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Small and Medium Scales Business Development Model and Value Chain of *Apis mellifera L.* Bee Cultivation in Riau Province

Pengembangan Model Bisnis dan Rantai Nilai Budidaya Lebah Apis mellifera L. Skala Kecil dan Menengah di Provinsi Riau

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Apis mellifera, value chain, beekeeping, alternative livelihood, peatland

ABSTRACT

Beekeeping practice was an alternative livelihood for communities around forest areas, offering a potential solution to reduce conflicts arising from the use and management of this ecosystem. Starting in the COVID-19 pandemic, the government introduced Apis mellifera from Java island into honey production in Sumatra due to its high productivity and adaptability to new environments. Therefore, this research aimed to explore the challenges and develop business models and value chains associated with commercializing Apis mellifera honey. The analysis used a qualitative descriptive method through observation and in-depth interviews with beekeeping entrepreneurs. There were two sales systems. The first was direct from beekeepers, and the second was indirect sales systems facilitated by collectors/industries. The collectors/industries gained a significant profit, approximately IDR. 80,000.00/kg, while beekeepers only received a minimum selling price. Marketing became a significant issue as beekeepers tended to focus more on cultivation efforts, resulting in a simplistic method of honey sales. Consequently, providing maximum economic value to the communities around the forest areas required synergy and assistance from related sectors.

KATA KUNCI
Apis mellifera, rantai nilai, budidaya lebah, mata pencaharian alternatif, gambut

INTISARI

Budidaya lebah madu merupakan salah satu sumber mata pencaharian alternatif masyarakat sekitar kawasan hutan, sehingga berpotensi mengurangi intensitas konflik dalam pemanfaatan dan pengelolaan kawasan hutan. Sejak pandemi covid-19, pemerintah melakukan introduksi Apis mellifera *dari Pulau Jawa untuk produksi madu di Pulau Sumatera karena memiliki produktivitas madu yang tinggi dan daya adaptasinya baik terhadap lingkungan. Tujuan penelitian ini adalah untuk mengetahui permasalahan, membangun model bisnis dan rantai pasok yang dapat menjadi acuan komersialisasi madu* Apis mellifera*. Metode yang digunakan adalah deskripsi kualitatif dengan melakukan observasi dan wawancara mendalam* (in-depth interview) *dengan pelaku usaha perlebahan. Hasil penelitian menunjukkan bahwa terdapat dua sistem penjualan yaitu penjualan langsung dari peternak lebah dan penjualan tidak langung melalui pengumpul/industri. Terdapat selisih keuntungan yang sangat besar yang diperoleh pengumpul/industri ± Rp.80.000,00 /kg, sedangkan peternak hanya memperoleh nilai jual minimal. Pemasaran menjadi permasalahan utama karena peternak cenderung lebih fokus ke upaya budidaya sehingga penjualan madu terkesan sangat sederhana. Diperlukan sinergitas dan pendampingan dari sektor terkait agar dapat memberikan nilai ekonomi yang maksimal bagi masyarakat sekitar kawasan hutan.*

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Introduction

The Ministry of Environment and Forestry, through the Ministerial Regulation No. 83 of 2016 concerning Social Forestry, regulates the use of forest resources to avoid and minimize conflicts. The regulation elaborates that Social Forestry is a sustainable management system implemented in State forest areas or customary forests managed by local or indigenous legal communities as the main actors to improve welfare, environmental balance, and socio-cultural dynamics. The Omnibus Law (Law on Job Creation) also regulates Social Forestry. The legal foundation of the Omnibus Law is in Articles 29A and 29B, emphasizing community empowerment to obtain legal access, mainly through social forestry permits. However, the social forestry program's effectiveness in resolving conflicts in forest management still needs to be improved, due to frequent social and tenurial conflicts caused by economic issues between communities and forest managers (Handoyo 2015; Prastya 2019).

Community empowerment collaborative forest management becomes one of the strategies to minimize conflicts and optimize resource use while improving community livelihood (Widjajanti 2011). Forest fire prevention efforts in the conflict areas also employ a community empowerment strategy using non-timber forest products or NTFP (Yusuf et al. 2019) to obtain ecological and economic benefits while maintaining forest sustainability (Ramawati et al. 2022). Beekeeping to produce honey has become one of the strategies applied in social forestry schemes through the Forestry Partnership Scheme between the Forest Management Unit (FMU) and the communities. Beekeeping has long been practiced by Indonesian communities living around forest areas '(Widiarti & Kuntadi 2012). However, beekeeping around forest areas in Riau, particularly Industrial Forest Plantations (IFP), began in 2019, triggered by a significant increase in honey demand due to the COVID-19 pandemic. Beekeepers imported bee colonies *Apis mellifera* from Java. *Apis mellifera* is a superior species originating from Europe (Hidayat 2011; Cridland et al. 2017) and brought to Indonesia from Australia (Hadisoesilo 1992).

