

The Livelihood Challenge of Forest Honey Bee Farmers amidst COVID-19 Pandemic in Mutis, Indonesia

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Abstract: The COVID-19 pandemic has affected various sectors of the global communities, including those that depend on forests for honey products. Furthermore, the dynamics of production and availability are completely affected by government restrictions. This study focuses on the short-term effects of the COVID-19 pandemic on the forestry sector. Specifically, it examines the pandemic effect on forest honey farmers in habitat management, harvesting, marketing, farmer institutions, and livelihoods. The study was conducted on forest honey bee farmers through field observations and structured and in-depth interviews. Data were collected using five variables and 30 indicators in Fatumnasi Subdistrict, South Central Timor Regency and analyzed using descriptive and quantitative analysis. The results showed that the COVID-19 pandemic has changed the socio-cultural and economic utilization of forest honey. Additionally, social restrictions have reduced habitat management performance, farmers institutions and livelihoods, harvesting, and marketing. This has increased pressure on the livelihoods of forest honey bee farmers than before the pandemic. Moreover, it has directly affected their lives and the ability to provide quality forest honey. Therefore, interventions are needed to strengthen marketing and institutional networks to face the changes during and after the COVID-19 pandemic.

Keywords: Rural communities; NTFPs; provision services; habitats; institutional

1. Introduction

The relationship between forests and humans has existed for a long time, especially as a source of raw materials for basic needs (Rasmussen et al. 2017; Kibria et al. 2018; Ali and Rahut, 2018; Kumar et al. 2019; Hussain et al. 2019; Damania et al. 2020). For instance, some forests provide food, woodwork, animal feed, water, energy, medicinal plants, and socio-cultural and religious attributes (Lee et al. 2015; Dash et al. 2016; Nepal et al. 2017; Ali and Rahut, 2018; Chow, 2018; Koffi et al. 2018; Barua et al. 2020; Umayya et al. 2020; Njurumana et al. 2020). Also, raw materials from the forests are a major source of community livelihood (Oli et al. 2016; Hussain et al. 2019; Ali et al. 2020) through the exchange rate (Ali and Rahut, 2018; Njurumana et al. 2020). However, this relationship has been affected by the COVID-19 pandemic through increased hardship, encroachment, illegal logging, and forest destruction (Golar et al. 2020; Mohan et al. 2021). Furthermore, social restrictions have changed access to forest resource use, such as honey used for health purposes (Hossain et al. 2020; Al-Naggar et al. 2020). These restrictions affect honey bee farmers, the management activities, and the availability of their products in the market.

Information regarding the management and marketing dynamics and their implications for the forest honey bee farmers livelihoods during the pandemic remains a mystery. Previous studies showed an increase in deforestation during the pandemic period (Golar et al. 2020; Brancalion et al. 2020; Mohan et al. 2021), including changes in natural recreational activities

(Derks et al. 2020). Furthermore, forestry law enforcement was simplified (Guardian, 2020) due to population pressure and changes in access to forest livelihoods (Workie et al. 2020; Sharma and Mahendru, 2020; Paudel, 2020; Anon, 2020; Corlett et al. 2020, Taylor, 2020). Therefore, this study complements the literature on the short-term effects of the COVID-19 pandemic on the forestry sector. Specifically, it examines the changes in habitat management, harvesting, marketing, farmer institutions, and the livelihoods of forest honey farmers around the Mutis mountain forest, Timor island.

2. Materials and Methods

2.1 Conceptual Framework

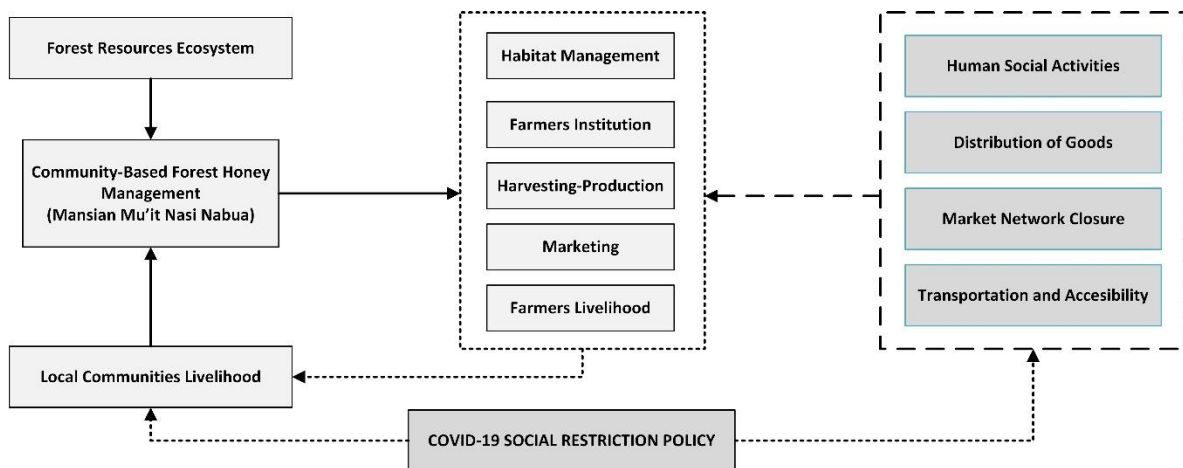


Figure 1. Flow chart of potential impact of COVID-19 social restriction policy on the livelihood of forest honey farmers in Mutis (Source: Developed from Wannaprasert and Choenkwan (2021))

