

Development Barriers of Stingless Bee Honey Industry in Bicol, Philippines

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Abstract— Beekeeping industry in Bicol, Philippines is dominated by stingless beekeepers. *Tetragonula biroi*, is an endemic stingless bee species in the region, which produces the most expensive honey in the local commercial market. However, beekeeping industry remains to be part of the informal business sector under the shadow of rural enterprises. Improving the industry's economic contribution would mean upgrading the chain through which beekeeping sector passes through. The purpose of the study is to assess the barriers in developing the stingless bee honey industry. The value chain approach was used in determining the issues along each chain level and in finding ways to strengthen the competitiveness of the industry. Results show that there is not enough support programs given to sustain the drive towards an efficient commodity flow of honey. The demand is high but there are few enablers to strengthen the flow of the commodity. The findings revealed seven development barriers: stability of honey supply, product standardization; product traceability; harvesting and processing policies; entrepreneurial support program; vulnerability to natural disasters; and research programs. Similar to farming, stingless beekeeping is a promising enterprise that is largely dependent on climatic condition. The risks associated with climate change and environment limit people from seriously pursuing stingless beekeeping as an entrepreneurial venture. To strengthen the industry, stakeholder's collaboration must be institutionalized to create strong business linkages among the chain operators. The distinctive characteristic of stingless bee honey should be positioned in a market niche that matches its benefit to target users. A review must be done on the provisions in the Code of Good Beekeeping Practices as regards the production chain of raw honey and its by-products to ensure that honey sold is of good quality, with fair price, and easily traceable.

Keywords— stingless beekeeping; *Tetragonula biroi*; Philippine beekeeping industry; development barriers.

I. INTRODUCTION

Beekeeping is recognized as an important component of agrifood production as it contributes to the pollination of crops at the farm level [1]. In fact, in Malaysia, apiculture is a viable complementary livelihood of pineapple farmers in rural areas with honey as a major source of income [2]. Hence, a fall of the beekeeping industry may adversely affect other agricultural industries since it pollinates about 80% of crops. The barriers of beekeeping industry developments in Latvia include disordered market, competition from imported honey, and high cost of production [3]. In some parts of Turkey, the beekeeping industry is confronted by high chemical use in the hives and differentiated quality of honey [4].

A study revealed that key success factors of beekeeping are the type of bee species, availability of bee flora, and the type of technology used in its propagation. Indigenous bee species (*Apis cerana L.*) raising is noted to be more econom-

ically feasible for many rural households than the European bee species (*Apis mellifera*). Thus, beekeepers in rural communities prefer adopting the indigenous method where hives are found on house walls [5]. In Malaysia, the local bee species (*A. cerana*) produces an annual yield of 5-9 kg per colony while the imported bee species (*Apis mellifera L.*) yields up to 15 kg per colony. Beekeepers resort to direct selling to avoid adulteration but at a premium price. The scarcity of honey supply implies an increasing demand in the local market [6].

Beekeeping is a farm enterprise in rural areas and is considered an informal food business like many agricultural crops. Thus, in India, scientific beekeeping is encouraged in rural communities. [7]. Non-government organizations and existing beekeepers played a significant role in the capacity building of beekeepers. However, very few beekeepers up-scale their products [8].

The informality structure of the beekeeping industry is observed in a global context. Even in Europe before, the

beekeeping industry is not well-documented despite its proliferation and expansion. Variations in apicultural industries in Europe, such as the high share of non-professional beekeepers, small quantity of colonies per beekeeper, and bee capacity, provide difficulty in assessing the industry status [9]. Beekeeping in the Philippine rural setting is experiencing the same structure.

The Philippines has four (4) native and one (1) foreign bee species: the giant honeybees, Asian honeybee, dwarf honeybee, stingless honeybee, and European honeybee. Bicol region, identified as one of the areas that produce honey, is the major source of stingless bee (*Tetragonula biroi* Friese) or called “*lukot*” or “*kiwot*” locally. Production of the stingless honeybee is more economical, requires simple hives, and claims to have healing properties. Because of these, it is more in demand than the European bee, which produces a much higher amount of honey.