The community in Riau has been familiar with hunting wild honey (*Apis dorsata*) for a long time. However, changes in spatial plans and forest conversion into oil palm plantations induced the decline of wild honey productivity. This phenomenon has shifted from hunting wild honey in forest areas to cultivating the *A. mellifera* bee species, which has high productivity. Several derivative beekeeping products include honey, royal jelly, bee pollen, propolis, beeswax, and bee venom (Singh et. al. 2021). Further diversification includes cosmetic products, such as honey masks, soap, cream, and propolis (Sarah et al. 2019). However, many people are still unaware of the content and benefits of honey produced by *A. mellifera* species, resulting in limited interest in the products. Beekeeping using *A. mellifera* species could become an alternative source of income for the communities around the forest areas through direct products such as honey and the added value produced by diversification (Amar et al. 2017). The honey produced by *A. mellifera* contains over 150 active polyphenolic compounds, including phenolic acid, flavonoids, flavonols, catechins, and cinnamic acid derivates. It also contains a-Cyclodextrin, which has prebiotic and anti-osteoporosis effects (Hasib et al. 2020). In addition, honey produced by *A. mellifera* in *Acacia crassicarpa* forest plantation forests has relatively stable antioxidants, total phenolics, and total flavonoid activities under heating treatment (Handayani et. al. 2022).

The issue arising from the proliferation of *A. mellifera* beekeeping businesses is an oversupply that surpasses market demand. This phenomenon leads to competition in honey-selling prices among beekeepers, indicating a potential imbalance in the supply chain, and the efficacy of transferring processed products from producers to consumers still needs to be fixed. In addition, good quality products with authenticity and quality guarantees become a crucial factor influencing consumers' preferences (Adji 2004). Therefore, *this* research aimed to explore the challenges and develop business models and value chains associated with commercializing *A. mellifera* honey produced by micro, small, and medium enterprises (MSMEs) in the IFP areas.

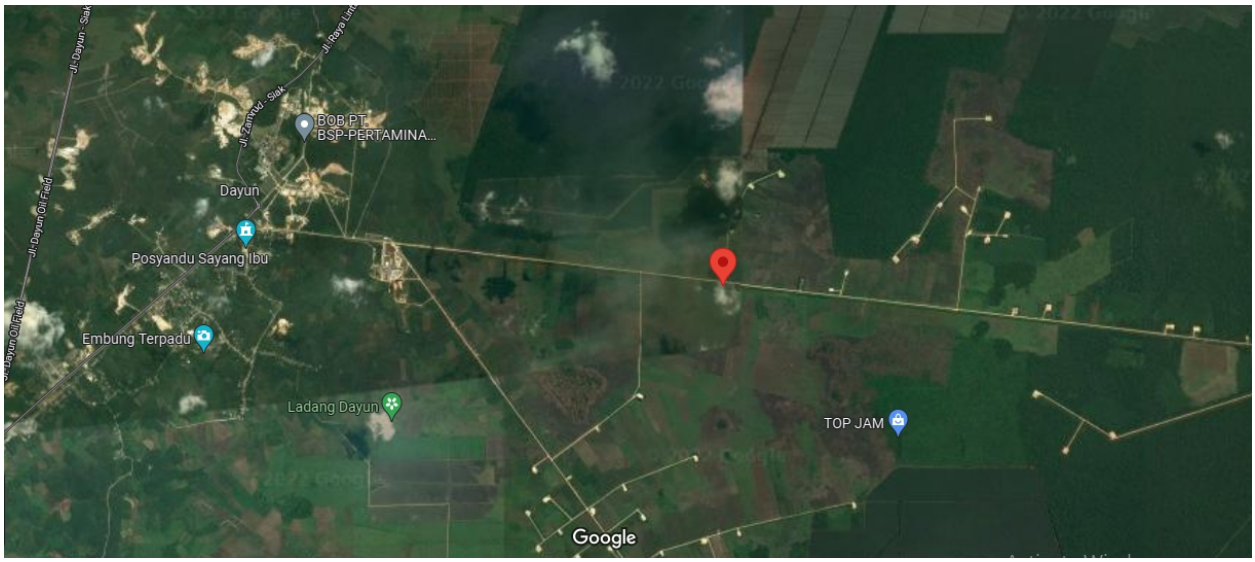

Figure 1. Locations of CV. BM in Dayun Village, Dayun Sub-district, Siak Regency, Riau Province

Methods

Time and Location

This research occurred in November 2022 at the *A. mellifera* bee farm owned by CV. BM located in Dayun Village, Dayun Sub-district, Siak Regency, Riau Province. It is within the oil drilling area of PT. BOB (Joint Operation Body - Badan Operasi Bersama). The farm involved 15 workers. They placed the bee colonies in oil palm plantation areas managed by the community and *A. crassicarpa* IFP managed by PT RAPP (Figure 1).