The COVID-19 pandemic has multiple implications for the global community, causing fear and human death in various countries (Goniewicz et al. 2020; Pfefferbaum and North, 2020; Saadat et al. 2020; Zhou et al. 2020). It has affected various sectors of life (Rowan and Galanakis, 2020), especially the source of livelihood, food value chain, income, basic needs fulfillment, and public health (Shammi et al. 2020; Tamru et al. 2020; Brickell et al. 2020; Sharma & Mahendru, 2020; Oncini et al. 2020; Paudel, 2020; Anon, 2020; Corlett et al. 2020; Taylor, 2020; Berretta et al. 2020; Rowan and Laffey, 2020; Wannaprasert and Choenkwan, 2021). The conceptual framework (Figure 1) explores the human-forest relationship through habitat management, farmer institutions, harvesting, marketing, and livelihoods during the COVID-19 pandemic (Chao, 2012; Gentle et al. 2020; Hossain et al. 2020; Al-Naggar et al. 2020; BBS, 2020; Mohan et al. 2021; Lima et al. 2021; Laudari et al. 2021; Davila et al. 2021). This relationship has changed due to social restriction policies during the pandemic, especially on transportation access, goods distribution, marketing networks, and community social activities.

2.2 Study Site

This study was conducted from August to September 2020 in five sample villages of Fatumnasi Subdistrict, South Central Timor Regency, East Nusa Tenggara (ENT), Indonesia (Table 1; Figure 2). The villages were categorized as very underdeveloped, located at 1,276-1,751 m above sea level. They experience 115 rainy days and 2,384 mm of rainfall annually (BPS, 2019). Furthermore, they are part of 2,308 villages surrounding forest areas in ENT (Njurumana et al. 2020), 292 in ENT, and 6,381 in Indonesia around conservation areas (Wiratno, 2018).

Table 1. Population demographics of Fatumnasi Subdistrict, ENT.

Village	Population			Households		Village Area	
	Male	Female	Total	Units	Family Members	Square (km ²)	Population Density
Fatumnasi	787	821	1608	433	4	34,97	46
Nenas	603	640	1243	271	4	58,57	21
Kuanoel	621	623	1244	322	4	38,24	33
Nuapin	1135	1140	2275	462	5	55,91	41
Mutis	279	297	576	116	9	10,96	53

Source: Data processed from BPS (2020)

The population in Fatumnasi District is 50.60% dominated by female, with four people as the average number of family members. Mutis, Fatumnasi, and Nuapin villages have population densities above the Fatumnasi subdistrict average of 39 people/km² (BPS, 2020). However, their population densities are lower than the South-Central Timor district average of 115 people/km² (BPS, 2021). Supporting facilities such as electricity networks from PLN (state electricity company) are only 34.1% of family units. This has resulted in weak telecommunication access, causing a high dependence on firewood.

Mutis mountain ecosystem comprises 19,586 hectares of protected forest and 12,316 hectares of nature reserves. These reserves have socio-cultural, economic, and environmental values for local communities (Dako et al. 2018; Dako et al. 2019; Pujiono et al. 2019; Budiman et al. 2020). Moreover, its socio-cultural values symbolize sociological existence for local communities, providing economic benefits as a source of livelihood. Economic activities include raising livestock and utilizing non-timber forest products, such as honey, mushrooms, firewood, medicinal and ornamental plants, natural tourism, and environmental services. The ecological value represents the rich biodiversity of flora and fauna and is one of the mountain tropical forest landscapes (Pujiono et al. 2019). Furthermore, it is a water catchment area for the Benain, Noelmina, and Noelfail watersheds. The three watersheds cross five of the six districts on the island of Timor, including the Democratic Republic of Timor Leste (Dako et al. 2018; Riwu Kaho et al. 2019).

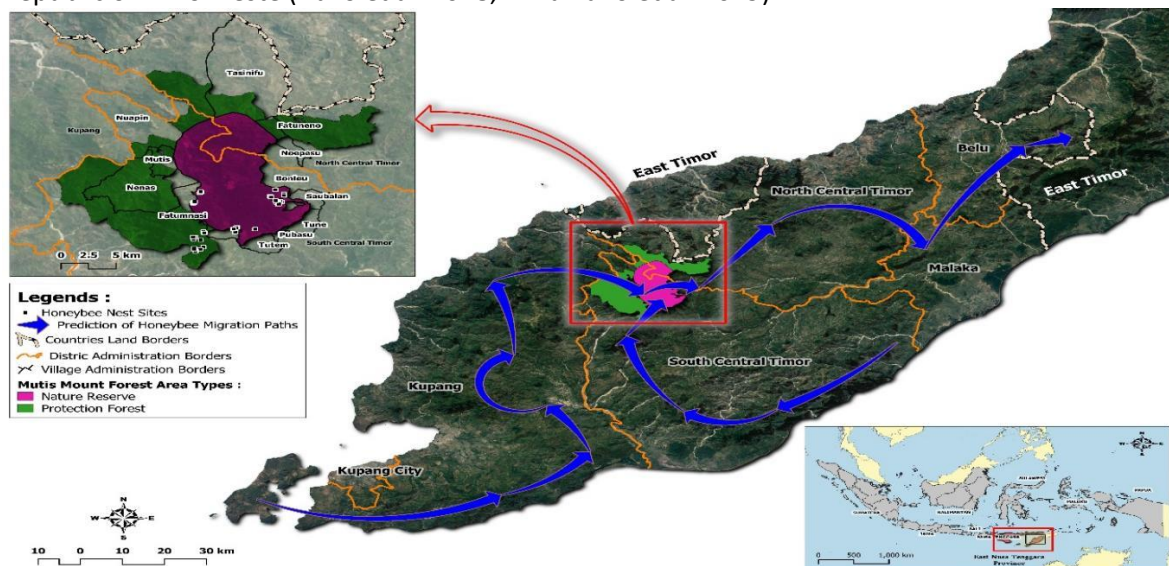


Figure 2. Map of the Mutis forest area on the Timor island (Source: Riwu Kaho and Nomeni, 2019)

