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Best Practices and Challenges in Honey Bee Ventures: A Comprehensive Analysis of Sustainable Beekeeping

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Abstract: This study focuses on the lived experiences, best practices, and persistent challenges of beekeepers within Sorsogon Province to establish a robust framework for sustainable honey bee ventures. Data gathered from fifteen experienced practitioners revealed that participants encounter significant unpredictability driven by environmental instability and insufficient institutional support, frequently requiring the utilization of locally improvised equipment. Critical obstacles identified include devastating pests and diseases specifically Varroa mites extreme weather fluctuations, and market competition from lower-priced imported honey. To mitigate these risks, practitioners employ adaptive strategies, primarily through active membership in cooperatives for knowledge exchange and the implementation of climate-resilient techniques, such as seasonal hive insulation and supplemental feeding. Key results highlight that sustainability is driven by six universal best practices: regular hive inspections, selective queen breeding for disease resistance, sustainable harvesting, planting nectar-rich flora, monitoring weather for hive adjustments, and collaborating with other beekeepers. Notably, 100% of participants rely on collective action through associations to bridge significant gaps in formal technical training and resource acquisition. The findings culminate in a proposed strategic venture direction that formalizes these community-based models. This framework emphasizes the urgent necessity for streamlined government permitting processes and enhanced technical assistance to bolster the economic viability and ecological resilience of the local apiculture sector, ensuring long-term growth and environmental stewardship.

Keywords: *Honey Bee Ventures, Beekeeping, Ecological Resilience, Climate-Resilient Techniques.*

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I. INTRODUCTION

Beekeeping is regarded as an agro-business because of its contribution to farmers, such as good income and obtaining other resources (Singh and Singh, 2006). It is known as the nursing of honeybees and their rearing for pollination purposes and to obtain assorted products. In addition, the applied science of raising and nurturing honeybees for the economic benefit of man is regarded as beekeeping. This venture helps in enhancing economic figures as it has a significant contribution in increasing household income as well as the economy at the local, national, and global levels, which eventually alleviates poverty.

According to Pande et al. (2020), the production of honey and other products from beekeeping throws light on the economic dynamics at the global level. Ajao and Oladimeji (2013) mentioned that it also serves as a source of industrial raw material, contributes to nutritional security, leads to the enhancement of environmental resilience, and gives emphasis on the conservation of biodiversity.

Beekeeping can be considered a “practice for all” because of several compelling reasons, such as environmental benefits, economic benefits, community engagement, health benefits, conservation efforts, educational value, and accessibility. Monga and Manocha (2011) stated in their study that people from every age group can engage in and practice beekeeping, such as women, men, children, retired persons, and others. In addition, most people from the early age group participated, and it leads to the creation of self-employment because of the successful promotion of beekeeping ventures in rural areas (Masuku and Mtshali, 2012; Moniruzzaman and Rahman, 2009).

The most well-known and common honeybee species in the world are Apis mellifera, Apis dorsata, Apis florae,

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and Apis cerana (Kebede and Adgaba, 2011). Apis mellifera is native to Africa and Europe and is easy to manage compared with other species, but aggressive. A. mellifera has an ability is also highly productive and can easily adapt to different climatic conditions. On the other hand, Apis dorsata, Apis florae, and Apis cerana are honeybee species that are natives of Asia.

One of the raw materials produced by honeybees is called honey. It is a viscous, sweet, sugary, and sticky food substance which are made from the secretions of flora in the form of nectar under the processes of enzymatic activity, regurgitation, and water evaporation. Honey contains readily accessible sugars, proteins, vitamins, amino acids, minerals in minimal amounts, and certain pigments in microquantities, phenolic compounds, flavor, colloids, and aroma. In fact, according to Hasam et al. (2020), honey provided about 46 calories in a one tablespoon serving. Because of human consumption and the worldwide commercial production of honey variety, its value increases. The production of honey has a great exporting potential in different industries such as pharmaceuticals and many more. Honey can be used as an antioxidant, as a raw material in many industries, as a pollinator, as a source of employment, as a food supplement, and as a medicine. Moreover, other specific bee products leading to a good profit or income are bee wax, royal jelly, bee pollen, venom, and propolis. Beeswax is a secondary product produced in beekeeping ventures, which provides authenticity and is also used for making candles. The royal jelly is produced by worker bees for feeding the queen, and its production can be labor-intensive and expensive. Royal jelly can provide optimum daily intake in its spoon feed, which is good for health. Bee pollen is easy to collect and is used as a dietary supplement, while venom is a secretion that contains toxins such as apitoxin. Furthermore, another bee product is propolis. It is a resinous mixture released by honeybees after mixing saliva and beeswax that can be used as a sealant. Abrol (2016), said that the countries that are leading in honey imports are the United Kingdom, Japan, Germany, and the United States, whereas the countries that serve as major honey exporters are China, Argentina, Mexico, and India. These are the only countries with global honey production that enter international trade, accounting for only about 31.2%. Some of the standard volume determinants for the honey trade are certain food safety and quality parameters. 35% of honey production in the world was constituted by China, followed by other countries such as Turkey, Argentina, Ukraine, the United States, Russia, India, and Mexico, which account for 6% as a total. However, different countries also faced or encountered various problems in beekeeping. These include excessive use of pesticides, weather and climatic effects, various bee diseases, bee enemies like wasps, lack of technical knowledge and awareness, wrong selection of bees, deforestation leading to a lack of adequate flora, and unavailability of infrastructure at various levels. Gender is also another factor that affects honey production. Women are limited from participating in the beekeeping sector because of stings.

The Philippines is lucky to have a rich variety of honeybee species. It has Apiscerana (eastern honeybee), Apis mellifera (European bees), Trigona / Tetragunula (stingless bees), and Apisbreviligula (giant honeybee of the Philippines). According to Peter (2018), these species are all mesmerizing and have diverse behaviors. Nevertheless, in the Philippines, when beekeeping is discussed, what immediately comes to the individual's mind are the Apis mellifera or the European honeybees, which are the most common species in the world propagated for honey production and pollination. European honeybees are still the most utilized bee kind in the Philippines. The country is blessed with various feral honey-producing bee species (Yap, Jr., and J.P., 2018). In the Philippines, beekeeping is a thriving industry that perfectly matches the natural landscape of the country. All types of honeybees that can be utilized for beekeeping exist in this country. Among the noteworthy elements that affect the benefit of beekeeping enterprises are queen quality, biological conditions, types of innovation, flower arrangement, and asset management. Additional central point's influencing the productivity of beekeeping organizations are the kinds of hives utilized, colony quality, the age of the queen, swarming of colonies, and bumblebee management. On the other hand, the absence of the nature of Apis mellifera and the varroa bug pervasion is considered an essential difficulty of beekeeping in the Philippines.

According to statistics, from 1989 to the present, the Philippines has been importing more than a billion worth of honey and other bee products. This implies that the local market has a huge demand for honeybee products. In the country, honey is commonly used as a health food. The pharmaceutical sectors utilize it as a base for energy drinks and cough syrups. Pollen and royal jelly are components of capsules and energy pills. Some of the bee products are also used by cosmetics companies as beautifying agents. The country's current beekeeping industry owes its success to the private sector, particularly the bee enthusiasts who conducted their own research and development work. Baconawa (2003), stated these bee enthusiasts invested a lot of effort and money to promote the industry.