There are an increasing appreciation and soaring demand for stingless bees as well as its products and by-products practically due to the myriad benefits it offers. Stingless bee honey has been scientifically proven to have high nutritional and medicinal value [9]; thus, it became the most popular and sought-after bee product [10], followed by colonies. While its demand continues to increase, the industry’s growth potential remains to be a promise. Hence, the study explored the constraints of stingless beekeeping development capacity. The study aims to identify the barriers of an efficient chain of stingless bee honey to understand the policy measures needed in improving the beekeeping industry.

II. MATERIAL AND METHODS

The study employed a qualitative approach using the value chain analysis of honey in Bicol Region. The study was conducted from October 2016 to December 2019 in the provinces of Camarines Norte, Camarines Sur, Albay, and Sorsogon of where most bee farms are located. Guide questionnaire was used to obtain data from the respondents, namely; the beekeepers (backyard or raiser and wild hunters) processor, input suppliers/ providers, farmers, traders, and consumers of honey in Bicol Region. The selection of respondents was assisted by the Department of Agriculture and the Regional Apiculture Center by providing the location of beekeepers and place of the market where they sell their produce. The center provided a list of beekeepers and hunters who were personally identified. The snowball method in identifying other beekeepers and hunters in the Bicol Region was used. Some of the research instruments that were used in gathering information for the study were the following: an in-depth interview with the respondents and in-depth discussion of data; guide questionnaire to obtain specific information from the respondents; actual observation of the bee farm to view the production and processing of honey; and, desk study from secondary data.

III. RESULTS AND DISCUSSION

Socio-demographic profiling was conducted to characterize the respondents, and results revealed that the highest percentage (28.16%) of respondents are 29-37 years old, followed by 18.75% with ages ranging from 38-45 and 46-53 years. The majority (78%) of the respondents are male,

while 22% are female, and all of them are married. More than 80% and less than 20% are high school graduates and college graduates, respectively. In the areas surveyed, the heads of family are the male who is primarily responsible for providing the needs of their family. Since the income generated from farming, as their primary occupation, is not fixed and varies season from the season, they looked for an alternative source of income, which is stingless beekeeping or hunting of stingless bee colonies in their respective localities. Apart from being an ideal alternative livelihood, stingless beekeeping is much preferred by beekeepers due to several reasons such as its simplicity in terms of technological requirements, high market demand for Bee products and by-products, as well as its suitability to rural livelihood programs such as organic or integrated farming, among others [10].

The Bicol region has three native honey-producing bee species, namely: Asian honeybee, *Apis cerana* L. (‘ligwan’ or ‘laywan’); Giant honeybee, *Apis dorsata* L. (‘pukyutan’ or ‘putyukan’); and stingless bees, *Tetragonula biroi* Friese (‘lukot’, ‘kiwot’, or ‘kiyot’). These species can be domesticated and used for beekeeping except for the giant honey bees. The Giant honeybees and the Asian honeybees have better honey-producing capacity than stingless bees because of its morphological and colony characteristics by having a broader body and bigger colony with enlarged food stores.

In the past, only these two species were known to Bee hunters but not until the discovery of stingless bees by a Beekeeper from Guinobatan, Albay, who used to be a hunter. He was an apiarist turned meliponist, for he started culturing the Giant honeybees and then shifted to raising stingless bees, particularly *T. biroi* species. He may be considered as the ‘father of beekeeping’ in Bicol, and probably in the Philippines, for he pioneered the techniques for domesticating both the Asian honeybees and stingless bees. Because of his accomplishments, he received support from the academe and the government. He obtained his ‘parent’ colonies of Giant honeybees and stingless bees from the wild through hunting. He unselfishly shared the apiculture and meliponiculture technologies he developed to his fellow villagers in the mid-1990s and that was the birth of the beekeeping industry in Bicol region. The first species used in beekeeping was the Asian honeybees. At the beginning, beekeepers were satisfied with apiculture using Asian honeybees. Eventually, they learned about meliponiculture or stingless bee culture. They were able to determine the pros and cons of each technology. Later, they gradually shifted to culturing stingless bees. Two beekeepers from Albay province (one from Guinobatan; one from Ligao) keep a few colonies of Asian honeybees primarily for educational and demonstration purposes during seminars, training, or farm tours.