2.3 Data Collection Procedures

This study was conducted using secondary data from government agencies and primary data from relevant respondents. Primary data were obtained using questionnaires and in-depth interviews with 35 (23.5%) of 149 households of forest honey bee farmer members of the Mutis Community Network (Jaringan Masyarakat Mutis (JMM)). This is an organization around the Mutis forest area that manages, harvests, and markets forest honey. Respondents for primary data comprised forest honey farmers, JMM administrators, traditional leaders, and village officials.

The data and information were collected on habitat management, harvesting, marketing,

farmer institutions, and livelihoods. Also, interviews with JMM administrators covered the institutional dynamics of farmer groups amid the COVID-19 pandemic, including interventions for forest honey bee habitat management. The interview with traditional leaders examined the challenges of traditional changing of harvesting honey, including management of customary areas (*Suf*) for production. Each respondent was given several questions about the changes in forest honey management and the implications for household resilience. Measurement indicators on a scale of 1-5 was determined and continued with an in-depth interview to determine the causing factors.

2.4 Research Variables and Data Analysis

This study used five variables and 30 study indicators in data collection. These variables include habitat management, harvesting, marketing, farmer institutions, and their livelihoods. They are considered influential factors for honey management dynamics in the Mutis forest area.

The primary data and information from in-depth interviews were analyzed descriptively and quantitatively. Analysis involved data tabulation, as well as weighing and scoring the change categories on the five variables and 30 indicators based on Becker et al. (2017) and Miller et al. (2017) with adjustments. Determining variable and indicator weights refers to the accumulated change values on a scale of 1-5. The change for each indicator was classified into five scales as very low (1), low (2), medium (3), high (4), and very high (5). Also, the result value was determined by the accumulated score of the indicator on each variable.

$$K = \sum_{ie=1}^n (w_{ie} \times x_{ie})$$

K = Indicator change category
 w_{ie} = i-th indicator's weight
 x_{ie} = i-th indicator's score

3. Results and Discussion

3.1 Demographic Profile of Informants

Most forest honey bee farmers are male because harvesting is physical work lasting several days or weeks based on the traditional management (*Suf*). The farmers survey potential bees during the season, plan the time for traditional ceremonies, and harvest honey in the *Suf* area. In contrast, female help in planning and harvesting by providing logistical needs and processing honey and wax through draining.

As Figure 3 shows, most farmers have a secondary school education, though they come from disadvantaged villages around the Mutis forest (BPS, 2020). The limited management capacity requires innovation and technology transfer support, especially in harvesting and processing forest honey to meet quality standards. This is because honey farming has good prospects, and most farmers are of productive age with sustainable management potential. Furthermore, 85.7% of farmers have long experience in farming honey forests. They mostly belong to the Timorese ethnic group, born and grew up in rural areas around the Mutis forest. Moreover, they have a high social kinship and relatively homogeneous customs, including recognizing the surrounding area and natural potential. They also manage beehive trees and facilitate the development of forest honey bee farming.

3.2 Dynamics of Forest Honey Bee Management

Forest honey management needs regulation to ensure quality, economic value, and benefits for different human needs (Grabowski & Klein, 2017; Nguyen et al., 2018). This management is expected to meet public demand for high-quality honey products on a national and international scale. Saudi Arabia is one of the importing countries, reaching 74% of the national need (Alnafissa & Alderiny, 2019). However, this massive demand is not accompanied by standard management because honey is the 6th food group prone to contamination (Aljohar et al. 2018; Soares et al. 2019; Moškrič et al. 2020; El-Nahhal, 2020). The management is expected to sustain the honey bee habitat, including ensuring an environmentally friendly and hygienic production system (Durant, 2019; Kovács-Hostyánszki et al., 2019). Subsequently, preserving bee habitat and honey production significantly determines the sustainability of the livelihoods of communities around the forest (Wahlen, 2017; Matias et al., 2018).

Forest honey has been managed conventionally using customary rules as a source of law to regulate the resources. Government regulations strengthened the customary rules by integrating forest honey in 591 non-timber forest product commodities (NTFPs) in Indonesia (MoF, 2007). Its implementation refers to Local Government Regulation (LGR, 2017), regarding the management of NTFPs in ENT and its derivative regulations. One of these regulations is Governor Regulation concerning the Mutis honey center (LGR, 2020).