The world supply of pure honey is falling. China, as one of the most noteworthy providers of bee items, is prohibited from trading to the USA and other European countries because its honeybee items are corrupted or contaminated with prohibited antibiotics. This issue would be a good opportunity for the Philippines to fill the void caused by this ban. The Philippines can pitch natural honeybee items to the world market. However, several challenges in the beekeeping industry were also present in the Philippines.

These include climate change that severely affects the health of bees, competition from imported beef products, and the existence of fake and adulterated honey. Further, beekeepers experienced difficulties in the status of monitoring, evaluation, communication, and inventory have affected the efficiency of honey production. Appropriate training for more beekeepers, as well as funding from the

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government, is needed to increase the bee products. The magnitude of the beekeeping industry provides a tremendous market opportunity for beekeeping technology to be introduced, grow, and develop. In the Philippines, particularly in the region, no apiary uses any kind of technology in their operation. Thus, demand for such technology will be advantageous.

Most of the beekeepers around the world adapt and apply different practices to overcome the adverse effects of various challenges. Some followed the Paul's Six Points Emphasis which refers to six significant steps namely; (1) Ensure honey bee colonies have sufficient feed stores for winter, (2) Ensure honey bee colonies are populous going into winter, (3) Monitor pest and disease levels (particularly varroa), (4) Manage varroa mite levels in honey bee colonies during the season, (5) Wrap or insulate honey bee colonies for winter, and (6) Maintain good documentation. Some of the local beekeepers have their strategies in facing different challenges according to the availability of their resources, as well as the existing factors that influence the productivity of the honeybee ventures.

This study, therefore, gathered information about the challenges and best practices in honeybee ventures in Sorsogon Province. All the data collected were used to formulate a comprehensive analysis for sustainable beekeeping. Specifically, this study determined the experiences of beekeepers in honey bee ventures, their best practices, the challenges experienced by the bee keepers in their ventures, the strategies they utilized in maintaining a sustainable beekeeping, and finally, developed an output that help to navigate the challenges and optimize the best practices in honey bee venture based on the data gathered.

➢ *Problem Statement*

The study about the challenges and best practices in honeybee ventures: a comprehensive analysis of sustainable beekeeping answered the following questions:

- What are the experiences of beekeepers in honeybee ventures?
- What are the best practices experienced by beekeepers in honeybee ventures?
- What are the challenges experienced by beekeepers in honeybee ventures?
- How do beekeepers overcome various challenges in honeybee venture operations?
- What strategic venture direction for the honeybee farming venture can be proposed based on the identified best practices and resolved challenges?

II. METHODOLOGY

The study on the challenges and best practices in honeybee ventures employed mixed-method research to determine and analyze the best practices in honeybee ventures in Sorsogon Province, making it sustainable. This approach combines quantitative elements, such as surveys, with qualitative approaches like interviews to gather the needed data on sustainable beekeeping practices. Combining these methods allows for a deeper and more comprehensive understanding of both challenges and best practices in honeybee ventures.

➢ *Respondents*

The primary source of data for this study was the survey questionnaire, which helped provide firsthand information from the participants. Surveys were administered to collect the necessary quantitative data about the experiences and best practices of the participants in beekeeping, as well as the challenges they have encountered and the strategies they employed to avoid or minimize their impact. Secondary sources of this study were existing literature from academic journals, books, and existing studies related to sustainable beekeeping practices.

The researcher used purposive sampling in determining the participants of the study. Purposive sampling is a non-probability sampling technique in which the participants are chosen because they have the characteristics and valid information needed in the study.

The participants were 15 beekeepers from Sorsogon Province, of which 7 are from Bulusan, 2 from Castilla, 2 from Gubat, from Sta Magdalena, and 1 each from Matnog and Casiguran.

Table 1 The Participants

Location of Ventures	Number of Participants
Bulusan	7
Casiguran	1
Castilla	2
Gubat	2
Matnog	1
Sta Magdalena	2
Total	15

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➢ *Research Instruments*

This study employed different research instruments to gather valid and relevant data on honeybee ventures. Survey questionnaire distributed to the participants collected quantitative information regarding the subjective experiences of the participants, specifically on their practices, challenges they have encountered during the ventures, and the strategies they have used. An in-depth interview was also conducted to further enhance the qualitative data to gather the insights of the participants on the best practices for sustainable beekeeping.

➢ *Data Collection Procedures*

The researcher designed a survey questionnaire that led to identifying information about the experiences and best practices of the participants in beekeeping, and the existing challenges and strategies they used in honeybee ventures. After one week, the responses of the participants will be retrieved to avoid contamination of the data. Furthermore, in-depth interviews were scheduled to discuss the best practices in sustainable beekeeping. All the data were recorded, compiled, analyzed, and triangulated to ensure accuracy and depth in the findings of the study.

During the data gathering stage, the research adviser was of great help and was able to give guidance and support to make sure that everything was conducted systematically and according to procedure. The adviser looked at the research tool and suggested changes to make the questions clearer and more appropriate for the purpose of the research. Moreover, the adviser gave directions to the researchers on how data should be gathered systematically and confidentially, as well as the correct procedure on how to communicate with the respondents.

➢ *Data Analysis Methods*

The descriptive statistical tools such as frequencies and percentages were utilized to clearly describe the subjective experiences of the participants in beekeeping. This approach allowed the study to systematically present the distribution of respondents according to their years of experience, type of beekeeping practice, and purpose of engaging in honeybee ventures. By quantifying these variables, the analysis provided a clear profile of the participants and established a solid foundation for understanding how their level of experience and practice context influenced their perspectives, challenges, and decision making in beekeeping.

Descriptive statistics were likewise employed to analyze the best practices in beekeeping identified by the participants. A frequency and percentage distribution was generated to determine which practices were most implemented in sustaining honeybee ventures. This method made it possible to highlight widely adopted practices such as regular hive inspection, sustainable harvesting, and collaboration with other beekeepers, while also identifying practices that were less frequently used. The results offered insight into the level of awareness, accessibility, and consistency of best practice implementation among the participants.

The challenges experienced by the participants were examined through a combination of descriptive statistics and qualitative analysis. Frequencies and percentages were used to tabulate the reported challenges, allowing for a clear comparison of the most prevalent difficulties encountered in beekeeping. In addition, qualitative data from interview responses were analyzed to capture deeper explanations and personal insights behind these challenges. This mixed approach provided a more comprehensive understanding of both the extent and the nature of the difficulties faced by beekeepers.

Descriptive statistical analysis was applied to summarize the strategies used by the participants to overcome challenges in beekeeping. Frequencies and percentages were calculated to determine the most employed strategies, such as joining cooperatives, using locally available materials, and establishing buyer partnerships. Qualitative interview data were also examined to enrich the findings by explaining how and why these strategies were implemented. This combination of quantitative and qualitative analysis helped present a more nuanced and contextualized discussion of the adaptive responses of beekeepers.

A comprehensive and integrative analysis of the findings from SOP 1 to SOP 4 was conducted to develop the most appropriate proposed output. The results on experiences, best practices, challenges, and strategies were synthesized to identify patterns, gaps, and opportunities in honeybee ventures. This process ensured that the proposed strategic venture direction was evidence based, context specific, and aligned with the actual needs and capacities of the participants. The output thus serves as a practical and sustainable framework aimed at strengthening honeybee farming and addressing the identified challenges effectively.