Of the five stingless bees recorded in Bicol [11], [12], *T. biroi* is the most preferred and widely used species in meliponiculture. This is also the banner commodity of the Regional Apiculture Center-Bicol (RAC-Bicol), located at the Central Bicol State University of Agriculture. The RAC-Bicol’s mission is to promote apiculture and meliponiculture in the Bicol region. A beekeeper from Ligao, Albay learned about beekeeping through a training provided by RAC-Bicol in 2004. He started raising *A. cerana*, colonies of which

were hunted from the wild. When Bicol was hit by a strong typhoon in 2007, his colonies were wiped out with only one left and thus, he resorted to raising stingless bees. He is a strong advocate of stingless beekeeping and one of the major suppliers of stingless bee colonies in Luzon.

A beekeeper must consider the biological nature of stingless bees, especially that Bicol is most prone to calamities. This is one of the greatest challenges that the beekeeping industry faces. Stingless bees, unlike *A. cerana* and *A. dorsata*, build perennial colonies and incapable of leaving the colony in case of possible threats. These characteristics make them highly vulnerable to disasters, environmental degradation such as pollution and deforestation; pesticide application; climate change; and pest attack (i.e., birds, frogs, some arthropods). The presence of these threats can jeopardize the bee's productivity and, consequently, the honey and colony supply. In December 2019, the Bicol region was badly hit by a strong typhoon, most especially Albay. The strong colonies of the two beekeepers from Ligao and Guinobatan, Albay, became weak because the plants and trees, as food sources, were destroyed. Also, they complain about the predator birds that eat the foraging bees. They were supposed to deliver colonies to their customers in the first quarter of 2020 but failed to do so because the colonies weakened. They postponed the harvesting of honey because there was not enough food for the bees. These scenarios cause an unstable supply of colonies and honey in the market.

Despite the increase in the number of beekeepers and the growing interest in honey production, the beekeeping industry remains to be part of the informal business sector under the shadow of rural enterprises. In order for the industry's economic contribution to improving, the chain through which beekeeping sector passes should be upgraded. Determining the factors that deter its development may aid in solving these hindrances. Stingless beekeepers dominate the beekeeping industry and the primary products are honey and colonies. The value chain of honey and colonies in the Bicol region is composed of four key players, namely: input providers, producers, processors, and traders.

The first key players are the Input Providers which refer to hunters and spotters of wild or feral colonies and are classified into three categories based on purpose or intent: (1) Honey Hunters (HH) hunts wild colonies and extract the honey to be sold to costumers. This applies to *A. dorsata* and *A. cerana* hunters. The chain has two types: (a) hunter-beekeeper-trader-consumer; and, (b) hunter-trader-consumer. For the first chain: the hunters sell the honey to beekeepers or middlemen at the price of Php 143.00 (\$2.86) - Php 286.00 (\$5.72) per liter and the beekeepers then sell it to traders at Php429.00 (\$8.58) per liter and finally, the traders sell to consumers at Php 514.00 (\$10.28) per liter. For the second chain: The hunters directly sell the honey to traders at the price of Php286.00 (\$5.72) - Php343.00 (\$6.86) per liter, and the traders sell it to consumers at Php 429 (\$8.58) per liter.

The price of honey varies depending on the number of players in the chain, the discretion of the seller, and the location of the transaction. As the number of players in the chain increases, the price also increases. When sold to relatives or friends, the price is discounted. When honey is bought in the

barangays or barrios that are far from the market place, the price is lower. The absence of pricing standards for honey might lead to underpricing overpricing, which the buyers and/or sellers may take advantage of. Another issue that is of excellent health concern is the purity and cleanliness of honey. The hunting practices of known hunters in Pili, Camarines Sur province were observed in the field. Results showed that the hunters were not mindful of proper sanitation for they used unwashed plant leaf as a funnel; used and unwashed shirt as a strainer; partially washed liquor bottles; and, dirty hands, in extracting and bottling the honey. Undoubtedly, the extracted honey was 100% pure but unhygienic. 2) Colony Hunters find wild colonies in forested/mountainous areas and sell it. Colony hunting, in this case, involves stingless bees only. The number of hunters is high in the provinces of Sorsogon and Albay. Two chains for colonies exist, such as (a) hunter-beekeeper, and, (b) hunter-middleman-beekeeper. For the first chain, the hunter sells the colonies directly to the beekeeper at a price ranging from Php 100.00 (\$2.00) to Php 500.00 (\$10.00). A beekeeper from Ligao disclosed that a small colony costs Php 100.00 (\$2.00) while a big one costs Php 200 (\$4.00) while a beekeeper from Guinobatan shared that the starting price is Php 250.00 (\$5.00). Ligao and Guinobatan are adjacent municipalities in the same province. In Camarines Norte Province, the hunter, sells the colonies to beekeepers at Php 350.00 (\$7.00) to Php 500.00 (\$10.00). For the second chain, the hunter sells the colonies to the middlemen at Php 100.00 (\$2.00) to Php 200.00 (\$4.00) then the middlemen sell it to the beekeeper at Php 500.00 (\$10.00) to Php 800.00 (\$16.00). Pricing varies considerably and is based on several factors such as (a) colony size; (b) colony source; (c) demand; and, (d) some players in the chain. The pricing issue is similar to honey.