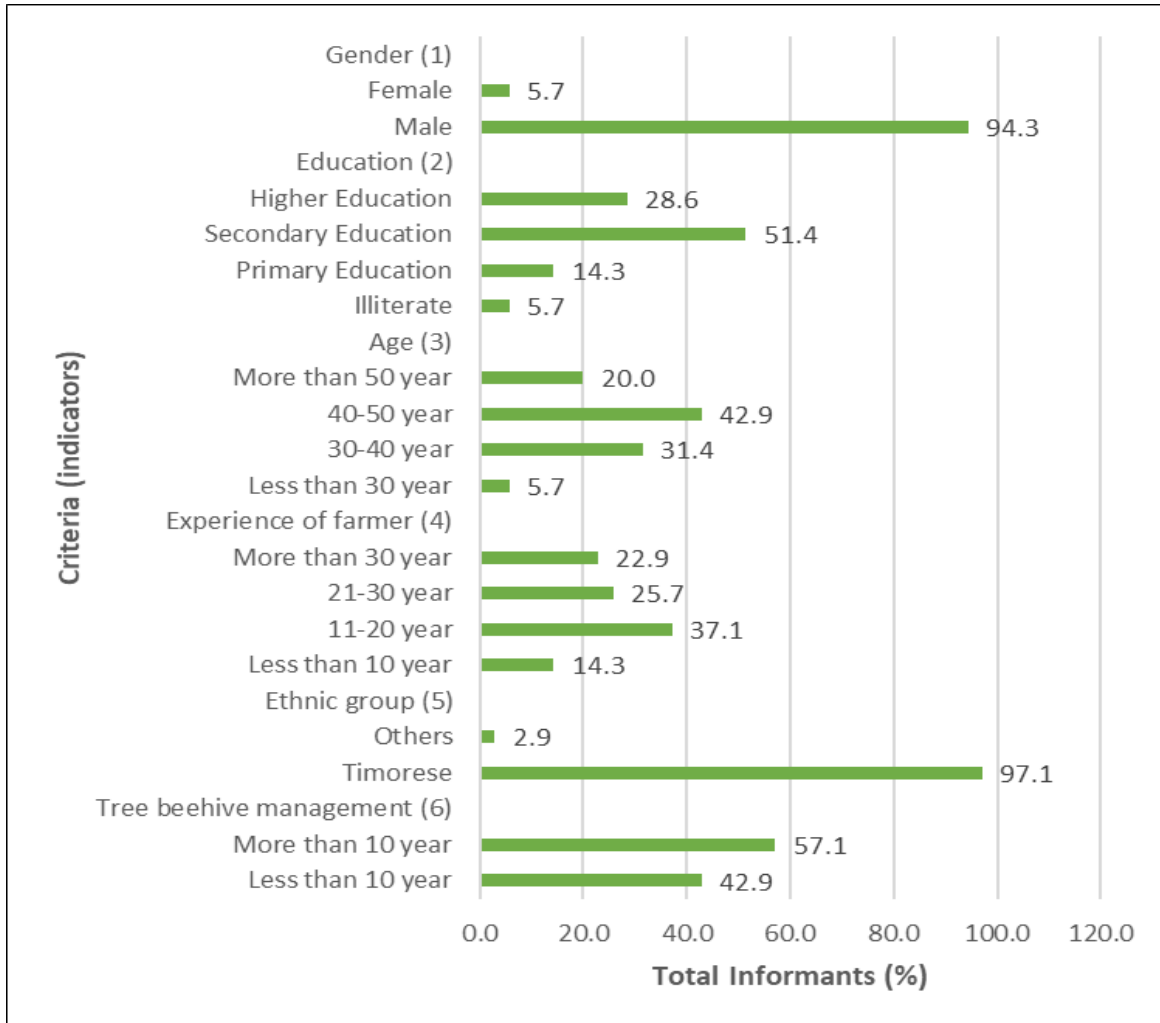


Figure 3. Demographic profile of informants in Mutis Sub District (Source: Primary Data, 2020)

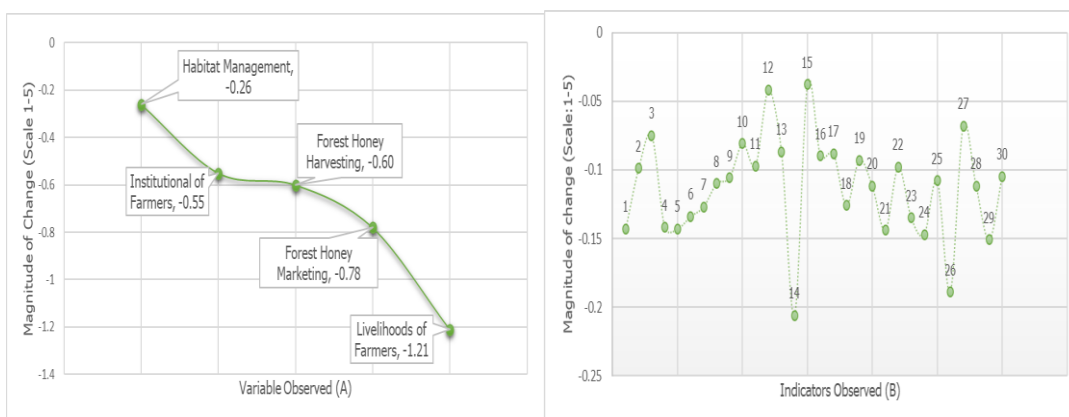


Figure 4. Change value of the variable (A) and indicator (B) observed (Source: Primary Data, 2020)

Regulating forest honey management as a leading NTFP aims for habitat conservation, continuous production, marketing strategies, and increasing income to farmers and state. However, the COVID-19 pandemic has created new challenges in forest honey management and utilization. This is seen from the declined performance through five variables and 30 indicators (Figure 4), increasing farmers' livelihoods challenges. Varying changes in each variable, including livelihoods, are caused by changes in each measuring indicator. These include economic difficulty, farmers' expenditures, changes in income, access to production facilities, government assistance, and farming development. Furthermore, the decrease in each variable and indicator implies declined performance of forest honey farmers during the COVID-19 social restrictions.