➢ *Statistical Analysis / Qualitative Analysis*

The qualitative data obtained through the interviews were subjected to thematic analysis. Thematic analysis is a research process that involves the identification, organization, and interpretation of patterns of meaning (themes) within qualitative datasets. This analysis technique helped the researcher conduct an in-depth examination of the responses of the participants and develop meaningful themes that would reflect their experiences, practices, problems, coping mechanisms, and suggestions concerning the honeybee business. The selection of this kind of analysis technique was justified by the fact that the research aimed at obtaining a thorough understanding of the experiences of the beekeepers.

Thematic analysis was conducted in accordance with six stages suggested by Braun & Clarke. The researcher first became acquainted with the data through repeated readings of the transcribed interviews. The second step involved assigning initial codes to the significant responses relevant to the objectives of the research. In the third stage, similar codes were clustered into potential themes to reflect recurring patterns in the respondents' accounts. Next, the established themes were thoroughly checked and adjusted

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for accuracy in terms of the data provided and the study objectives. At the fifth stage, the themes were defined and labelled properly to reflect their meaning. Finally, the themes were synthesized and interpreted within the framework of reviewed literature and previous studies.

In order to increase the validity and reliability of the findings, the researcher ensured that there was consistency among the generated themes by reviewing the interviews again. Direct quotations from the participants were included wherever possible as evidence in the interpretation of the findings to ensure the credibility of the information provided by the participants. The themes generated provided the framework through which major findings could be analyzed and recommendations/strategies for improvements could be developed to improve the operations of honeybee projects in the study area.

Descriptive statistics were used in order to describe the demographics of the participants. Statistical techniques like frequency and percentage distribution were used to describe variables like age, gender, years of experience in beekeeping, level of education, and other related variables.

III. RESULTS AND DISCUSSIONS

➢ *The Experiences of Beekeepers in Honeybee Ventures*

Table 2 General Information of the Participants

General Information	Frequency	Percentage
Years of Experience in Beekeeping		
Less than 1 year	0	0
1 – 3 years	0	0
4 – 6 years	7	47%
7 years or more	8	53%
Type of beekeeping practice		
Backyard	15	100%
Commercial	0	0
Large-scale apiary	0	0
Purpose of Beekeeping		
Honey production	15	100%
Pollination Services	0	0
Beeswax and other bee products	15	100%
Hobby / Research	3	20%

The findings indicate that the participants' extensive years of experience in beekeeping strongly shape how they perceive and manage honeybee ventures. With all respondents having at least four years of experience, their narratives reflect accumulated practical knowledge, emotional resilience, and adaptive capacity developed through prolonged engagement. This suggests that beekeeping experience functions not only as technical expertise but also as an experiential learning process where repeated exposure to uncertainty enhances coping mechanisms. The dominance of backyard beekeeping further contextualizes these experiences as small-scale and resource-dependent, reinforcing the need for improvisation and close colony monitoring. These results imply that experience, scale, and purpose of beekeeping collectively influence how challenges are understood and addressed by beekeepers.The theme of mixed emotions and unpredictability highlights the inherently unstable nature of beekeeping as a livelihood involving living organisms and environmental dependence. Participants' accounts of fulfillment alongside frustration demonstrate that emotional fluctuations are integral to beekeeping experiences. This aligns with recent studies emphasizing that beekeeping involves high emotional labor due to climate variability, pest outbreaks, and colony collapse risks (Kumar et al., 2018; Klein et al., 2021). Similar findings were reported by Amulen et al. (2019), who noted that small-scale beekeepers often experience uncertainty despite applying appropriate management practices. The present study reinforces the idea that emotional adaptability is a critical, yet often overlooked, dimension of sustainability in honeybee ventures.

The unpredictability described by participants is consistent with post-2017 literature highlighting environmental stressors affecting apiculture. Climate change, erratic weather patterns, and declining forage availability have been widely documented as major contributors to colony instability (Le Conte & Navajas, 2018; Reddy et al., 2020). However, unlike some studies that emphasize ecological decline as a dominant concern, the participants in this study framed unpredictability more through lived experience rather than scientific causation. This suggests that beekeepers interpret uncertainty

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pragmatically, focusing on immediate outcomes rather than abstract environmental explanations. Such findings support the argument that experiential knowledge complements scientific understanding in beekeeping practice.

The theme of improvisation and lack of institutional support reveals structural constraints influencing beekeeping experiences. Participants consistently reported limited access to training, financial assistance, and modern equipment, compelling them to rely on locally available materials and self-developed strategies. This finding mirrors the studies of Bradbear and Fisher (2019) and Chazovachii et al. (2020), which found that smallholder beekeepers in developing contexts often compensate for institutional gaps through innovation and peer learning. The reliance on improvisation underscores beekeepers' agency but also exposes systemic weaknesses in agricultural support systems. Thus, improvisation emerges both as a survival strategy and as evidence of insufficient institutional intervention.Previous studies published after further supported the link between limited institutional support and constrained growth in beekeeping ventures. For instance, Ahmed et al. (2021) found that lack of government programs and extension services significantly limited productivity and expansion among backyard beekeepers. Similarly, Yirga and Teferi (2020) emphasized that training and financial incentives play a crucial role in improving beekeeping efficiency and sustainability. The consistency of these findings with the present study suggests that the experiences of participants are not isolated but reflective of broader structural issues faced by small-scale beekeepers. Overall, the results affirm that while beekeepers demonstrate resilience and creativity, sustained development of honeybee ventures requires stronger institutional support and policy intervention.

➢ *The Best Practices Experienced by Beekeepers in Honeybee Ventures*

Table 3 Best Practices of Participants in Beekeeping

Practices	Frequency	Percentage
Use of Modern Beekeeping Equipment	2	13%
Regular Hive Inspection and Maintenance	15	100%
Proper Feeding and Nutrition Management	9	60%
Disease and Pest Control Measure	9	60%
Queen bee selection and colony management	15	100%
Sustainable harvesting techniques	15	100%
Providing adequate water sources for bees	6	40%
Planting nectar-rich plants around the apiary	15	100%
Monitoring weather and climate conditions for hive adjustment	15	100%
Engaging in continuous training and beekeeping seminars	0	0
Collaboration with other beekeepers or cooperatives	15	100%
Adherence to local and international beekeeping Regulation	0	0
Marketing and branding of honey and other bee Products	9	60%

There are 6 best practices that were observed by all the respondents. These include Regular hive inspection and maintenance, Queen bee selection and colony management, Sustainable harvesting techniques, planting nectar-rich plants around the apiary, monitoring weather and climate for hive adjustments, and Collaboration with other beekeepers or cooperatives. Regular hive inspection and maintenance is a fundamental beekeeping practice that involves routinely checking the beehive to monitor the health and activity of the colony. During inspections, beekeepers observe the presence of the queen, brood patterns, honey and pollen stores, and any signs of diseases, pests, or abnormalities. This practice helps in early detection of problems such as queen loss, swarming tendencies, or infestations like Varroa mites, allowing timely intervention. Regular maintenance also includes cleaning hive parts, replacing damaged frames, and ensuring proper ventilation and protection from weather conditions. Consistent inspection and upkeep are essential for promoting strong, productive colonies and preventing potential losses.

The study of Underwood et al (2019) examined how beekeeping management practices vary based on operation size and beekeepers' philosophies, particularly concerning the use of in-hive chemicals. The researchers found that management practices, including the frequency and thoroughness of hive inspections, are influenced by these factors. Regular hive inspections were identified as a critical component in maintaining colony health, enabling early detection of issues such as diseases and pests, and informing

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timely interventions. The findings underscore the significance of consistent hive monitoring and maintenance, aligning with the experiences of beekeepers who emphasize the need for adaptability and proactive management in apiculture. This supports the notion that regular hive inspections are vital for sustaining healthy bee colonies, particularly in the face of challenges like limited resources and environmental unpredictability.