The colonies, as it is considered products of beekeeping, should be subjected to product standardization. However, policies on such are not yet available. (3) Colony Spotters (CS) locate feral colonies of stingless bees and provide information to the hunters/beekeepers as to the exact location of the hives. For every spotted colony, a spotter receives a fee of Php 20.00 (\$0.50) to Php30.00 (\$0.60). Colony spotting is another income-generating activity for the people residing in rural areas. The old folks, who frequently visit the forests, are the best colony spotters due to their strong familiarity with the area. Because of old age, they are no longer capable of hunting. A good number of colony spotters are found in Sorsogon and Albay. Colony spotting has two chains: (a) colony spotter- beekeeper; (b) colony spotter-middleman-beekeeper; and, (c) colony spotter-middleman-hunter-beekeeper. One beekeeper in Masbate followed the first chain. A beekeeper in Albay admitted that the second chain worked for him. Another beekeeper from Camarines Sur was able to accumulate more colonies through the third chain. The chains also imply the price of the colony. As the number of players in the chain increases, the higher is the tendency for the price to increase. The last player, in this case, the beekeepers, are to suffer most.

Hunting of stingless bee colonies, eventually, is detrimental to its biodiversity and must be regulated or stopped. Cognizant of this risk, a local executive collaborated with RAC-Bicol and requested for the conduct of beekeeping

training to the tribal community composed of bee hunters. The ultimate goal is to educate the hunters on sustainable beekeeping and to provide them an alternative source of income. Thus, each trainee was awarded two starter colonies after the training. Through the Department of Trade and Industry, the trainees were trained on product development, packaging, and labeling and provided with the needed equipment and supplies. This was a commendable effort by the local government of Prieto Diaz, Sorsogon, as they provided financial and technical support to the hunters in establishing their backyard meliponaries. The tribal community got discouraged hunting when they realized the advantages of beekeeping. Unfortunately, hunting in the provinces of Sorsogon, Albay, and Camarines Norte is rampant. For hunting to discontinue, government intervention, with the support from the academe, is necessary just like what the local government of Sorsogon did. Hunters should be taught about the sustainable way of keeping bees. Nevertheless, hunting is good if done responsibly. If the hunters became beekeepers, they would be encouraged to plant more trees and crops as these are the major resources needed by the bees.

The stingless beekeepers as Producers, are the second key players in the value chain. Because of low capital required and fast return on investment, the number of beekeepers is escalating year after year, and so is the demand for colonies. With or without formal training, individuals engage into beekeeping, either in part-time or full-time capacity, to gain additional income. Income is generated through various activities such as colony multiplication, honey production, product development, and, sometimes, pollination services. The large chunk of their income comes from the sales of colonies.

However, due to the attractive price of colonies, beekeepers are tempted to hastily produce starter colonies to meet the demand of the market, not taking into consideration the quality. For instance, a new beekeeper from Camarines Sur bought her starter colonies in hive boxes from a beekeeper in Camarines Norte at Php 1,500.00 (\$30.00) each and believed that the colonies were strong and well-established. As the days passed, the colonies were observed getting weaker and weaker. When these were opened for inspection, the buyer found out that the starter colonies were taken not from the managed colonies but from the hunted colonies that were cut into pieces in sizes fitted to the hive box. This is a violation of the provision in the Philippine National Standard for the Code of Good Beekeeping Practices that starter colonies should only come from managed colonies to limit the overhunting of wild populations [13]. When a complaint was raised, the seller admitted that he has no formal training on beekeeping and is also a neophyte beekeeper, just like the buyer. His limited knowledge and lack of necessary skills in beekeeping are the causes of such failure. The hunted colonies were bought from a hunter in their area at Php 400.00 (\$8.00) each. He was able to produce 4 starter colonies from one big hunted colony.

