AGRIKULTURA CRI Journal 1 (1) **ISSN: 2782-8816 January 2021**

UTILIZATION AND COMMERCIAL PRODUCTION OF STINGLESS BEES AND ITS PRODUCTS IN BICOL, PHILIPPINES

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Abstract — Upscaling meliponiculture can increase income through the utilization and commercial production of the bee and its products. This includes improved and sustained production with the abundant colony and pollen sources, enhanced pollination, and developing health and wellness products from stingless bees. The research objectives were: map out the geographical distribution, abundance, and morphological characterization of stingless bees in the Bicol Region; determine the pollen sources of bees in meliponaries and bloom pattern in the area; determine the pollination efficiency by stingless bees on pigeon pea; and, develop food and cosmetic products from stingless bees.

Stingless bee colonies were sighted in all provinces in Bicol. Geographical locations were: Albay (Daraga), Camarines Norte (San Lorenzo Ruiz), Camarines Sur (Goa, Iriga, Tinambac), Catanduanes (Viga, Bagamanoc, Panganiban), Masbate (Aroroy), Sorsogon (Bulusan, Casiguran, Pilar, Prieto Diaz) but most abundant in Albay. Open nested colonies with clustered brood are T. *sapiens* while closed nested colonies with spherical brood are T. *biroi.* Acetolyzed bee bread from different meliponaries confirmed the pollen sources and documented the plant species, raw pollen, acetolyzed pollen, and bloom pattern. Pollination efficiency with 15 adult bees on pigeon pea flowers was 96.88%. Food and cosmetic products using pollen, propolis, and honey that were developed include moisturizing creams, propolis sprays, hand sanitizers, bath soaps and shampoo bars, macaroons with honey, polvoron with pollen, and honey-propolis candies. Three (3) IEC materials were distributed in trainings, exhibits, and fora.

Keywords — **Stingless bees distribution, product utilization, pollen sources, pollination.**

INTRODUCTION

The Bicol region is blessed with two major indigenous species of bees, namely *Apis cerana* and *Tetragonula biroi* which are found abundantly in its forests. Numerous research have been done by the Central Bicol State University of Agriculture being the Regional Apiculture Center (RAC) in upscaling the beekeeping technology particularly the stingless bees which are indigenous in the region. Results of investigations paved the way to the development of technology on stingless bees, referred to as Meliponiculture. In 2013, cultural practices have been published by Mostoles.

The stingless bees locally known as "lukot" produce honey, propolis, pollen, Royal jelly, and wax. Numerous benefits derived from its products such as honey, propolis, and pollen have been documented. To wit: honey as an effective cure for asthma and other respiratory diseases, bee glue or propolis with antimicrobial properties, and bee pollen as a protein source. These products were likewise developed by the university such as the cream and astringent (Mostoles and Ruiz, 2010), but massive commercialization is still wanting. Investigations are being made on Royal jelly and wax. With the stingless bees' high survival and low absconding rates, the nucleus can be produced commercially, utilized for pollination contracts to generate additional income for food security, especially by the marginal farmers.

For the sustainability of this emerging agro-industry, utilization and commercialization efforts must be done. Technology adaptation and verification can be initiated by knowing the distribution of the stingless bees in the wild, its pollen sources, and the bloom pattern in meliponaries, crop pollination efficiency. When good apicultural practices are developed and the yield of by-products has increased, there will be a need to process and utilize these products either for food, medicine, or skincare. For the past 12 years, commercial production of *T. biroi* mushroomed in the region, with no less than 20 meliponaries established (Mostoles et al, 2015). However, only a few sustained the industry due to abiotic and biotic constraints. The availability of the feral colonies in some areas has been done and the species were identified. Morphological analysis of stingless bees collected from the provinces of Camarines Sur and Albay was carried out in 2008 with eight species noted and now with ongoing studies on the bioinformatics of stingless bees. The performance of stingless bees in different hives and ecosystems were evaluated. Pollen sources identified were coconut, guava, citrus, mango, pili, avocado, neem tree, star apple, jackfruit and banana, *Wedelia*, *Chromalaena*, *Mimosa*, gumamela, shanghai beauty, santan, eggplant, pepper, squash, corn, and other weed species. Previous documentation by Mostoles and Ruiz (2010) was done on pollination of *Jatropha,* effects of propolis on skin irritations, wounds, and scratches, but required clinical analysis.