Dayun Village served as the parent village in Dayun District, approximately 25 km from the Siak city center. Covering a land area of ±82,604 ha, Dayun Village predominantly consisted of peat soil. In 2020, Dayun Village had the highest population in the District, accounting for 8,348 people (BPS 2021). The majority of the population had completed elementary education. The population consisted of Malay ethnic groups and migrants from Batak, Javanese, and Minang. Private sector jobs such as working at IFP and oil palm plantations became the dominant income source for the community in Dayun Village, with average monthly incomes ranging from IDR. 1,500,000.00 to 2,000,000.00. Forest conversion into oil palm plantations resulted in a reduced number of Sialang trees, the preferred nest for *A. dorsata,* leading to wild honey scarcity. This situation prompted the indigenous community, specifically the Malay ethnic group, traditionally hunting wild honey, to shift to beekeeping (Nurhazana et al. 2021; Pramadha et al. 2021). The CV. BM was a business group engaged in beekeeping and selling its products from Dayun Village. In its operations, CV. BM engaged the local community as workers, particularly casual workers and beekeepers, who played essential roles in beekeeping success.

Dayun Village has favorable bio-physical conditions for the beekeeping of *A. mellifera*, including an average rainfall of 2,461 mm, air temperature of 26.7°C-27.9°C, and humidity of 80%-85% (Abou-Shaara 2014; Caselles et al. 2019; Li et al. 2019). Being surrounded by *Acacia crassicarpa* IFP and oil palm plantations, the communities of Dayun Village had the opportunity to engage in *A. mellifera* beekeeping. The *A. crassicarpa* could produce abundant nectar all year long. It contrasted with beekeeping in Java, where beekeepers relied more prevalent on flowers (Handayani et al. 2022; Pribadi et al. 2023; Suhesti et al. 2023). The oil palm plantations became the source of pollen, a protein source responsible for the physiological and immune functions of worker, male, and queen bees (Bryś et al. 2021; Hassan 2011).

Data Collection

This research used the qualitative description method, which included direct observations, questionnaires, and in-depth interviews to gather the primary data and necessary information. Interviews with key informants included the owner/investor,

manager, beekeeper, and field worker of CV. BM. Interviews were also conducted with honey collectors and honey traders. The selection of key informants used snowball sampling, emphasizing the depth of information exploration rather than the number of interviewees. Secondary data consisted of supporting information from technical reports and other relevant sources.

Analysis

Processing and analysis of data incorporated reducing data, presenting data, and drawing conclusions based on the field data. The analysis focused on uncovering facts in the natural setting using the depth study analysis method (Moleong 2014). Processing and analysis of data incorporated reducing data, presenting data, and drawing conclusions based on the field data. The analysis focused on uncovering facts in the natural setting using the depth study analysis method. The analysis comprised the following procedures. The data presentation comprised descriptive and integrative presentation forms. The data comparison compared the compiled and interpreted data with the research objectives. The synthesis addressed the research questions and drew conclusions.

Results and Discussion

Business Model

The Malay community in Riau has a long-standing history with peat and forest (Sialang) bees. The tradition of harvesting sialang honey has been ingrained over generations, forming a significant part of their cultural heritage (Riau 2017). The decrease in Sialang trees shifted the tradition of wild honey hunting to beekeeping as their income source. The communities tried local species *of A. cerana* beekeeping before the introduction of *A. mellifera.* However, communities encountered severe challenges in *A. cerana* breeding, particularly issues related to absconding (Koetz 2013). For this reason, beekeepers preferred *A. mellifera* due to its relatively high adaptability and honey production, facilitating more accessible care and maintenance. *A. mellifera* could produce 35–40 kg of honey per colony per year (Juniarti 2019). The community in Java cultivated *A. mellifera* species widely.

In Riau, one of the predominant models for A. *mellifera* beekeeping was a profit-sharing system that incorporated investors, which was different from the typical honey beekeeping system that emphasized the inclusion of all community members (Saputra & Afifah 2021). The beekeeping model at CV. BM involved the Investor as the capital owner and management as the party managing the funds from the Investor for beekeeping activities, marketing, and sales. These included the third-party selection to provide beekeepers and casual laborers for harvesting. The *A. mellifera* beekeeping activities at CV. BM involved 15 workers. The inventor and manager should agree on the profit and loss sharing, which is recorded in an official cooperation contract document. The common share was 60% for the managers and 40% for the investors. Depending on the negotiation, some could result in a 50:50 share. In CV. BM, the profit-sharing ratio was 60:40, where 60% of the profit went to the manager, and 40 % went to the investor.