It is the Producers that dictate the price based on several parameters such as colony strength (starter, strong), hive type (coconut shell, box), and source (business-registered bee farms, cooperatives, backyard beekeepers). Each starter colony costs Php 1000.00 (\$16.00) to Php 1,500.00 (\$30.00) while established colony is priced at Php 1,500.00 (\$30.00)

to Php 2,500.00 (\$50.00). The parameters on classifying starter, strong, and weak colonies are yet to be put in place. The classification may be too subjective, for it will depend only on the personal discretion of the beekeeper as the seller of colonies. The indicators for differentiating starter and strong colonies are the number of supers or box layers and the number of brood layers. The box size should not be used as basis for the colony strength. Two suppliers from Camarines Sur and Albay sell starter colonies hived in boxes of different sizes. The starter colony being sold from Camarines Sur has a bigger box but fewer brood combs, food stores, and workers is contrary to the one being sold Albay. Surprisingly, the starter colony from the former is more expensive than the latter. Again, the issue boils down to a lack of product and price standardization. With the growing demand for colonies and limited supply of colonies, it is expected that price will continue to shoot up if left uncontrolled due to a lack of price standardization guidelines or policies. Until now, qualification standards for colony strength are lacking

Colony division in stingless bees is usually done twice or thrice a year, depending on the availability of melliferous plants around a meliponary. And so, some beekeepers resort to buying hunted colonies to increase the number of colonies in a short time. To be able to sell it at a higher price, they transfer it to coconut shells or hive boxes. They allow it to establish itself in its new location and develop. Since the price is affected by the colony strength and hive type used, it is imperative to set standards for these parameters. Several beekeepers in the region have developed their own hive box design using different wood types/classes, resulting in differences in price. A beekeeper from Albay uses a relatively smaller and thinner box made of lumber and wood while a beekeeper from Camarines Sur makes a bigger and thicker box purely made of wood. The colony in the former box costs Php 1,500.00 (\$30.00) while a colony in the latter box costs Php 2,500.00 (\$50.00). Another beekeeper from Albay sells colonies hived in coconut shells at Php 1,500.00 (\$30.00) while a beekeeper in Camarines Norte only sells it at Php 1,000.00 (\$20.00). Another factor that affects the price is the business status or classification of the beekeeper. The actual experience of a cooperative in Albay will be cited as an example to elucidate this matter. Knowing that their cooperative does not have the necessary registration to operate a business, its members lack the confidence to give a high price despite its popularity as a supplier of good quality colonies in the Bicol and other regions.

The processors, as the third key players, process and create value-addition by developing innovative or new products using stingless bee honey and propolis as raw material or ingredient for food, feed, medicine, and cosmetics. Two kinds of processors were identified: (a) beekeeper, and (b) non-beekeeper. In Camarines Sur, three processors are beekeepers themselves, and one is non-beekeeper. The beekeeper-processors sell lip balms, honey-propolis ointments for insect bites and wounds, honey-propolis soaps, honey-glazed pili nuts, throat sprays, propolis tincture for toothache, and honey face masks while the non-beekeeper processor produces bottled fresh fruit juices with honey. A beekeeper-processor from Camarines Sur sells lip balm and throat spray directly to consumers but produces it only when there is an

order. The non-beekeeper processors buy the raw materials from the beekeepers. In Albay, two beekeeper-processors make a honey-propolis-beeswax ointment, honey-propolis soaps, and propolis sprays. A beekeeper-processor from Albay sells the products to a middleman that regularly buys the product. Then the middleman sells it to consumers. For instance, the propolis-honey ointment is sold to the middleman at Php30.00 (\$0.06) each, and the middleman sells it to consumers at Php50.00 (\$1.00) each. Similarly, a beekeeper-processor in Sorsogon produces various products mixed with honey and propolis that were harvested from her bee farm. She only sells honey and propolis if there is a surplus. In this case, the beekeeper processors have an advantage over non-beekeeper processors as the former have their own supply of raw materials. The products developed are new and not yet approved by the Food and Drugs Administration. Hence, it is only produced in a small volume. Scientific research and product testing need to be done to determine whether it is effective or safe for use. Studies and training on product development, packaging, and storage are lacking.