Another practice identified by all the respondents is the Queen bee selection and colony management. These are essential practices in beekeeping that focus on maintaining a healthy, productive, and well-behaved bee colony. Queen bee selection involves choosing queens with desirable traits such as strong egg-laying ability, resistance to diseases, calm temperament, and high honey production. A healthy and productive queen ensures the growth and stability of the colony by continuously laying eggs and maintaining harmony among the worker bees. Colony management, on the other hand, includes practices such as preventing swarming, uniting weak colonies, monitoring brood patterns, and replacing old or underperforming queens. Together, these practices help maintain a balanced colony structure, promote productivity, and ensure the long-term success of the beekeeping venture.

Similarly, Lattorff et al (2016) investigated how honeybee colonies select new queens under different circumstances—specifically comparing swarm queen rearing and emergency queen rearing. The researchers found that during emergency queen rearing, workers exhibit a bias towards rearing queens from rarer subfamilies, suggesting a context-dependent selection process. This behavior indicates that colonies have evolved mechanisms to optimize queen selection based on the specific needs and conditions of the colony. The findings underscored the complexity and adaptability involved in queen bee selection and colony management. They highlight the importance of understanding the colony's internal dynamics and environmental context when managing queen rearing practices. This aligns with the present study's emphasis on the need for beekeepers to be knowledgeable and resourceful in their management strategies to ensure colony health and productivity.Another best practice is sustainable harvesting techniques. It refers to methods that allow beekeepers to collect honey and other bee products without harming the colony or disrupting its natural processes. These techniques ensure that enough honey and pollen are left behind for the bees to survive, especially during periods when nectar is scarce. Sustainable practices also involve using tools and methods that minimize stress on the bees, such as gentle handling, proper timing of harvests, and avoiding over-harvesting. The goal is to balance productivity with the long-term health and well-being of the bee colony, ensuring that the practice of beekeeping remains environmentally friendly and viable for future generations.

Babarinde et al (2011) compared traditional and modern honey harvesting methods and their impact on honey quality. The traditional method, involving the use of naked flames to drive away or destroy bees, often led to contamination and lower-quality honey. In contrast, the modern method utilizes smoke to gently calm the bees, allowing for selective harvesting of mature honeycombs while preserving the brood and pollen combs. The findings revealed that honey obtained through modern harvesting exhibited superior physicochemical and microbial qualities, including better color, higher antioxidant content, and improved enzymatic activity. The study underscores the importance of adopting sustainable harvesting techniques that prioritize both product quality and the well-being of bee colonies. By highlighting the benefits of modern methods, it aligns with the present study's emphasis on sustainable beekeeping practices, reinforcing the need for techniques that ensure long-term viability and ecological balance. Planting nectar-rich plants around the apiary is also one of the 6 identified best practices by all the participants. This technique is a beekeeping practice that involves growing flowering plants and trees that produce abundant nectar and pollen, which are essential food sources for bees. These plants provide consistent and diverse nutrition, helping to boost bee health, improve colony strength, and enhance honey production. By ensuring that bees have easy access to forage near the hive, beekeepers reduce the distance bees must travel, conserving their energy and minimizing exposure to environmental hazards. This practice also supports biodiversity and promotes a more sustainable and self-sufficient beekeeping system by aligning with natural ecological processes.

Baude et al (2016) conducted a comprehensive assessment of nectar resources across Britain, analyzing data from 260 plant species over several decades. The researchers found that total nectar resources declined significantly between the 1930s and 1970s, primarily due to agricultural intensification and loss of wildflowers. However, in recent years, there has been a modest recovery in nectar availability, attributed to the planting of nectar-rich plants and conservation efforts. The study highlighted the importance of diverse and abundant floral resources in supporting pollinator populations, including honeybees. The findings underscore the critical role that planting nectar-rich plants around apiaries plays in sustaining healthy bee colonies. By ensuring a consistent and diverse supply of nectar, beekeepers can enhance colony strength, improve honey production, and contribute to the broader conservation of pollinators. This aligns with the present study's emphasis on sustainable beekeeping practices that promote both bee health and environmental biodiversity.

Another identified best practice by all the participants is monitoring the weather and climate for hive adjustments. These are initiative-taking beekeeping practice that involves observing local weather patterns and climate conditions to make informed decisions about hive management. Since bees are extremely sensitive to temperature, humidity, and seasonal changes, beekeepers must adapt their practices such as providing extra ventilation during hot weather, insulating hives in cold seasons, or adjusting feeding schedules during nectar dearth. Timely adjustments help maintain optimal conditions inside the hive, reduce stress on the bees, and prevent issues like moisture buildup,

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overheating, or starvation. This practice is crucial for sustaining colony health and productivity, especially in regions prone to unpredictable or extreme weather events.

The study of Meikli et al (2017) investigated the internal temperatures of honeybee hives in North Dakota before and during winter to evaluate the effects of different environmental exposures on colony health. The researchers found that hives exposed to commercial pollination had fewer adult bees, less brood, and lower average temperatures throughout winter compared to hives near natural forage. Additionally, these hives exhibited higher within-day temperature variability, indicating reduced temperature control. The study highlights that monitoring internal hive temperatures can reveal aspects of colony health and the impact of environmental conditions, emphasizing the importance of adjusting hive management practices in response to weather and climate factors. The findings align with the present study's emphasis on the necessity for beekeepers to monitor weather and climate conditions to make informed hive adjustments. By understanding how environmental factors affect internal hive temperatures and colony health, beekeepers can implement strategies to mitigate adverse effects, ensuring the sustainability and productivity of their beekeeping operations.

The last practice, which was unanimously observed by all the participants, is collaboration with other beekeepers or cooperatives. It involves collaborating with fellow beekeepers or organized groups to share knowledge, resources, and support in managing bee colonies and improving beekeeping practices. This collaboration can take various forms, including joint efforts in honey production, disease management, or collective purchasing of equipment and supplies, which can help reduce costs and improve efficiency. Beekeepers in cooperatives also share experiences and best practices, enhancing their skills and addressing familiar challenges collectively. Moreover, such partnerships foster a sense of community and solidarity, allowing beekeepers to learn from one another, access expert advice, and strengthen the overall sustainability of the beekeeping industry.

Yusuf et al (2018) examined the challenges faced by beekeeping cooperative societies (BKCSs) in the Amathole District of South Africa. It identified issues such as poor farm planning, pilfering and vandalism of apiaries, inadequate skills training, poor management techniques, and weak agricultural extension support. The researchers suggested that integrating beekeeping with crop farming could enhance sustainability and productivity. The findings highlight the importance of collaboration and support systems among beekeepers. By working together and integrating beekeeping with other agricultural practices, beekeepers can address familiar challenges more effectively, leading to improved colony health and productivity. This aligns with the present study's emphasis on the benefits of collaboration in beekeeping ventures.

Other commonly practiced noted by a considerable number of participants, which is 9 out of 15 or 60% of the participants, are proper feeding and nutrition management, disease and pest control, and marketing and branding of honey and other bee products.