No comprehensive study and documentation on the distribution, pollen sources, and pollination efficiency of the stingless bees is available in the region. This information could serve as a basis and useful guide for future beekeepers not only in the Bicol region but in other parts of the country. The objectives of the research were: a. Mapping the distribution and abundance of stingless bee in the wild and identify the species found in the different provinces of the region; b. Identify the pollen sources of stingless bees in the wild and in meliponaries; c. Determine the pollination efficiency of stingless bees on pigeon pea; and, d. Develop and improve food and cosmetic products from stingless bees.

MATERIALS AND METHODS

Distribution and Relative Abundance of Stingless Bees in the Bicol Region

All the provinces in the region were surveyed for the presence of feral colonies of stingless bees in the wild and meliponaries. Documentation of the nesting sites, hive entrance, and hive architecture was done, and 25 adult bees were collected for morphological examination and identification. Location (coordinates and elevation) of the nests were determined using the Garmin GPS 12XL with maps generated.

Pollen Sources of Stingless Bees and Bloom Pattern

Pollen from the bee bread was collected from meliponaries in Sorsogon (Castilla, Casiguran, Pllar), Masbate (Aroroy and San Pascual, Burias) , Catanduanes (San Andres), Camarines Norte (San Lorenzo Ruiz, Camarines Sur (Pamplona, Gainza, Bula, Pili), and Albay (Guinobatan, Ligao City). The strength of these apiaries differed based on the number of colonies cultured and the suitability of their surroundings. Acetolysis of the bee bread samples was done in the laboratory. A drop of glycerine was added to the acetolyzed sample, mounted on a slide, and examined under the microscope. Photo documentation of the identified raw and acetolyzed pollen was done. Flowering plants (trees, shrubs, etc) in the meliponaries were noted and the time of flowering was recorded.

Pollination of Pigeon Pea

Field evaluation of the pollination efficiency of pigeon pea by stingless bees was done at San Jose, Pili, Camarines Sur. There were five treatments: Treatment 1- Open type of pollination, the flower of pigeon pea is exposed to the pollinators such as wasp, butterfly, and bees; Treatment 2- No bees were introduced and the flowers were caged to represent the control; Treatment 3- Five (5) individuals of stingless bees were introduced per caged branch of pigeon pea bearing flower; Treatment 4- Ten (10) individuals of stingless bees were introduced per caged branch of pigeon pea bearing flower; Treatment 5 - Fifteen (15) individuals of stingless bees were introduced per caged branch of pigeon pea bearing flower. Before caging and introduction of bees, each branch serving as the sample was first evaluated by counting the number of closed flowers. For each treatment, the corresponding numbers of stingless bees were introduced inside the cage. For T1, the branches were labelled and the no. of flowers counted. For T2, the no. of flowers in the sample branch was counted and enclosed in the cage without any pollinators inside. Daily monitoring of the cage was done until the flowers were pollinated and until the fruit set was initiated. The pollinated flowers were counted as well as the total number of flowers and the percentage pollination efficiency was computed and documented.

Food and Cosmetic Products from Stingless Bees

Food products were developed making use of either or a combination of the by-products such as propolis, pollen, and honey. Sensory evaluation of the products followed by packaging and labelling were done. The project focused on developing cosmetic products such as soap, shampoo bar, hand sanitizers, and throat spray. Previously developed moisturizing cream was enhanced. As the research is on technology adaptation and verification, IEC materials were developed for distribution to potential adopters.