The interviews revealed that Dayun Village hosted six *A. mellifera* beekeepers, with approximately 3,000 bee colonies. The CV. BM managed 400 bee colonies imported directly from Pati (Central Java) at a purchase price of approximately IDR. 1,700,000.00 per colony. A truck transported the bee colony, with 167 colonies or boxes per trip. The standard box size for A. *mellifera* was 40 cm x 30 cm x 26 cm, made of non-odorous wood such as sengon, coconut, and suren, and placed near their food sources (Figure 2). In CV. BM, the *A. mellifera* colonies were placed in the oil palm plantation areas managed by the community, adjacent to the *A. crassicarpa* forest areas managed by PT. RAPP.

One bee colony could yield 5-7 kg of honey during the dry season and 1 kg during the rainy season. During the dry season, beekeepers harvested the honey twice a month; during the rainy season, they harvested it only once a month. Several factors affected honey production between the dry and rainy seasons, including the absence of nectar as a food source due to rainfall (Mohamed & Faraj 2022; Landaverde et al. 2023). During the rainy season, bees tended to be dormant in their hives and consumed honey for survival. Harvesting all honey could lead to food shortage and death due to starvation (Branchi-

Figure 2. Location of beekeeping managed by CV. BM (Doc: Pribadi, 2022)

ccela et al. 2019; Neov et al. 2019; Smart et al. 2019). Therefore, beekeepers took the opportunity to divide the colonies and develop new colonies during the rainy season to produce a significant amount of honey after the rainy season.

There were two honey sales systems. The first was direct from beekeepers. In this case, CV. BM promoted, packaged, and sold the honey using its brand (BM Honey). The second was indirect sales systems facilitated by collectors/industries to reach the end consumers. In this case, CV. BM applied a minimum purchase requirement of 50 kg with a significantly lower selling price. The collectors/ industries were not obligated to use the BM Honey band.

With the number of managed bee colonies, in average CV. BM produced approximately 1 ton of honey per harvest, with twice-a-month harvests during the dry season. Depending on the season, direct and indirect sales were varied, with direct sales ranging from 20% to 40% and indirect sales from 60% to 80%. Direct honey sales from producers to the food and beverage industry were almost nonexistent. Some industries dislike dark-colored honey with a pungent taste, which could affect the taste of their end products. The food and beverage industry prefers honey with a light color and mild taste. Additionally, some industries desired a significantly lower than the offered price.

The modern and traditional markets became the channels of almost all industrial honey products. Large-scale companies dominated the honey market share in Indonesia. The market share of small and medium-scale honey producers was around 7.4% (Sarah et al. 2019). Only some people who understood the benefits and preferred *A. mellifera* honey bought the honey directly from the farm, including consumers outside the city.

Value Chain

Farmers sold in two ways, namely through direct sales to consumers as well as sales intermediated by collectors and industry. Consumers could buy honey directly from the farm, online, or by contacting the beekeepers. Beekeepers typically sold honey in plastic bottles, with or without a brand (Figure 3). The price was between IDR. 70,000.00 and IDR. 120,000.00/kg for retail and between IDR. 35,000.00 and IDR. 40,000.00/kg for wholesale, with a minimum purchase of 50 kg. Meanwhile, industrial honey should pass through various treatments to reduce its water content to approximately 18%-20%. The selling price for industrial honey was around IDR. 200,000.00/kg. Low water content could prevent honey fermentation. Johanes et al. (2015) al. reduced honed water content from 23.2% to 18.1% by drying the honey for 12 hours. Darmawan & Agustarini (2011) also reduced honey water content from 23.20% to 21% by

Figure 3. Honey packaging without labels (left) and with labels (right)

