey bee food sources, which was previously classed as moderate, has the potential to expand. To improve the diversity of food supplies, it was still necessary to supplement additional plant species as honey bee food sources. The optimal carrying capacity of the region for the presence of honey bees is indicated by the abundance of viable food sources. With sufficient food sources, bees do not need to fly far or even travel to different regions to get nourishment.

A feed source determines the success of honey bee farmers, where the three most critical elements affecting bee populations are climate, food supplies and chemicals (Buchori et al. 2022). Bees thrive in environments where the diversity of plant species is high. This affects the diversity and quantity of available feed sources. Various food sources will increase the chances of honey bees finding suitable food sources (Parreño et al. 2022). So, the creation of diversity in honey bee cultivation locations dramatically affects the survival of honey bees.

Table 3. Diversity value of Shannon-Wiener (H') forage for honey bee plants.

No	Local name	Scientific name	$\sum pi \ln pi$
1	Kelapa	*Cocos nucifera*	0.359
2	Bungur	*Lagerstroemia speciosa*	0.032
3	Waru	*Hibiscus tiliaceus*	0.137
4	Jati	*Tectona grandis*	0.032
5	Pulai	*Alstonia scholaris*	0.032
6	Pisang	*Musa acuminata*	0.285
7	Sengon	*Albizia chinensis*	0.032
8	Laban	*Vitex pubescens*	0.032
9	Petai	*Parkia speciosa*	0.055
10	Kakao	*Theobroma cacao*	0.150
11	Durian	*Durio zibethinus*	0.109
12	Jengkol	*Archidendron pauciflorum*	0.075
13	Karet	*Hevea brasiliensis*	0.274
14	Petai cina	*Leucaena leucocephala*	0.055
15	Sonokeling	*Dalbergia latifolia*	0.032
16	Mangga	*Mangifera indica*	0.109
17	Suren	*Toona sureni*	0.075
		H'	1.874

Development of honey bee cultivation based on feed sources

Honey bee cultivation on forest land manifests the multifunctional use of the forest. Land management type, composition and density of forest vegetation affect honey yields (Sultanova et al. 2019). Based on the obtained data, it can be seen that the food source for honey bees in Mataram Village is not lacking. However, suppose you look again, where the composition of plant species is too dominated by kelapa and the value of diversity was classified as moderate. In that case, it still possible to enrich other food sources.

The Mataram Village community forest was initially focused on kelapa production, from which only the sap was taken. Then honey bees are introduced to be developed at this location. The initial objectives of forest management affect the management activities carried out and also affect the composition of the forest (Ojha and Di-

mov 2017). Based on this, the Mataram Village community forest stands were dominated by kelapa and when the bees were introduced, the main food source came from kelapa. As for other plants, not too much. This indicated by the value of RD and RF. Kelapa density has high and also spread throughout the plot, RD and RF values, which were quite different from other types indicate the dominance of this species compared to other types. The diversity index value also shows the level of diversity, which still classified as moderate.

Enrichment of honey bee source plants was considered very important, given the condition of the people's forest vegetation in Mataram Village. In dry and flower seasons, honey bees usually find it easy to get food. However, during the rainy season, bees will experience a lean season. It necessary to have various types of plants that can support food sources during the dry or rainy seasons, so that the bee feed is maintained throughout the year. The development and selection of plant species enrichment for honey bee feed must also pay attention to ecological and economic aspects comprehensively without reducing the primary function of the forest due to reciprocal use of the forest and society (Sukardi et al. 2022). This research could be used as a reference for species enrichment by looking at the species available in community forest areas. The selection of other types can be studied further by looking at the suitability of plant species, land conditions and the community's wishes.

Conclusions

This study concludes that honey bees food source in OTM consist in 17 plants species, including kelapa, bungur, waru, jati, pulai, pisang, sengon, laban, petai, kakao, durian, jengkol, karet, petai cina, sonkeling, mangga, and suren. Kelapa, bungur, pisang, laban, jengkol, kakao, mangga and petai cina, are source of pollen. While, kelapa, bungur, waru, jai, pulai, pisang, sengon, petai, durian, karet, sonokeling, mangga and suren are source of nectar. A Shannon-Wiener (H') index value is 1.874. The importance of plant diversity as a food source for honey bees falls into the moderate range. To encourage the growth of honey bee farming in Mataram Village, it remains necessary to diversify the types of plants from which honey bees were derived.

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