Forest honey farmers in Mutis are part of 8,643,228 families in Indonesia (BPS, 2018), 140 million people of Southeast Asia (Moeliono, 2017), and between 1.6 and 1.85 billion people worldwide (Chao, 2012; FAO, 2015; Miyamoto, 2020; Mohan et al. 2021). These farmers depend on forests for their livelihoods, jobs, and income. Optimizing forest benefits is influenced by the institutional role of farmer groups. This is because they have social capital, understand community conditions, and assist their members in dealing with the COVID-19 pandemic (Gentle et al. 2020). The forest honey harvesting variable is affected mainly by access restrictions with implications for its harvesting and utilization (Hossain et al. 2020; Al-Naggar et al. 2020; Lima et al. 2021). This includes marketing constraints due to limited product distribution during the pandemic (BBS, 2020; Lima et al., 2021). Consequently, limited marketing affects livelihood sources, increasing economic hardship and poverty. Moreover, it causes the suspension of forestry activities, increasing illegal logging, and decreasing forestry's economic contribution (Laudari et al., 2021). Studies in the Solomon Islands, Vanuatu, PNG, and Timor Leste have shown an increase in poverty and a decrease in per-capita income and household consumption during the COVID-19 pandemic (Davila et al. 2021).

3.2.1. Habitat Management

The forest honey bee habitats, such as water, food, and vegetation, are factors determining the colony's sustainability. However, the improvement of habitat management has encountered problems because most are located in protected forest areas and nature reserves. These areas experience access restrictions due to the COVID-19 pandemic. On the contrary, the community has a traditional Suf-based management area within the state forest. It is estimated to reach 11,400 ha, managed by at least 226 family units in the Mutis forest area (Riwu Kaho & Nomeni, 2019). Moreover, Suf land has socio-cultural value because it provides economic and ecological benefits and is the cultural landscape of local communities (Dharmiasih, 2020). Community synergy with forest area stakeholders is needed to improve habitat quality for the strategic value of forest honey for farmers' livelihood. Also, this synergy should increase traditional ceremonial sites in the Suf area to protect nest and forage trees in state forests.

Ampupu (*Eucalyptus urophylla*) is the dominant vegetation of the Mutis Forest and the primary breeding ground and food source for honey bees. The dominance level indicated that the important value index (IVI) at the tree, poles and sapling levels reached 134.0%, 66.1%, and 69.6%, respectively. In contrast, the understorey was dominated by *Cromolaena odorata* with an IVI value of 119.7% (BBKSDANTT, 2018). Furthermore, the domination of ampupu has implications for the ecological services of the Mutis forest in honey production. This is because 97% of the honeycomb is found in the trees growing on a slight to very steep topography (Riwu Kaho & Nomeni, 2019). The large growing space supports the availability of nectar and pollen, including the adaptation for forest honey bees to utilize dominant tree species, such as ampupu (Nagir et al., 2016). On the contrary, natural regeneration is decelerating and requires intervention to accelerate the process and support its ecological role in the future. However, the farmers' participation in managing and protecting natural plant regeneration due to illegal grazing and forest fires has been hampered by access restrictions during the COVID-19 pandemic.

One threat to the forest honey bee habitat is 87.5% and 96.9% the need for firewood and carpentry activities in the Mutis forest area respectively (Dako et al. 2018). This pressure has contributed to the decline in densely vegetated forests in the past 30 years (Pujiono et al. 2019), affecting the habitat's carrying capacity. Therefore, control is needed to maintain the forest honey

bee habitat and the carrying capacity of its ecosystem (Woyke et al., 2012). The pressures on land use and cover changes are consistent with farmers information regarding the decreasing population of *Apis dorsata*'s hive and forage trees in the last five years. This information supports the analysis results that a decrease in habitat management reduces other variables. The pressure has been increased by the limited access to control by forestry agencies and honey farmer institutions during the pandemic. Consequently, it has implications for increasing honey bee habitat destruction.

Farmers realize that increasing the quality and quantity of forest honey bee habitat determines the production and utilization sustainability. Furthermore, planting is carried out to build food security and economic resilience amidst the impact of the pandemic. Therefore, they cultivate plants that produce nectar in gardens and yards, including *Citrus reticulata*, *Persea americana*, and *Coffea arabica*. Moreover, they maintain trees that grow naturally around the garden, such as *Myristica* sp., *Ficus* sp., *Bombax malabarica*, *Acacia leucophloea*, *Scheilera olease*, *Areca catechu*, *Cocos nucifera*, *Albizia Chinensis*, *Gyrocarpus americanus*, *Wenlandia buberkilli* var. *timorensis*, *Todalia asiabeca* and *Albizzia Saponaria*. The farmers participation in tree conservation and the enrichment of species through cultivation improves human and environmental ecosystem services (Njurumana, 2016; Njurumana, 2019; Durant, 2019; Bänsch et al. 2020; Wakhidah et al. 2020).

3.2.2. Forest Honey Bee Farmer Institutions

The resilience of farmers institutions during the pandemic impacted forest honey management because the JMM group members were less affected by social distancing. This is because the institutional coordination has not changed significantly than before the pandemic. Additionally, several indicators that contributed to change limit farmer group meetings, resulting in management coordination without members. The village distribution of JMM farmer members experiences inaccessibility through expensive long-distance transportation costs and restricted human movement. This makes the work agenda of farmer groups experience obstacles, affecting performance. Furthermore, all farmer group members' coordination and regular meetings were stopped due to social restrictions. As a result, the implementation of the work program experienced changes in priorities and targets. The collective agreement in organizing farmers has also adjusted to the pandemic situation. Subsequently, several new agreements have become a reference in management and marketing. The agreements include eliminating regular meetings of farmer group members and authorizing only one core management to coordinate the honey management and marketing.