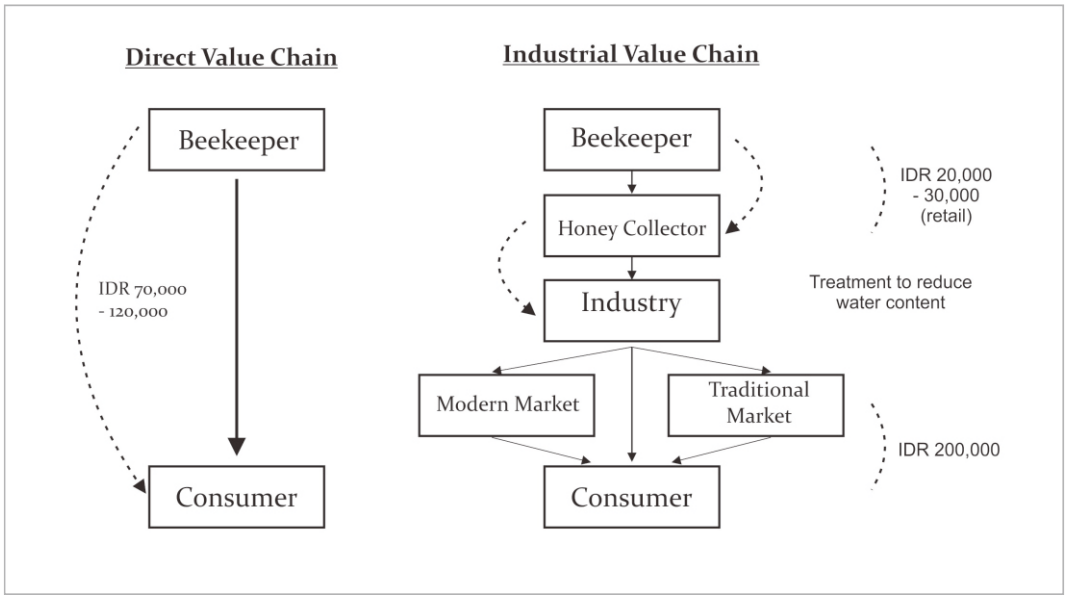

Figure 4. Flowchart of differences in value chains of direct and indirect *A. mellifera* honey sales

using a dehumidifier device in an airtight room and placing honey in a tray at a certain thickness. The Indonesian National Standard (SNI) 3545:2013 requires a maximum honey water content of 22% (Adityarini et al. 2020).

Direct and indirect sales resulted in different incomes for beekeepers (Figure 4). Farmers who sold honey directly to consumers or collectors with regular packaging obtained a significantly lower selling price than the industry. The difference was approximately IDR. 80,000.00/kg. Packaging and reducing water content required significant investment and maintenance costs, which were unaffordable for many beekeepers. In addition, most beekeeper products had no label. The trade regulations and bureaucracy, such as permits from the National Agency of Drug and Food Control (BPOM) or the local Department of Industry and Trade, challenged beekeepers to label their products. Labels or branding attract consumer attention and make products appear unique and easily remembered. Furthermore, it could create strength, uniqueness, and consumer preference, generating loyalty. Repurchases often occur after consumers achieve satisfaction (Alfian & Marpaung 2017). The CV. BM facilitated capacity building for beekeepers, particularly on the hygiene standards to comply with the regulations and post-harvest processing to diversify products.

Challenges

With the COVID-19 pandemic in Indonesia, people in Riau searched for alternative sources of

Table 1. Identification comparison of A.mellifera cultivation challenges at two different locations

No.	Parameter	Location of *A. mellifera* beekeeping	
		Pati (Central Java) (Widiarti & Kuntadi 2012)	Dayun Village (Riau)
1	Availability of feed sources	The quantity of bee feed plants is limited and seasonal. For example, the kapok tree, which is a main feed source, is becoming scarce for migratory beekeeping.	Feed sources in the form of A. crassicarapa plants are abundant, eliminating the need for the shepherd model and encourage the stationary beekeeping.
2	Funds/working capital	During lean periods, beekeepers need extra funds to purchase sugar as supplementary feed, leading to increase operational costs.	A profit-sharing system between investors and farmers could reduce risks for beekeepers.
3	Beekeeping Extension	Lack of beekeeping extension often leads to rejection of migratory beekeeping, as they are perceived to damage flowers and prevent pollination.	Lack of beekeeping extension
4	Technical assisstance	Lack of technical assisstance from relevant institutions. Farmers feel that they are managing and developing honey beekeeping on their own.	Limited supports from the Local Government and timber plantation companies (IFP).
5	Queen quality	No high-quality queen bees, impacting the population growth of colonies.	Queen quality is similar to the origin of the colonies in Pati, Central Java.
6	Pests and diseases	Infestation of the Varroa destructor could cause significant losses.	Infestation of the Varroa destructor could cause significant losses.

income from *A. mellifera* beekeeping. *A. mellifera* species was not native to Riau, requiring proper investigation to determine its survival level and adaptation ability to a new ecosystem different than Java. Previous research suggested the availability of feed sources, funds or working capital, beekeeping extension or information, technical assistance, high-quality queen bees, and pests and diseases became the primary issues in *A. mellifera* beekeeping in Pati, Central Java ('Widiarti & Kuntadi 2012).