In the chain, the fourth and the last key players are the Traders that purchase honey either from the Input Providers or Producers or both and sell it to other key players. They are classified into three types depending on how they acquire the honey and to whom they sell it: 1) Wholesaler-consumers pertain to traders that act as middlemen by purchasing large volumes of honey and directly selling it to consumers. A gallon of stingless bee honey bought at Php 1,500.00 (\$30.00) is sold to consumers at Php 2,000.00 (\$40.00). 2) Wholesaler-retailers are traders that purchase a large volume of honey and sell it in retail prices. A liter of honey purchased at Php 1000.00 (\$20.00) is sold at Php1300 (\$26.00) - Php 1500.00 (\$30.00) per liter. Two non-beekeepers from Sipocot and Pili, Camarines Sur, as well as one non-beekeeper from Camarines Norte, operate in this type of chain. selling honey per 250ml, 350 ml, 500 ml, or per liter. (3) Assembler-processors are traders that purchase in low volume, gradually increase the amount, and sell only to consumers in bulk. It costs them Php 600.00 (\$12.00) per bottle and sells it at Php 1,000.00 (\$20.00), either in retail or wholesale price. They sell honey in gallons. Some Producers act as assembler-processors like the case of two beekeepers from Camarines Norte who buy hunted colonies of *T. biroi*. They extract the honey either through the drip method or press method or the combination of both.

The drip method yields good quality honey that can be priced higher than those honey extracted using other means. Some of the practices of input providers that tend to lower the quality of the extracted honey are: (a) indiscriminate harvesting of both ripe and unripe honey leading to increased moisture content; (b) poor straining process leaving honey with more pollen and other impurities; (c) lack of pasteurization; (d) not using food grade containers in bottling and storing honey; (e) adulteration; and, (f) in observance of proper sanitation measures such as the washing of hands before and after extracting honey, use of clean and sterilized tools and equipment, and keeping a sanitized working/production area at all times. These practices are not following the Code of Good Beekeeping Practices on proper and hygienic harvesting and processing of honey set by the Bureau of Agriculture and Fisheries Standards. Most of the

hunters, beekeepers, and traders are unaware of the existence of these guidelines. The commonly used containers in storing and bottling honey are recycled plastic gallons of vinegar, soy sauce, and fish sauce, recycled plastic bottles of carbonated soft drinks or artificial juice drinks; and, recycled hard liquor bottles (i.e., Gin bottles).

Most of the honey being sold to traders and consumers have no product labels and are poorly packaged. Apart from purity, the quality of honey should likewise be based on originality [14]. Thus, proper labeling and record-keeping are important. The label, as much as possible, should indicate the botanical, geographic, and entomological origins of honey for easy traceability, in case of fraud, health-related encountered problems relative to honey consumption, and other quality issues. As the demand for honey is rising, there is a strong tendency for beekeepers and traders to adulterate the honey to increase the volume and, ultimately, to gain more profit. The absence of a proper label in the container is too risky for the consumers because if the honey they purchased is adulterated, running after the trader would be difficult.

It was noted that the buying and selling prices of honey vary not just in the region but even within provinces. These may be due to a lack or absence of price and product standardization guidelines or policies, specifically for stingless bee honey. The honey being sold within a province with the same content is priced differently. For example, an unlabeled 250 ml stingless bee honey packed in a recycled artificial juice drink bottle is being sold by a beekeeper from Pili, Camarines Sur at Php 250.00 while a beekeeper from Goa, Camarines Sur is selling it at Php 350.00. Considering that Pili is just 49 kilometers away from Goa.

The popularity of honey tends to overshadow the other valuable bee products; hence, they are least known to all hunters, producers, and processors. *T. biroi* produces propolis in large amounts, but oftentimes, these are wasted. Scientific studies show that like honey; propolis also contains compounds that have antimicrobial, antioxidant, anti-inflammatory, and cytotoxic activities properties, among others [15]. Unaware of these benefits, the propolis obtained from colonies is just thrown away or used for cooking as it burns quickly with fire. This the case of the beekeepers from Camarines Norte (3), Camarines Sur (1), Albay (1), Sorsogon (2), Masbate (1) and Catanduanes (1). Propolis removed from the colonies during honey harvesting, and colony splitting are not valued. They simply leave it on the harvesting/working area or throw it in trash bins.