External factors and the awareness of COVID-19 spread have influenced the access and efficiency of forest honey marketing. The interview results showed a sales decline from 10-60%, with an average change of 0.133 in sales value (Figure 4 (B) indicator 6), especially honey farmers outside the JMM organization. The honey processing by JMM members applied quality standards, while other farmers use conventional methods. As a result, this has destabilized honey prices outside the organization due to the urgent need for money and the low bargaining position of farmers. As a countermeasure, this requires assistance to improve honey processing according to established standards. Several agreements regarding forest honey management are proposed by farmers, especially the security of nest trees due to increased bee colonies. As a result, the security of the forest honey bee colony is well maintained due to clear boundaries of customary management areas. This creates a small possibility for taking honey except outside the Suf area (local term: wild honey), accessible to the general public. Also, pressure on forest destruction, such as land fires, has decreased during the pandemic.

3.2.3. Harvesting

Harvesting is a routine annual agenda carried out by the community between January and March, as well as from May to July. This adjusts the flowering season for several types of honey bee forage plants. Forest honey utilization manifests the triangle philosophy of community life, known as *mansian, mu'it, nasi nabua'*. This means that humans, forests, and livestock (all life in the forest) are an inseparable unit that supports each other. The relationship works in synergy to encourage the use of Mutis forest ecosystem's natural resources to maintain function and balance. When one of the three components is neglected, the community considers it management malpractice.

The philosophy's manifestation encourages forest honey utilization according to community traditions. This usually begins and ends with a traditional ceremony attended by between 50 and 150 people in the Suf area. Each clan owns and understands the boundaries of the managed Suf area. They use natural boundary markers such as rivers, ridges, and natural stones. Furthermore, traditional ceremonies involve the community, religious and traditional leaders, and the general public to ask permission for forest honey utilization. After harvesting, they perform a ceremony to recall the flying honey bees to occupy the colony.

Traditional ceremonies for harvesting forest honey have been simplified by adjusting to social restrictions during the pandemic. These have reduced the number of people involved in these ceremonies and harvesting. Moreover, the restriction reduces the socio-cultural legitimacy of customs and culture in the harvesting process. The community believes that cultural practices in the use of forest honey should not be simplified because it causes losses during harvesting. This farmers' confidence supports the 2020 data on forest honey harvesting from 149 households in the JMM group. It showed a decrease of 1700 liters (54.7%) from the average harvest yield of 3,106 liters annually between 2009 and 2019.

Farmers believe that the honey production decline is caused by simplifying traditional honey harvesting ceremonies during the pandemic. This is a reduction of social responsibility (customary attributes) towards nature, with implications for the ecological services obtained through the volume of forest honey production. Furthermore, this traditional ceremony signifies the exchange of equal resources with the environment as a honey producer. However, some farmers do not conduct the ceremonies because the harvest potential is not equivalent to the material sacrificed in the ceremony. Instead, they only involve nuclear family members in honey harvesting as a solution. The honey produced from managed bee trees ranges from 5 to 15 trees per family, yielding between 50 and 250 liters. However, this is lower than the production in the Sisimeni Sanam forest area in 2019, ranging between 500 and 1,215 liters (Mooy, 2020). The presumption of this difference is due to the influence of the COVID-19 pandemic and the comparison of the number of honey farmers in the Mutis forest.

The availability of professional climbers also determines the quality and quantity of honey yields, especially in reaching the beehives on tall trees with large diameters. Regeneration of the climbing profession has not been well organized because it is limited in number and affects the harvest timeliness. Furthermore, most climbers do not have Suf because they seek employment in urban areas. The COVID-19 pandemic movement restrictions have made most climbers working as laborers in urban areas not return to the village for honey harvesting. Travel regulations require a COVID-19-free letter from a health agency, with a very short validity period and high cost. However, forest honey should be harvested on time to maintain its quality and quantity. The limited availability of climbers creates competition for users. As a result, this increases the service bargaining between forest honey bee tree owners and climbers. Additionally, the scarcity increases the commitment of climbing services from 30% to 50% of the total yield. This is almost equivalent to the commitment of climbers in the Sisimeni Sanam area, reaching 50% of the harvest (Mooy, 2020). Economically, this business is profitable because the climbers' share is almost equivalent to the forest honey bee tree owners.

3.2.4. Marketing

The forest honey marketing was subject to social and regulatory restrictions during the COVID-19 pandemic due to changes in access within and outside the district. Subsequently, restrictions of social and transportation access affect human movement with direct implications for forest honey demand. The largest decrease occurred in the community that conducted individual marketing ranging between 10-70% from the previous condition. This decline is due to the difficulty of access for buyers outside the village to take directly harvested forest honey from the farmer. It was caused by limited transportation facilities, including strict travel requirements and expensive costs. However, the situation is different in the organized honey marketing through the JMM farmer group. The selling price is more stable because it has a definite sales agent, and the organization bears operational costs. Also, the honey marketed meets product processing standards, hygienic packaging. The distribution processes apply the COVID-19 standard protocol, building consumer

confidence to buy.