Marketing became one of the challenges during the abundance of honey production. Establishing a beekeeper association became one of efforts to maintain price stability and to enhance marketing capability. However, price competition persisted among beekeepers and sellers of *A. mellifera* honey due to the need for binding agreements and legal consequences to minimize self-interests in price competition. Therefore, the development of SMSE beekeeping required synergy between beekeepers and local, provincial, and central governments.

In this case, CV. BM played several roles through collaboration with various stakeholders, including local governments, private sectors, state-owned enterprises (SoE), and regional-owned enterprises (RoE), to market honey products and boost sales. Among other efforts were promoting honey consumption among civil servants of the local government by setting 'honey consumption day' and buying honey directly from the beekeepers. The SoE and RoE facilitated domestic and international sales through exhibition spaces as promotional and marketing platforms to increase sales. These efforts were sub-optimal and insignificantly increased honey sales. The implementation of social forestry in *A. mellifera* beekeeping involved various parties. The intensive collaboration among beekeepers and other parties was essential to ensure the success and sustainability of social forestry activities. Moreover, collaboration among various stakeholders required continuous improvement to ensure effective coordination and synergy.

Based on the identified challenges, three main issues required urgent intervention. The issue of price disparities between beekeepers and collectors required an increase in direct sales to the end consumers and a decrease in indirect sales to balance the market share and prevent monopoly. The challenges related to increasing production capacity required an incremental increase in working capital, upgrading technical capabilities, and enriching bee-feed plant sources. Involving local and central governments through working capital subsidies and relevant training programs could improve production capacity and technical capability. Marketing challenges could be addressed through collaboration with relevant universities to provide support in marketing, including packaging and branding

innovations.

The *A. mellifera* species shoved its adaptation capability in the CV. BM in Riau province with *A. crassicarpa* as the primary feed source. The availability of this abundant feed source served as a supporting factor for the success of honey beekeeping. Furthermore, *A. crassicarpa* could produce nectar from the axils of leaves abundantly all year long. This type of honey was known as acacia honey, the flagship honey of Riau province. From a sociocultural perspective, the community had a long history with bees, specifically wild species, facilitating the quick adoption of new species. Riau was a wild honey (*A. dorsata*) producer long before the introduction of beekeeping practice.

The community required intensive assistance to create positive economic benefits from beekeeping. *A. mellifera* beekeeping was highly profitable, with a B/C ratio of more than one (Adalina 2008). The B/C ratio of *A.mellifera* beekeeping in CV. BM was 4.30, indicating that the beekeeping business was profitable, making the activity acceptable and worth continuing. However, community empowerment through beekeeping in the IPF area needed clear marketing strategies and sustainability. Unclear marketing strategies could significantly impact income, leading to economic disempowerment and potential new conflicts.

Conclusion

In conclusion, this research revealed that *the A. mellifera* beekeeping business in Dayun used a profit-sharing system, with a 60% share for the manager and 40% for the investor. In honey sales, farmers only benefited from a bottom selling price, while collectors and industries obtained the most significant profit with a difference of approximately IDR. 80,000.00/kg. This issue could be addressed by gradually increasing the volume of direct sales to consumers. Compared to honey beekeeping in Java, which used a migratory system (*angon*) due to limited food sources, beekeepers in Riau could conduct stationary beekeeping. This reason made *A. mellifera* beekeeping financially feasible. However, marketing activities posed the most significant challenge, requiring support and collaboration from various stakeholders to enable beekeepers to achieve more ideal profits.

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Author Contributions: Andhika Silva Yunianto contributed to the ideas, writing concepts, data collection, and the field of social forestry. Avry Pribadi played a role in interviews, data collection, and honey beekeeping. Hery Kurniawan contributed to the research design, data collection, and silviculture. Ahmad Junaedi participated in data collection, silviculture, and land suitability. Siti Wahyuningsih contributed to data collection and land suitability, while Michael Daru Enggar Wiratmoko played a role in data collection, the field of economics, and honey beekeeping.

References

Abou-Shaara HF. 2014. The foraging behaviour of honey bees, *Apis mellifera*: A review. Veterinární Medicína **59**(1): 110. DOI: 10.17221/7240-VETME:

Adalina Y. 2008. Analisis finansial usaha lebah madu *Apis mellifera* L. Jurnal Penelitian Hutan dan Konservasi Alam **5**(3):217237.

Adityarini D, Suedy SWA, Darmanti S. 2020. Kualitas madu lokal berdasarkan kadar air, gula total dan keasaman dari Kabupaten Magelang.Buletin Anatomi dan Fisiologi **5**(1):18-24.

Adji S. 2004. Khasiat dan manfaat madu herbal. Agromedia Pustaka Jakarta.