Only very few traders from Camarines Sur, Albay, and Sorsogon are producing propolis by-products such as propolis tincture for toothache, propolis mouth and throat spray, honey-propolis-beeswax lip balm, and honey-propolis-beeswax ointment for wound and insect bites. These by-products are produced in small quantities only because the producers, processors, and traders are uncertain of its market. A kilo of raw propolis is sold at Php600.00 (\$12) to Php1000.00 (\$20). Raw propolis may be classified into four types, and the price is dependent on its classification. Classification is based on the location where the propolis was harvested. The propolis obtained from the involucre and the storage pots is more expensive than those found in the batsmen and hive entrance. The former two types of propolis are

highly pliable, soft, and sticky, while the latter two types are hard and less sticky. In fact, there is an international demand for this bee product, but local supply is limited. There is a great potential for propolis both in the local and foreign market.

Another bee product that is packed with essential micro- and macronutrients, but given less attention, is the bee bread. Compared with *A. cerana* and *A. mellifera*, stingless bees produce less bee bread and harvesting of which is tedious as it is done only manually. Whether dry or fresh, the price of bee bread is the same. A kilo of which can be sold at Php 1000.00 (\$20) to Php 1200.00 (\$24). Only minimal processing is done with the harvested bee bread. The main buyers of this product are the game fowl breeders, cockfighters, and old-aged Chinese businessmen, who are the main buyers of this product. Some beekeepers from Camarines Sur and Albay serve as suppliers of this bee product.

Many of the processors/beekeepers are marginal farmers and consider beekeeping as a sideline job only. They lack financial resources and technical capacity to create new products. This is what limits them from utilizing other high-value products of stingless bees. The honey, for instance, is usually sold raw and unprocessed, and they do not even bother to pasteurize it. They give less importance to other bee products that, if processed, would give them more income. The lack of knowledge of value-adding would have been the reason for such action.

Product marketing and promotion of stingless bee products and by-products are weak. Products developed are of few kinds, limited in supply, and with poor packaging. Only those traders and processors that have enough capital can produce more. Limited production is affected by low market acceptability and unstable supply of honey and other bee products as raw materials. For these products to capture a bigger market, these aspects must be given preferential attention by the government and the beekeeping industry, in particular. This problem may be like Brazil, where stingless beekeeping is still regarded as a non-commercial activity [16]. The conventional applications of stingless bee honey as an antimicrobial, antioxidant, anti-inflammatory, and wound healing, among others, have not been explored in developing new products [17]. While honey from stingless bees is viewed as a niche product, marketing plays an important role. In Malaysia, a study on consumers' purchase intention for honey was found to be influenced by a medical condition, quality of the product, brand reputation, and pricing. Consumers were aware of the health benefits, but they do not use it regularly [18].

The use of stingless bees for pollination services is a win-win for the beekeepers. However, this practice is not yet popular in the region. Stingless bees are efficient pollinators of crops because of their body size and foraging habit. Since they are small, they can successfully pollinate even small and delicate flowers. Being polylectic, they get to visit and feed on different kinds of crops and, in the process, pollinate the flowers. Renting the colonies to crop growers or farm owners would give beekeepers an income. Two mango growers, one each for Camarines Sur and Masbate, have rented colonies from a beekeeper for pollination. However, due to lack of proper coordination among the farm owner, farm caretaker and beekeeper, bees died due to pesticide

poisoning. This kind of beekeeping endeavor is quite risky but economically rewarding. The farm owner is directly transacting business with the beekeeper, thus limiting the number of players in the chain. This should be promoted widely in the region. The beekeeper gets paid for the service rendered by the bees and at the same time, the bees get fed. In the Philippines, the rental fees have not yet been set. The price depends on the beekeeper's decision and discretion.