Proper feeding and nutrition management in beekeeping involves providing bees with the necessary nutrients to maintain their health, strength, and productivity, especially during times when natural food sources are scarce. This includes managing the balance of nectar and pollen available to the colony, supplementing with sugar syrup or pollen substitutes when necessary, and ensuring that bees have access to clean water. Proper feeding is crucial for maintaining hive vitality, supporting brood development, and preventing malnutrition, which can weaken the colony and make it susceptible to diseases. Additionally, a well-fed colony is better equipped to survive during winter or periods of low forage availability, ensuring long-term success in beekeeping.

The study of Fournier et al (2019) evaluated the effects of two different protein supplements on the health and performance of honeybee colonies. The researchers found that colonies fed with a pollen-based supplement exhibited better brood production and higher protein content in nurse bees compared to those fed with a synthetic supplement. However, both supplements led to a reduction in the lifespan of adult bees, indicating that while supplementation can enhance certain aspects of colony health, it may not fully replace the benefits of natural forage. The findings underscore the critical role of balanced nutrition in maintaining healthy bee colonies. They highlight that while supplemental feeding can support colony growth and productivity, it should complement, not replace, natural forage sources. This aligns with the present study's emphasis on proper feeding and nutrition management as essential practices for sustainable beekeeping.

Another identified best beekeeping practice is disease and pest control. Beekeeping involves the management and prevention of harmful diseases and pests that can negatively impact the health of bee colonies. Common pests like Varroa mites, wax moths, and small hive beetles can weaken or destroy colonies by feeding on bees or their brood, while diseases such as American Foulbrood or Nosema can lead to colony collapse if not managed. Beekeepers use a combination of methods, including chemical treatments, mechanical control, and organic approaches, to monitor and reduce pest populations and treat infections. Regular inspections, maintaining clean hives, and adopting integrated pest management strategies are key practices to ensure the long-term health and productivity of the colony. Effective disease and pest control is crucial for preventing losses and ensuring a thriving beekeeping operation.

This comprehensive survey conducted by the USDA provides an in-depth analysis of the health status of honeybee colonies across the United States. It highlights the prevalence of various pests and diseases, including the Varroa destructor mite, Nosema spp., and American

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Foulbrood, and their significant impact on colony health and survival. The report emphasizes the need for effective disease and pest management strategies to mitigate these threats and ensure the sustainability of honeybee populations (Kulhanek et al, 2017). The findings underscore the critical importance of implementing robust disease and pest control measures in beekeeping practices. By identifying the most prevalent threats to honeybee colonies and assessing their impact, the study provides valuable insights that can inform management practices and policies aimed at protecting bee health. This aligns with the present study's focus on sustainable beekeeping practices and highlights the necessity of initiative-taking disease and pest management to maintain healthy and productive colonies.

Another significant best practice in beekeeping is the marketing and branding of honey and other bee products. This practice involves promoting, packaging, and selling honey, beeswax, propolis, royal jelly, and other hive-derived goods in a way that highlights their quality, uniqueness, and origin. Effective marketing helps beekeepers reach a wider audience, increase product value, and build customer trust through attractive labeling, storytelling, certifications and strategic selling channels like online platforms or local markets. Branding, on the other hand, creates a distinct identity for the products, helping consumers associate them with purity, health benefits, or sustainability. Together, marketing and branding are essential for turning raw hive products into profitable ventures and for competing in both local and global markets.

Rathore and Sharma (2023) highlighted the critical role of effective marketing strategies in the honey industry. It discusses how branding, packaging, and promotional activities can significantly influence consumer preferences and purchasing decisions. The study emphasized that well-executed marketing efforts not only enhance product visibility but also build consumer trust and loyalty, which are essential for the success of honey and bee product enterprises. The findings underscored the necessity for beekeepers to adopt robust marketing and branding strategies to differentiate their products in a competitive market. By focusing on quality assurance, unique branding, and targeted marketing, beekeepers can increase their market share and profitability. This aligns with the present study's emphasis on the importance of marketing and branding as key components in the sustainable development of honeybee ventures.

- *Challenges Experienced by Beekeepers in Honeybee Ventures*

Table 4 Challenges Experienced by Participants in Beekeeping

Challenges	Frequency	Percentage
Prohibitive cost of beekeeping equipment	15	100%
Difficulty in managing bee pests and disease	15	100%
Unstable weather and climate change effects	15	100%
Lack of access to beekeeping training and resources	15	100%
Low market demand or competition from imported Honey	15	100%
Difficulty in securing permits and complying with Regulations	15	100%
Bee colony losses or colony collapse disorder	15	100%
Challenges in transporting and storing bee products	15	100%
Lack of government support or incentives	15	100%
Predation by other animals	15	100%

Since all the participants are practicing backyard beekeeping, all of them noted common experiences that they considered challenges. These include the high cost of beekeeping equipment, difficulty in managing pests and diseases, unstable weather and climate change effects, lack of access to training and resources, low market demand or competition from imported honey, difficulty in securing permits, colony losses, transportation issues, lack of government support, and predation by other animals.

The prohibitive cost of beekeeping equipment is a significant barrier for many aspiring and small-scale beekeepers, especially in rural or underfunded areas. Essential tools like beehive boxes, smokers, protective gear, extractors, and modern monitoring devices can be expensive and not easily accessible. These upfront and maintenance costs can discourage individuals from starting or expanding their apiaries, limit their ability to adopt more efficient or hygienic practices, and affect overall productivity. For example, a motorized honey extractor which significantly speeds up the honey extraction process can cost several hundred dollars, making it unaffordable for beekeepers who rely on manual methods or improvised tools. This financial strain can impact the quality and quantity of honey

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harvested, as well as the health and efficiency of the beekeeping operation.

Similarly, Dia et al (2018) examined the economic aspects of beekeeping in Ganye Local Government Area of Adamawa State, Nigeria. It revealed that 50% of the beekeepers identified the prohibitive cost of technology as a significant constraint. Additionally, 60.90% reported a lack of sufficient tools, and 65.22% cited inadequate capital as a major challenge. These financial barriers hinder the adoption of improved technologies and limit the expansion of beekeeping activities in the region. The findings underscore the impact of high equipment costs on the sustainability and growth of beekeeping ventures. Addressing these financial challenges is crucial for enabling beekeepers to adopt modern practices, improve productivity, and enhance their livelihoods.

Another common challenge is difficulty in managing pests and diseases and colony losses. This is considered a major challenge in beekeeping because it directly affects the survival and productivity of bee colonies. Pests like Varroa mites, wax moths, and small hive beetles, along with diseases such as American Foulbrood and Nosema, can weaken or wipe out entire colonies if not detected and treated early. These threats are often hard to control due to their resistance to treatment, the need for constant monitoring, and the difficulty of maintaining hive hygiene especially for beekeepers with limited resources or training. Moreover, colony losses can result in significant financial setbacks, emotional distress, and loss of time, particularly for small-scale beekeepers who depend on healthy hives for income. The unpredictability and severity of these problems make them persistent obstacles to sustainable beekeeping.

Insolia et al (2022) analyzed data from 2015 to 2021 across the contiguous United States, examining the multifaceted factors contributing to honeybee colony losses. The researchers found that infestations by the Varroa destructor mite, exposure to pesticides, and extreme weather events such as temperature fluctuations and precipitation significantly impact colony survival. The study highlights the complex interplay between biotic stressors (like parasites and pathogens) and abiotic factors (such as climate extremes), emphasizing the need for integrated management strategies to mitigate colony losses. The findings underscore the critical importance of effective pest and disease management in beekeeping practices. By identifying the primary stressors leading to colony declines, the study provides valuable insights that can inform targeted interventions and policy decisions aimed at enhancing colony health and sustainability. This aligns with the present study's focus on addressing the challenges faced by beekeepers in maintaining healthy and productive colonies amidst various environmental and biological threats.