Alfian I, Marpaung M. 2017. Analisis Pengaruh label halal, brand dan harga terhadap keputusan pembelian di Kota Medan. At-Tawassuth **2**(1):122145.

Amar FN, Dwiningsih E, Humaerah AD. 2017. Analisis nilai tambah produk turunan madu pada CV. Madu Apiari Mutiara Cimanggis, Depok, Jawa Barat. Jurnal Agribisnis **11**(5):6276. DOI: 10.15408/ aj.v11i1.11834

Branchiccela B, Castelli L, Corona M, Díaz-Cetti S, Invernizzi, C, Martínez de la EG, Mendoza Y, Santos E, Silva C, Zunino P, Antúnez K. 2019. Impact of Nutritional stress on the honeybee colony health. Scientific Reports **9**(10156):111. DOI: 10.1038/s41598-019-46453-9

Bryś MS, Skowronek P, Strachecka A. 2021. Pollen dietproperties and impact on a bee colony. Insects

12(798). DOI: 10.3390/insects12090798

Caselles CA, Soto VC, Galmarini CR. 2019. Effect of environmental factors on bee activity and onion (*Allium cepa* l.) seed yield. Revista de La Facultad de Ciencias Agrarias **51**(2):1326.

Cridland JM, Tsutsui ND, Ramírez SR. 2017. The complex demographic history and evolutionary origin of the western honey bee, *Apis mellifera*. Genome Biology and Evolution **9**(2):457472. DOI: 10. 1093/gbe/evx009

Darmawan S, Agustarini R. 2011. Penurunan kadar air madu hutan alam Sumbawa.Balai Penelitian Teknologi Hasil Hutan Bukan Kayu Lombok Barat. NTB, 319-321.

Hadisoesilo S. 1992. Evolutionary and development of beekeping in Indonesia (pp.39-44). In Proceeding of the Beenet Asia. Workshop on Priorities in R&D on Beekeeping in Tripical Asia. Beenet Asia, Universiti Pertanian Malaysia, Southbound.

Handayani TH, Budiman MA, Amalia RLR, Pribadi A, Elfirta, RR, Ferdian PR. 2022. Aktivitas antioksidan, total fenolik, dan total flavonoid madu *Apis mellifera* dari Hutan Akasia (*Acacia crassicarpa*) Riau, Indonesia dengan beberapa perlakuan pengeringan. Jurnal Biologi Indonesia **18**(2):231243. DOI: 10.47349/jbi/18022022/231

Handoyo. 2015. Resolusi konflik di Taman Nasional Tesso Nilo Riau, Indonesia: Tinjauan Relasi pemangku kepentingan. Jurnal Analisis Kebijakan Kehutanan **12**:89103.

Hasi A, Wahjuningrum DA, Ibrahim MHR, Kurniawan HJ, Ernawati R, Hadinoto MEK, Mooduto L. 2020. ALP (alkaline phosphatase) expression in simple fracture incident in rat (Rattus norvegicus) femur bone supplemented by *Apis mellifera* honey. Journal of International Dental and Medical Research **13**(3):887891.

Hassan HMM. 2011. Chemical composition and nutritional value of palm pollen grains. Global Journal of Biotechnology & Biochemistry **6**(1):17.

Hidayat MR. 2011. Penelusuran asal wilayah lebah madu A. mellifera di Indonesia menggunakan daerah intergenik cox1/cox2 DNA mitokondria. Jurnal Biopropal Industri **01**:2737.

Johanes, Kurniawan I, Yohanes. 2015. Penurunan Kadar air madu dengan dehidrator vakum. Jurnal Online Mahasiswa Bidang Teknik dan Sains **2**(1):15. https://jom.unri.ac.id/index.php/JOMFTEKNIK/article/view/6308/6008

Juniarti PI. 2019. Pengenalan koloni lebah madu Bagian 2. Dinas Lingkungan Hidup dan Kehutanan Daerah Istimewa Yogyakarta. https://dlhk.jogjaprov.go.id/pengenalan-koloni-lebah-madu-bagian-1

Koetz AH. 2013. Ecology, behaviour and control of Apis cerana with a focus on relevance to the Australian Incursion. Insects **4**:558592. DOI: 10.3390/insects4040558

Landaverde R, Rodriguez MT, Parrella JA. 2023. Honey production and climate change: Beekeepers perceptions, farm adaptation strategies, and information needs. Insects **14**(493). https://eric.ed.gov/?id=ED100311

Li X, Ma W, Shen J, Long D, Feng Y, Su W, Xu K, Du Y, Jiang Y. 2019. Tolerance and response of two honeybee species *Apis cerana* and *Apis mellifera* to high temperature and relative humidity. PLoS ONE **14**(6):118. DOI: 10.1371/journal.pone.0217921

Mohamed I, Faraj F. 2022. The effect of rainfall and temperature on honey production evidence from Libya. AlQalam Journal of Medical and Applied Sciences **5**(2):438446.