Stingless beekeepers in the region are not organized, except for a cooperative in Ligao, Albay. The majority works and operates on their own, with no or limited collaboration with their co-keepers. Such an existing set-up is not healthy for the beekeeping industry. It is perceived that the problems confronting the industry today would be ironed-out if there is a solid organization that would serve as a platform for discussion of relevant issues and concerns as well for the exchange of ideas among the beekeepers. Issues on pricing, quality, supply, among others, would be properly addressed. The organization will serve as the 'voice' of the members. The cooperative in Ligao, Albay, with almost 20 members, supplies colonies to various parts of the country. They developed their own hive box design, construct boxes based on the design, and sell good quality colonies at the same price. The Head leads the group and, at the same time, serves as the Quality Control Officer. All members receive benefits commensurate to their contribution to the organization.

IV. CONCLUSIONS

Considering the abundance of the endemic and climate-resilient stingless bee species, *T. brio*, Bicol has a competitive advantage in the stingless bee industry compared with the regions in the Philippines. However, their existence in the wild is most threatened because of excessive hunting in the region. With improving the popularity of beekeeping, demand for stingless bee colonies is continuously increasing, and so is hunting in various provinces of the region. The beekeeping industry in the region is beset by challenges that could hamper its development, including the threat for extinction of stingless bees if hunting would not stop.

Seven development barriers were identified based on the results of this study. The first is the unstable honey supply. Dependency of producers and traders to hunted colonies, low number of beekeepers, honey-producing capacity of *T. biori* are the possible reasons for the fluctuating supply of honey. The second is the absence of established price standardization guidelines. The high price variation may connote a negative impression to the market since it will imply differences in the quality of honey produced.

As a result, this will create confusion to buyers on whether the honey they are buying is pure or adulterated. Also, setting a common price for stingless bee honey in the Bicol region and the Philippines, in general, would be beneficial for all the key players in the value chain. The third is the lack of clear policies on product traceability. Most of the honey sold are unlabeled and poorly packaged, thus, poses high risks to consumers. Fraudulent buyers can not be easily tracked in the absence of such policies. The fourth is the inadequate harvesting and processing procedures set by the Bureau of Animal Industry for stingless bee honey. The guidelines focused more on *A. mellifera* honey. The fifth is

the lack of entrepreneurial support programs that would sustain the efficient commodity flow of stingless bee honey.

The different key players of the have limited knowledge on the proper harvesting, processing, packaging, storing, pricing, value-addition, and marketing of honey. The sixth is the vulnerability of the Bicol region to natural disasters such as typhoons and volcanic eruptions. Productivity of the bees is compromised in the event of these calamities. Such environmental risks are likely to limit people from pursuing beekeeping as an agribusiness venture. The seventh is the limited studies on the various aspects of stingless beekeeping. Other valuable bee products await attention, recognition, and scientific exploration. Researches on these products must be intensified and capacity building/enhancement programs be provided to interested individuals, groups, or cooperatives.

The problems on pricing and traceability can be sketched out from the quality issue of honey. Traders who come from the same community where they bought honey would sell honey at different prices but at a lower price compared to the market price. A handful of buyers detected some adulteration which insisted them to probe on the real sources of honey. Hence, to protect the integrity of stingless beekeeping industry, certification of product purity must be developed through a government-academe partnership with academe providing research and development initiatives and entrepreneurial ecosystem to the entire community; and the government providing enabling policies for rural empowerment and environmental protection. Similar to farming, stingless beekeeping is a promising enterprise that is largely dependent on climatic condition. The risks associated with climate change and environment limit people from seriously pursuing stingless beekeeping as an entrepreneurial venture. To strengthen the industry, stakeholder's collaboration must be institutionalized to create strong business linkages among the chain operators. The government should provide financial assistance to backyard beekeepers and small-time processors so they could have additional capital to upscale their business by utilising other valuable bee products such as propolis, pollen, and beeswax. Since stingless bee products are new to market, product marketing and promotion is deemed necessary. The distinctive characteristic of stingless bee honey should be positioned in a market niche that matches its benefit to target users.

To further boost the industry, connection among the all key players should be strengthened such as provision of training and seminar on proper beekeeping management practices, proper evaluation of beekeepers and hunters, address the issue on pricing system and honey fraud. Support from the government and private agencies will likewise contribute to the success of beekeeping industry. A review must be done on the provisions in the Code of Good Beekeeping Practices as regards the production chain of raw honey and its by-products to ensure that honey sold is of good quality, with fair price, and easily traceable.

ACKNOWLEDGMENT

The authors would like to thank the Central Bicol State University of Agriculture for the administrative and logistic support and the Regional Apiculture Center

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