Honey marketing is a challenge for those working individually, and a drop of 87% has also declined the bargaining power of farmers. This has decreased the selling price by between 30 and 40% from the previous condition. There has been an urgent demand for necessities and medicines during the pandemic and difficulty in obtaining cash. This has promoted the system of exchange or bartering goods for goods among the community. Farmers admitted that the system relies heavily on bargaining power with the kiosk or shop business owner. Additionally, pricing is not commensurate with the selling value of honey under normal circumstances before the pandemic. Another influencing factor is the less optimal internal coordination between forest honey management and farmers during the pandemic period. Also, the movement of special and mass tourists from outside the village significantly declined. This situation limits forest honey marketing, especially those expecting foreign tourists.

3.2.5. Livelihoods of Forest Honey Bee Farmers

Most farmers in Mutis Forest depend on agriculture, forestry, and animal husbandry for their livelihoods. The income per capita is around Rp. 201,894-368,929 per month (Dako et al. 2018), less than the district average of Rp. 690,269 (BPS, 2018) and Rp. 711,629 (BPS, 2020). Furthermore, they cultivate with productivity of five tonnes of rice and three tonnes of maize per hectare. This includes livestock cultivation, such as horses, cows, goats, pigs, and native chickens (BPS, 2020).

The livelihoods of forest honey farmers experienced changes in several observed indicators during the pandemic. The majority experienced a decline in income by 10-60% from pre-pandemic conditions due to the reduced volume of honey harvested and limited marketing accessibility. Moreover, online marketing has not been developed due to low technology mastery complicated by limited job alternatives, such as services, implying decreased access to cash.

Social restrictions and accessibility have decreased the livelihood sources of forest honey farmers by 20-80%. Therefore, farming development aims to improve food security and optimize the use of food sources on managed farms. Also, additional efforts were made through increased diversification of crops and horticulture to build food security and reduce household expenditure. These limitations have increased the economic difficulties of forest honey farmer households from 10-60% from the previous condition.

The economic difficulties faced by farmers during the COVID-19 pandemic have encouraged the increased development of various agricultural commodities. This has been accomplished by intensifying agricultural land use by 10-40%. The cultivated commodities are plants that support food security and household income. They include shallots (*Allium cepa*), garlic (*Allium sativum*), potatoes (*Solanum tuberosum*), cayenne pepper (*Capsicum annum*), corn (*Zea mays* spp), peanuts (*Arachis hypogaea*), cassava (*Manihot esculenta*), and sweet potato (*Ipomoea batatas*). Furthermore, farmers cultivated biopharmaceutical plants, traditionally used to improve health and immunity during the pandemic. Examples include ginger (*Zingiber officinale*), galangal (*Alpinia galanga*), cutcherry (*Kaempferia galanga*), turmeric (*Curcuma longa*), and Curcuma (*Curcuma zanthorrhiza*).

The limited livelihoods have reduced the income of forest honey producers by 10 to 70% compared to the previous state. Furthermore, access to facilities and infrastructure for honey production is limited, especially tools for washing, storing, packaging, and producing. This change was influenced by restrictions on distribution routes and transportation accessibility during the pandemic.

The decrease in production has reduced forest honey consumption by 10-50% for farmer families. The average consumption reached 0.91g per capita per day, lower than the average for the ten highest honey-consuming countries of 3.01-9.62 per capita per day (FAO, 2019). Additionally, farmers prioritize marketing to obtain cash to buy necessities and overcome the 10-60% decline in food security from the previous condition. They also optimize the use of food resources on garden land to meet family needs. This includes receiving government social assistance for food security during the COVID-19 pandemic.

3.3 Discussion

Sustainable forest management is an important activity for honeybee habitat management that increases productivity as a source of livelihood for 80-95 million people in Indonesia (Chao, 2012; Mohan et al., 2021). Farmers that hunt forest honey are generally in groups and organized in institutions with strong social ties to jointly mitigate the impact of the COVID-19 pandemic (Gentle et al. 2020). However, harvesting and marketing of forest honey and farmers livelihoods are affected by social restrictions. Moreover, they experience difficulties harvesting and utilizing forest honey due to limited marketing distribution channels (Hossain et al. 2020; BBS, 2020; Al-Naggar et al. 2020; Lima et al., 2021). This builds livelihood pressures that drive economic hardship and increasing poverty (Laudari et al. 2021; Davila et al. 2021).

Social restrictions during the COVID-19 pandemic have decreased community activities, natural tourism visits, and special interest tours around the Mutis forest. This decline triggers economic networks and community livelihoods changes, including farmers access to harvesting forest honey. As an economic activity, harvesting integrates socio-cultural aspects through the usual ceremonies as the main input. Additionally, customary ceremonies are a collective agenda carried out regularly by forest honey farmers. They strengthen solidarity with the universe and fellow communities with genealogical relations.

The social restrictions at the peak of the honey harvesting tradition influence community participation. The people believe that the customary rituals significantly affect the quantity and quality of the harvest. Furthermore, socio-cultural legitimacy through customary ceremonies motivates the community and harvesting personnel in carrying out their duties. This means that harvesting is an economic activity and a socio-cultural collective action to unite society supporting each other. Therefore, it is momentum for solidarity with the community, traditional and religious leaders, the indigenous peoples. Each clan has a role in the ceremonies, and those involved in the traditional aspect seek permission for forest honey utilization.

The challenge in honey harvesting is bridging the rationalization and simplification of small-scale traditional rituals during a pandemic. Furthermore, the simplification decreases the unity and intrinsic values and tradition inheritance to the younger generation. This implies fading solidarity among stakeholders in forest honey management. Moreover, social restrictions limit the transfer of meaning and cultural values. It also limits the participation of young people to experience the internalization of socio-cultural values in utilizing forest honey. This may lead to a chain break of inheriting these values in forest resource management. Consequently, it reduces forest honey management meaning to mere economic activity. Therefore, the synergy of socio-cultural, economic, and ecological aspects is weakened, reducing local values in managing natural resources, such as forest honey.