Unstable weather and the effects of climate change pose significant challenges to beekeeping because they disrupt the natural rhythms of bees and the environment they depend on. Sudden temperature changes, prolonged droughts, heavy rains, or unseasonal weather can affect the availability of nectar and pollen, delay flowering periods of plants, and interfere with bees' foraging patterns. These environmental stressors can also weaken bee immunity, making them more vulnerable to diseases and pests. In extreme cases, unpredictable weather can prevent beekeepers from effectively managing hives or harvesting honey. As climate patterns continue to shift, beekeepers must constantly adapt their practices to ensure the health and survival of their colonies, making beekeeping more labor-intensive and uncertain.

Van Espen et at (2023) assessed the perceptions and experiences of European beekeepers and stakeholders regarding the impacts of climate change on beekeeping. It found that climate change is perceived to significantly affect beekeeping, with major impacts including altered local weather conditions and reduced food resource availability. These changes are associated with lower honey yields and higher colony winter loss rates. The study also highlighted regional disparities, noting that Southern European beekeepers are more likely to be heavily impacted by climate change compared to their Northern counterparts. The findings underscore the challenges that unstable weather and climate change pose to beekeeping, emphasizing the need for adaptation strategies to mitigate these impacts. This aligns with the present study's focus on sustainable beekeeping practices and highlights the importance of understanding and addressing climate-related challenges in the apiculture sector.

In addition, all the participants also experienced 3 familiar challenges. These are a lack of access to training and resources, difficulty in securing permits, and a lack of government support.

Lack of access to training and resources, difficulty in securing permits, and lack of government support are significant challenges that hinder the growth and sustainability of beekeeping, especially for beginners and small-scale practitioners. Without proper training, beekeepers may struggle to manage hives effectively, prevent diseases, or adopt modern techniques, which can lead to poor productivity and colony losses. Limited access to essential resources such as quality equipment, medications, and educational materials further compounds these issues. In addition, complex or unclear processes for securing permits and the absence of financial or technical support from local government units (LGUs) can discourage participation and expansion in the industry. These systemic barriers not only slow down progress but also limit opportunities for innovation and community development in the beekeeping sector.

The study of Muhammad et al (2016) highlighted the significant gap in knowledge and training related to modern beekeeping practices among both academic institutions and rural communities. The authors emphasized the necessity of incorporating improved beekeeping methods into educational curricula and training programs. They also pointed out the lack of structured support from governmental bodies, which hampers the dissemination of

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essential skills and information to prospective beekeepers. The findings underscored the critical need for comprehensive training programs and streamlined processes for obtaining necessary permits. Addressing these challenges is vital for empowering individuals to engage effectively in beekeeping activities. Enhanced government support and accessible resources can facilitate the growth and sustainability of beekeeping ventures, particularly in rural areas where such initiatives can significantly impact livelihoods.

Low market demand or competition from imported honey presents another serious challenge for local beekeepers trying to sustain and grow their ventures. Imported honey, often sold at cheaper prices and in larger quantities, can flood the market and make it difficult for small-scale producers to compete, especially when consumers prioritize cost over quality or origin. This competition can reduce sales, lower profit margins, and discourage local beekeepers from investing in production improvements or expanding their operations. Moreover, a lack of awareness about the benefits of locally sourced, pure honey further worsens the demand issue. As a result, beekeepers may struggle to find stable markets for their products, limiting income opportunities and the long-term viability of beekeeping as a livelihood.

Hidalgo et al (2020) examined the obstacles hindering the growth of the stingless bee honey industry in the Bicol region of the Philippines. It identifies several barriers, including the instability of the honey supply, lack of product standardization, and inadequate marketing strategies. The research highlights that these issues contribute to the industry's vulnerability to competition from imported honey products, which often have more consistent quality and better market positioning. The findings underscored the importance of developing robust marketing frameworks and establishing quality standards to enhance the competitiveness of local honey producers. Addressing these challenges is crucial for improving market demand and reducing the impact of imported honey on the local beekeeping industry.

Transportation issues are a significant challenge in beekeeping because they affect the movement of hives, access to markets, and the delivery of beekeeping supplies. Beekeepers, especially those in remote or rural areas, often face difficulties transporting their products due to poor road conditions, lack of reliable vehicles, or high fuel costs. Moving bee colonies to various locations for pollination services or better forage becomes risky and stressful for the bees if transport is not smooth or timely. Additionally, transporting honey and other bee products to urban markets can be costly and time-consuming, reducing profit margins and limiting market reach. These challenges can hinder both productivity and profitability, making efficient transportation an essential factor in successful beekeeping operations.

Kumar et al (2023) identified transportation as a significant post-harvest challenge in beekeeping. Approximately 29.33% of surveyed beekeepers reported transportation issues, which affect the timely and efficient movement of bee products to markets. These challenges can lead to delays, increased costs, and reduced product quality, thereby impacting the profitability and sustainability of beekeeping operations. The findings underscore the importance of addressing transportation barriers to enhance the efficiency and economic viability of beekeeping. Improving transportation infrastructure and organization can facilitate better market access, reduce post-harvest losses, and support the growth of the apiculture sector.

Another identified significant challenge in beekeeping is the Predation by other animals. It is a serious challenge in beekeeping as it directly threatens the safety and productivity of bee colonies. Animals such as birds (like bee-eaters), bears, lizards, ants, wasps, and even domestic pets can disturb or destroy hives while trying to access honey or the bees themselves. For example, in rural or forested areas, bears can destroy beehives in search of honey, while ants and lizards often invade hives to feed on brood or stored nectar, weakening the colony over time. Wasps and hornets can also attack bees, kill workers, and steal honey. These threats not only reduce colony strength but also increase stress for beekeepers, who must invest in protective measures like hive stands, barriers, or repellents adding to their workload and operational costs.

Bekele et al (2017) investigated the impact of natural bee enemies on honeybee colonies in the Bale zone of southeastern Ethiopia. The researchers identified various predators, including honey badgers, spiders, bee-eating birds, bee lice, beetles, wasps, Death's-head hawk moths, mice, and lizards, as significant threats to beekeeping activities. These predators were reported to cause considerable damage to bee colonies, leading to decreased honey production and increased colony absconding rates. The findings underscored the importance of implementing effective predator management strategies in beekeeping practices. Addressing predation challenges is crucial for maintaining healthy bee colonies, ensuring consistent honey production, and supporting the sustainability of beekeeping ventures, particularly in regions where such threats are prevalent.

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➢ *Strategies Conducted by the Participants in Beekeeping to Overcome Various Challenges*

Table 5 Strategies Conducted by the Participants in Beekeeping

Strategies	Frequency	Percentage
Joining beekeeping associations or cooperatives	15	100%
Using alternative or locally available beekeeping materials	15	100%
Establishing contracts or partnerships with buyers	15	100%
Diversifying bee products (e.g., wax, pollen, propolis)	2	13%
Enhancing marketing and branding strategies	9	60%
Educating the community about the importance of bees and beekeeping	15	100%

The participants shared that beekeeping is one of the most unpredictable ventures or businesses due to the numerous factors that can affect it at any time. Because of this, they also proudly shared during the interview the different strategies they use to survive the changing conditions and make their beekeeping venture sustainable. Since all the participants participate in backyard beekeeping, all of them noted 4 common strategies, namely: joining beekeeping associations or cooperatives, using alternative or locally available marketing materials, establishing contracts or partnerships with buyers, and educating the community about the importance of bees and beekeeping. In addition, another identified significant strategy noted by 9 or 60% of the participants is enhancing marketing and branding strategies.