Moleong LJ. 2014. Metode Penelitian Kuantitatif, Edisi Revisi. PT Remaja Rosdakarya, Bandung.

Neov B, Georgiev A. Shumkova R, Radoslavov G, Hristov P. 2019. Biotic and Abiotic factors associated with colonies mortalities of managed honey bee (*Apis mellifera*). Diversity **11**(237):116. DOI: 10.3390/d11120237

Nurhazana N, Iznillah, ML, Pianto SR. 2021. Dampak program CSR binaan PT Pertamina RU II Sungai Pakning: Analisis soial return on investment (SROI) dan sensitivitas. Jurnal Akuntansi dan Ekonomika **11**(2):203212. DOI: 10.37859/jae.v11i2.2817

Pramadha R, Yoga SV, Hartono R, Satria WD, Hidayat R. 2021. Analisis Laba sosial atas investasi: Menyibak Asap panen madu hutan gambut untuk kesejahteraan yang lebih cerah. Journal of Social Development Studies **2**(2):6881. DOI: 10.22146/jsds.2187

Prastya IY. 2019. Konflik dalam pengelolaan hutan lindung. Jurnal Kebijakan Publik **10**(2):111. DOI: 10.31258/jkp.10.2.p.111-118

Pribadi A, Kurniawan H, Junaedi A, Yunianto AS, Wiratmoko MDE, Wahyuningsih S, Novriyanti E, Aswandi, Kholibrina CR, Roza D. 2023. Financial analysis of beekeeping practices at *Acacia crassicarpa* plantation forest in Riau Province , Indonesia. Jurnal Manejemen Hutan Tropika **29**(2):136149. DOI: 10.7226/jtfm.29.2.136

Ramawati, Ekawati S, Kurniasari DR. 2022. Bentuk kelembagaan dan dampak pemberdayaan masyarakat melalui pemanenan madu hutan (Apis dorsata) di Taman Nasional Ujung Kulon. Jurnal Analisis Kebijakan Kehutanan **19**(1):114. DOI: 10.20886/jakk.2022.05.30.1-14

Riau RE. 2017. Madu hutan. https://www.rekoforest.org/id/masyarakat/madu-hutan/

Saputra MPD, Afifah N. 2021. Strategi pengembangan bisnis pada Pusat Koperasi Madu Hutan Kapuas Hulu melalui bisnis model canvas (BMC). Proceeding Seminar Bisnis Seri V, 249268.

Sarah D, Suryana RN, Kirbrandoko. 2019. Strategi bersaing industri madu (Studi kasus: CV Madu Apiari Mutiara). Jurnal Aplikasi Manajemen dan Bisnis **5**(1):7183. DOI: 10.17358/jabm.5.1.71

Singh AS, Takhellambam M. 2021. Honey bee products: Honey and royal jelly and their nutritional and medicinal values to humans. British Journal of Bio-Medical Research **5**(3):16041619. DOI: 10. 24942/bjbmr.2021.815

Smart MD, Otto CRV, Lundgren JG. 2019. Nutritional status of honey bee (*Apis mellifera* L.) workers across an agricultural land-use gradient. Scientific Reports **9**(16252):110. DOI: 10.1038/s41598-019-52485-y

Suhesti E, Zalizar L, Triwanto J, Ervayendri, Setyobudi RH, Waskitho NT, Ibrahim JT, Maftuchah, Hadinoto, Vincēviča-Gaile Z, Tonda R, Anggara A, Hartono R, Lestari SU, Pakarti TA. 2023. Quality assessment on honey produced from six months old Acacia crassicarpa. E3S Web of Conferences **374**. DOI: 10.1051/e3sconf/202337400012

Widiarti A, Kuntadi. 2012. Budidaya lebah madu *Apis*

mellifera L. oleh masyarakat pedesaan Kabupaten Pati, Jawa Tengah. Jurnal Penelitian Hutan dan Konservasi Alam, **9**(4):351361.

Widjajanti K. 2011. Model Pemberdayaan Masyarakat. Jurnal Ekonomi Pembangunan **12**(1):1527.

Yusuf A, Hapsoh H, Siregar SH, Nurrochmat DR. 2019. Analisis kebakaran hutan dan lahan di Provinsi Riau. Dinamika Lingkungan Indonesia **6**(2):67. DOI: 10.31258/dli.6.2.p.67-84