The limitation of bee tree climbers is also a challenge interpreted as a professional cultural monopoly to benefit certain parties. Additionally, the tendency for young climbers to seek a source of livelihood in urban areas negatively impacts the climbing profession. As a result, farmers are in constant need of skilled climbers to help harvest forest honey. Therefore, customary and community leaders should evaluate these policies and allow other parties to pursue the profession and optimize the harvesting of forest honey during and after the COVID-19 pandemic.

The community's socio-cultural use of forest areas is an ornament that enriches the value of the forest benefits. Subsequently, the resources become an economic commodity interspersed with socio-cultural and religious-human interests. When these three aspects are closely integrated, they become a leveraging factor for increasing community participation in forest conservation. Therefore, forests, with all their resources, are the main input for functioning socio-cultural, religious, and economic instruments. Although the local community balances these tools, they should be improved to cover forest conservation efforts and community livelihoods.

Management and protection of forest honeybee habitats should not decrease during the COVID-19 pandemic because it affects production and farmers livelihoods. There is a strong mutual beneficial co-existence relationship between honey bees and flowering plants in the forest and yard. This is because bees obtain nectar and pollen from plants, with implications for their populations and forest honey production for farmers. Therefore, honey production during and after the

pandemic is a function of the habitat's carrying capacity. The sustainability of forest honey production is determined by the management and improvement of the quality of habitat by farmers. Habitat management interventions by farmers during the COVID-19 pandemic are carried out by increasing dryland farming-based livelihood sources with forest honeybee habitat enrichment. This is through cultivating plant species to improve livelihoods and health sources (biopharmaceuticals) during the pandemic. Additionally, the plants serve as forest honeybee feed trees in the buffer zone of the Mutis nature reserve and protected forest. Habitat enrichment interventions on agricultural cultivated land bring the sources of forage and bee trees closer to farmers settlements, enhancing monitoring, management, and harvesting.

4. Conclusion

This study complements the literature on the short-term impact of the COVID-19 pandemic on forestry. It examines the changes in habitat management, harvesting, marketing, farmer institutions, and the livelihoods of forest honey farmers around the Mutis mountain forest. The community considers forest honey a strategically valuable commodity socio-culturally, economically, and ecologically, and a source of livelihood. The strategic value of forest honey encourages collective management, strengthening kinship, and social solidarity. Furthermore, it strengthens human and forest relations as a manifestation of the triangle of life in the Mutis community.

The COVID-19 pandemic and social restriction policies have reduced the institutional performance of forest honey farmer groups in habitat management, harvesting, marketing, and livelihoods. As a socio-cultural tradition, forest honey harvesting has been simplified by restricting community participation, decreasing honey production. Moreover, social restrictions have caused a decline in demand and marketing of honey products, decreasing income sources for forest honey farmers livelihoods. Therefore, the farmers initiated the cultivation of crops and biopharmaceuticals to support food security and income sources. Furthermore, there is a need for internal consolidation by strengthening the institutional performance of these farmers to mitigate the impact of social restrictions during the pandemic.

5. Recommendations for Livelihoods-Sustainability

The farmers capacity in habitat management should be increased to support the sustainability of their livelihood sources. Also, it is necessary to strengthen harvesting strategies and farmer institutions and expand marketing networks. Habitat management should be strengthened through intervention by forest area stakeholders to improve the socio-ecological functions of traditionally managed areas. This could be accomplished through the participatory cultivation of forest plants. Since most honeybee habitats are in forest areas, their utilization should be following regulations through social forestry schemes. This ensures the sustainability of the ecological functions of the forest and increases community welfare. Furthermore, habitats should be developed on customary and private lands by maintaining and protecting various feed and nest trees growing naturally from the risk of fire and damage by loose livestock.

Improving the honey bee habitat should be followed by increasing the farmers capacity to harvest forest honey to maintain its quality and quantity. This could be carried out through strengthening the technical capacity of climbers to professionally pay attention to work safety aspects. Other improvements include setting up service standards for climbers, and transforming cultural barriers to regenerate climbers in quality and quantity. Additionally, the local government should facilitate village youth to participate in harvesting training. They should also be involved in post-harvest honey processing, including using equipment to diversify products according to market needs. The resulting honey product needs to be packaged in various shapes and sizes to have a competitive and comparative value. Furthermore, forest honey farmer institutions need to innovate in strengthening wider marketing networks. This includes the use of online marketing to facilitate and ensure market certainty for their products. The role of this institution is important in improving the management capacity of business-oriented organizations. Consequently, it strengthens the farmers entrepreneurial capacity in marketing forest honey, expands organizational networks, and increases farmer group members.

6. Areas for Further Research

This study obtained a strong relationship between the influence of the COVID-19 pandemic on the livelihoods of honey farmers as a forest-dependent community. However, further research is required to provide information on different types of forests and commodities. In this context, a study is proposed on farmers resilience, including restoring forest and human relations after the pandemic. The first study should examine the locality mapping of traditional community management outside and inside the forest area and synergize the management policy. The second study needs to examine the dynamics of forest honeybee management and habitat change. This is especially the management and enrichment of honeybee tree species and forest honeybee feed trees in increasing their carrying capacity for honey production. The study should explore the dynamics of forest honey production and the economic value of several NTFP commodities for community livelihoods. The fourth study should explain the challenges and opportunities of climber regeneration in the cultural context of the Mutis people.

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