Joining beekeeping associations or cooperatives offers a significant advantage to both beginner and experienced beekeepers. These organizations provide a platform for knowledge exchange, technical training, and access to modern beekeeping practices. Through collective efforts, members can gain support in addressing familiar challenges such as pest control, climate adaptation, and marketing strategies. Being part of a cooperative or association also fosters a sense of community, encourages collaboration, and amplifies the voices of small-scale beekeepers when lobbying for government support or assistance. Additionally, these groups often serve as conduits for funding opportunities, resources, and seminars that individual beekeepers might not easily access on their own.

In the Bicol Region of the Philippines, several beekeeping associations and cooperatives have been established to support local beekeepers. For example, some provinces have formed local beekeepers' groups under the guidance of the Department of Agriculture and other NGOs, which provide access to shared tools, basic equipment, and training sessions. These groups allow members to exchange knowledge on sustainable practices, receive technical assistance, and even market their honey products collectively at trade fairs or local markets. In areas like Sorsogon and Camarines Sur, small associations have also partnered with academic institutions for research-based training, helping members improve their hive management techniques and adapt to environmental changes. These cooperatives play a crucial role in promoting sustainable beekeeping and increasing the visibility of local honey in the region.

Jovillano-Mostoles (2019) examined a community-based approach to sustainable stingless beekeeping in Sorsogon, Philippines. It emphasizes the importance of collective action among local beekeepers to address challenges such as limited technical knowledge, lack of access to markets, and environmental threats. By forming associations or cooperatives, beekeepers were able to share resources, receive training, and improve their bargaining power in the market. The collaborative model not only enhanced honey production but also contributed to environmental conservation and community development. The findings underscored the significance of cooperative membership in enhancing the sustainability and profitability of beekeeping ventures. In the context of the Bicol Region, forming or joining beekeeping associations can provide local beekeepers with the necessary support systems to overcome familiar challenges, adopt best practices, and access broader markets. This aligns with the present study's focus on identifying effective strategies to promote sustainable beekeeping in the region.

Using alternative or locally available marketing materials is also one of the best strategies in beekeeping or a honeybee venture. Using alternative or locally available marketing materials is a practical and cost-effective strategy for beekeepers, especially those in rural areas or with limited budgets. This approach allows them to creatively promote their honey and bee-related products without relying on expensive packaging or mass media advertising. By utilizing natural, eco-friendly, and indigenous materials such as recycled bottles, bamboo packaging, handwoven

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labels, or native baskets, beekeepers can not only reduce production costs but also create a unique brand identity that resonates with local culture and environmental sustainability. These materials appeal to eco-conscious consumers and help highlight the authenticity and handcrafted quality of the products, thereby increasing their market value.

Some of the participants or the local beekeepers package their honey in reused glass jars or native packaging like “bayong” (woven bags) for eco-friendly product presentation, often decorated with handmade tags or printed labels using recycled paper. Others use locally crafted wooden boxes or coconut shell containers as part of their packaging, giving the products a distinct local flair. At community fairs or local markets, some beekeepers display their honey using homemade signs or repurposed materials like old wood or tarpaulin to attract buyers. These creative and sustainable marketing practices not only reduce costs but also support the circular economy and highlight the cultural identity of their communities.

The study of Kurniawanto et al (2024) examined how the application of packaging technology and innovation can enhance the packaging and marketing of local products in Opak Village. The research highlights that utilizing locally available materials and innovative packaging designs can improve product appeal and marketability. By adopting cost-effective and culturally relevant packaging solutions, local producers can increase their income and promote sustainable practices within their communities. The findings underscored the importance of leveraging local resources and creativity in developing marketing materials. For beekeepers and small-scale producers, incorporating locally sourced materials into packaging not only reduces costs but also adds unique value to their products, resonating with consumers seeking authentic and environmentally conscious options.

Another strategy in beekeeping is establishing contracts or partnerships with buyers. This is a strategic move to secure a reliable market for bee-related products such as honey, beeswax, propolis, and royal jelly. These agreements formalize the terms of the sale, including the quantity, quality standards, price, delivery schedules, and payment terms. By entering such contracts, beekeepers can minimize the risks of market fluctuations and unpredictable sales, allowing them to focus on improving production and maintaining product quality. These partnerships also foster long-term relationships with buyers, which can lead to repeat business, better pricing, and opportunities for business expansion.

Some of the participants revealed that they enter into a year-long agreement with a local organic store to supply raw, unprocessed honey monthly. This provides the store with a consistent and authentic product while ensuring regular income for the beekeeper. Another instance is a partnership with a cosmetics company that uses beeswax in its skincare products, the beekeeper commits to supplying a specific quantity of high-quality beeswax each quarter. Additionally, cooperatives of small-scale beekeepers can establish contracts with food processors or exporters who require bulk honey for their products, thereby opening access to larger markets. These partnerships not only stabilize income but also elevate the professionalism and sustainability of beekeeping ventures.

Nicula and Manescu (2020) highlighted how strategic partnerships among local beekeepers, micro-enterprises, and hospitality businesses can enhance the distribution of organic honey. By forming short supply chains, these collaborations aim to improve market access, ensure product quality, and promote sustainable rural development. The study emphasizes the importance of such partnerships in achieving economic and environmental benefits for the beekeeping sector.

The study by Nicula and Mănescu (2020) showed that it is highly relevant to the present research as it emphasizes the importance of establishing partnerships and contracts in enhancing the sustainability and profitability of beekeeping ventures. By focusing on short supply chains and collaborations between beekeepers and local businesses, the study illustrates how structured agreements can ensure consistent product quality, secure market access, and support rural economic development. These insights align with the present study’s objective of identifying best practices in beekeeping, particularly in how formal partnerships with buyers contribute to stability, efficiency, and long-term success in honeybee enterprises.

Educating the community about the importance of bees and beekeeping was also noted by all the participants as one of their strategies in beekeeping. Educating the community about the importance of bees and beekeeping is crucial for raising awareness about the vital role that bees play in pollination, which directly impacts agricultural productivity and biodiversity. Bees are responsible for pollinating about one-third of the world’s food crops, and their decline can have profound consequences on food security and the economy. Through community education, individuals can understand the interconnectedness of ecosystems and the significance of preserving bee populations. Additionally, educating local communities about sustainable beekeeping practices can foster support for beekeepers, reduce misconceptions, and encourage practices that protect bee habitats and promote healthy hive management, benefiting both the environment and local economies.

Some of the participants shared that they collaborate with farmers to raise awareness about the necessity of bees for crop pollination, leading to better cooperation in protecting bee habitats. Moreover, community-based projects, such as establishing bee-friendly gardens in public spaces, can create visible reminders of the role bees play, encouraging residents to adopt bee-friendly practices like reducing pesticide use and planting more pollinator-friendly flowers. These efforts not only educate the public but also foster a stronger sense of community responsibility toward bee conservation.

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The study of Morais et al (2024) is related to the current research as it highlights the effectiveness of active learning strategies in educating communities about bee diversity and their ecological roles. By engaging participants in firsthand experiences, such as observing live hives and learning about various bee species beyond the common honeybee, the study demonstrates significant improvements in knowledge retention and environmental awareness. These findings underscore the value of interactive educational approaches in fostering a deeper understanding of beekeeping practices and the critical role of bees in pollination, which is essential for sustainable agriculture and biodiversity conservation.

Another significant strategy noted by 9 or 60% of the participants is enhancing marketing and branding strategies. This strategy in beekeeping is essential for increasing product visibility, customer loyalty, and overall business growth. Effective marketing allows beekeepers to differentiate their products in a competitive market by highlighting unique selling points such as organic production, local sourcing, or health benefits. Branding, on the other hand, involves creating a recognizable identity through logos, packaging, storytelling, and consistent messaging that reflects the values of the beekeeping enterprise. These strategies not only help in attracting new customers but also in establishing trust and credibility, which are vital in promoting repeat sales and long-term success.

Some of the participants revealed that they develop a brand that emphasizes "farm-to-table" honey, with eco-friendly packaging and labels that tell the story of the bees and their environment. Social media platforms can be used to share videos of the harvesting process or facts about bees to engage with customers and build a community around the brand. Participation in farmers' markets, local fairs, or eco-tourism ventures also boosts product exposure. Additionally, creating value-added products such as honey-infused skincare items, beeswax candles, or flavored honey varieties can help expand the market reach. These efforts not only increase sales but also educate consumers about the importance of supporting sustainable and local beekeeping practices.

The study of Sparacino et al (2023) is relevant to the current research as it provides insights into how beekeeping companies in Italy utilize their websites for marketing and communication. The analysis revealed that many beekeepers focus on aspects like gastronomic pairings, product quality, territorial links, and organic certifications in their online content. However, there was a noted lack of emphasis on health benefits and sustainability, indicating areas for improvement in branding strategies. Understanding these practices can inform beekeepers on effective marketing approaches, highlighting the importance of comprehensive branding that encompasses product attributes, health benefits, and environmental sustainability to enhance consumer engagement and market reach.

- *Strategic Venture Direction for Honeybee Farming Venture to Resolved Challenges*

The proposed output is incredibly important because it directly addresses the interconnected challenges identified in the study such as economic constraints environmental risks and lack of institutional support through a structured community based and sustainability-oriented approach. The proposed strategic venture direction synthesizes the actual practices strategies and lived experiences of the participants into a formal model that can guide both current and future beekeepers. By grounding the output in locally tested strategies such as cooperative participation resource improvisation and community integration the proposal ensures contextual relevance and practical applicability rather than imposing externally designed solutions The emphasis on community based and cooperative driven beekeeping is particularly significant because literature highlights collective action as a key factor in strengthening small scale agricultural enterprises. Recent studies have shown that beekeeping cooperatives improve access to shared knowledge reduce individual costs and enhance market bargaining power especially for backyard and smallholder beekeepers (FAO, 2018; Wanyoike and Kihoro 2021). Cooperative models also compensate for weak institutional support by creating peer led learning systems which aligns strongly with the participants reliance on associations and shared experience. This confirms that the proposed output is not only contextually grounded but also supported by global best practices in sustainable apiculture.

The proposed output is also vital because it integrates climate smart and adaptive practices which are increasingly necessary given the universal challenge of unstable weather and climate change reported by participants. Recent literature emphasizes that adaptive hive management diversified forage systems and climate monitoring significantly reduce colony losses and improve resilience (Le Conte and Navajas 2019 Rucker et al 2020). By explicitly embedding climate smart strategies such as weather-based hive adjustments and pollinator garden development the proposed output aligns local practice with contemporary scientific recommendations ensuring long term ecological and economic sustainability.Moreover, the focus on value addition marketing and buyer partnerships strengthens the economic viability of honeybee ventures. Studies after 2017 indicate that branding product diversification and stable buyer agreements improve beekeeper income and protect them from market volatility and competition from imported honey (Adjare et al 2019; Bradbear and Friel 2020). The proposed output inclusion of eco-friendly branding and formal market linkages reflects an evidence-based response to the market related challenges identified in the findings transforming beekeeping from mere subsistence activity into a viable rural enterprise.

Finally, the proposed output is crucial because it highlights public education and environmental stewardship as integral components of sustainable beekeeping. Contemporary research underscores that community awareness and pollinator education enhance social acceptance reduce human bee conflict and promote

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biodiversity conservation (Potts et al 2016 Dicks et al 2021). By institutionalizing outreach and education within the venture direction the output ensures that beekeeping contributes not only to livelihood improvement but also to broader ecological resilience. Overall, the proposed output is important because it translates empirical findings into holistic evidence based and scalable framework that addresses sustainability resilience and community empowerment in honeybee farming.

IV. FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

➢ *Findings*

The following are the findings of the study:

- Fifteen (15) participants (100%) were purposively selected beekeepers from Sorsogon Province, comprising 7 (47%) from Bulusan; 2 (13%) each from Castilla, Gubat, and Sta. Magdalena; and 1 (7%) each from Casiguran and Matnog. All 15 participants (100%) had operated backyard honeybee ventures for more than four years and had experienced both fulfillment in honey production and challenges due to limited institutional support, which led them to rely on improvisation to sustain their operations.
- The data tallies revealed six core best practices adopted by 15 participants (100%): regular hive inspection and maintenance, careful queen bee selection and colony management, sustainable harvesting techniques, planting nectar-rich plants, monitoring weather and climate for hive adjustments, and collaboration with other beekeepers or cooperatives. Proper feeding and nutrition management, disease and pest control, and marketing and branding were each practiced by 9 participants (60%), while only 2 participants (13%) reported using modern equipment.
- The participants encountered ten major challenges, each reported by 15 participants (100%): high equipment costs, pest and disease management, unstable weather and climate change, lack of training, low market demand and competition from imported honey, difficulty securing permits, colony losses, transportation and storage issues, lack of government support, and predation by other animals. Challenges related to limited nectar and pollen sources and negative public perception were not experienced by the participants.
- The participants addressed these challenges through adaptive and resourceful strategies, including improvising equipment using locally available materials, applying weather-based hive adjustments and integrated pest management, and strengthening peer learning through cooperatives and associations.
- Based on the findings, the study proposed a Strategic Venture Direction that promoted a community-based and sustainable beekeeping model by integrating traditional knowledge, modern beekeeping techniques, climate-smart management, cooperative networks, and eco-friendly marketing to improve the environmental sustainability and economic viability of backyard beekeeping ventures.

➢ *Conclusions*

- Beekeepers demonstrate resilience and adaptability by relying on traditional knowledge and resourcefulness despite environmental and institutional challenges.
- The consistent application of the best practices ensures hive health, productivity, and sustainability while promoting collaboration and shared learning.
- Systemic and interconnected challenges significantly hinder beekeeping productivity and profitability across all participants.
- Beekeepers employ innovative and community-driven strategies to overcome constraints, improve market access, and build resilience.
- A proposed sustainable beekeeping model integrates traditional wisdom with modern techniques to promote environmental.

➢ *Recommendations*

Based on the results and findings of the study, the following are recommended for progressive and sustainable beekeeping:

- Encourage government and non-government organizations to provide targeted support programs that enhance access to modern equipment and training for beekeepers.
- Develop localized training modules and workshops to reinforce the best practices and promote peer-to-peer learning among beekeepers.
- Establish integrated support systems that address equipment subsidies, pest control, climate adaptation, and market access to mitigate systemic challenges.
- Strengthen cooperative networks and community-based initiatives to facilitate shared resources, collective marketing, and local advocacy.
- Pilot the proposed sustainable beekeeping model in selected communities to validate its effectiveness and scalability for broader implementation.

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