RESULTS AND DISCUSSION

Distribution and Relative Abundance of Stingless Bees in the Bicol Region

A distribution map of the stingless bees in the different Bicol provinces was generated through GIS Mapping and is presented in Figure 1. Nesting sites and brood types are presented in Figure 2. The description of the colonies is presented below.

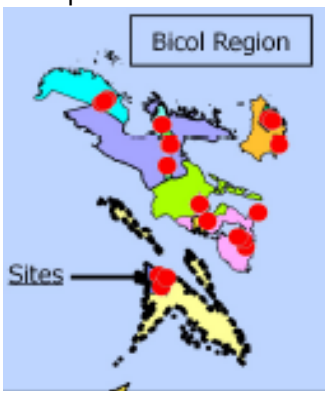

Fig. 1. Distribution of Stingless Bees in different provinces in the Bicol region.

A. Nest on coconut.

B. Brood types: L-spherical; R-cluster.

Fig. 2. Nesting sites (A) and Brood types (B) of Stingless Bees.

In the province of Albay, eight colonies were found in Barangay de la Paz (Daraga) with 1 nesting on hollow coconut (closed type, 123.6909°E, 13.13536°N) while 7 colonies on narra (open and closed nest,123.6957°E, 13.13413°N) At Brgy. Dinoronan, an open nested colony (123.6913°E, 13.13622°N) was found nesting on dried lanipga *(Toona kalantas)* tree. The mean distance between colonies is 0.396 km, considered as clump due to their closeness.

In the municipality of Aroroy (Masbate), Brgy. Matalang-talang had two clustered colonies in an old house (closed, 123.3486°E, 12.50322°N), Brgy. Cabangcalan, had two clustered colonies found in the kitchen (closed, 123.3692°E, 13.40157°N) and Brgy Pinanaan had two stingless bee colonies, one with spherical and the other clustered brood in the wall made of hollow blocks with protruding hive entrance (closed and open, 123.4143° E, 13.48182°N), two colonies (open and closed nesting). The mean distance of colonies was 9.912 km indicating a dispersed condition.

At Brgy. San Roque, Bulusan (Sorsogon), two open-nested spherical colonies were collected on coconut and betel nut (124.0819°E, 12.7541°N) while at in Brgy Del Rosario, Pilar, closed nesting spherical colonies were found in coconut. At Brgy. Tigbao (124.01549°E, 12.84297°N), and Brgy. Inlagadian (124.05908°E, 12.81576° N), both in Casiguran, closed nesting types with spherical brood nested on coconut were collected. At Brgy. Quidolog, Prieto Diaz (124.18708°E, 12.05975°N, and 124.05908°E, 12.81576°N), closed nesting and spherical brood colonies were found in the hollow sampaloc log. The mean distance of colonies from each other was 25.993 km indicating that it is widely dispersed.

At Brgy. San Pedro town of Goa (Camarines Sur), three colonies were

noted- all are spherical brood, in *Ficus nota* tree (open, 123.44736°E, 13.66064°N), in gumihan (*Artocarpus sericarpus*) tree (closed, 123.44149°E, 13.66923°N), and in lanipga tree (closed, 123.4345°E, 13.66089°N) Mean distance between colonies is 8.665km.

At barangay Matacong (Camarines Norte), a closed nesting and spherical brood colony hived in coconut (122.86342°E, 14.03032°N). The same type of colony was collected in Brgy. Mampurong (122.887306°E, 14.04695° N). At Barangay Dagotdotan, open nested spherical brood hived on narra (122.9116°E, 14.0676°N). The mean distance between colonies was 4.473 between colonies.

It was observed at Brgy. Ananong (Viga, Catanduanes) (124.30764°E, 13.87383°N), that a closed nesting colony hiving on a fern tree was observed to have an elongated hive. At Brgy. San Miguel (Panganiban) (124.27756°E, 13.89388°N), a closed nesting colony nesting in a hollow trunk of anislag tree observed to have an elongated hive entrance and clustered brood type. The same type of colony nesting in hollow narra trunk was seen at Brgy. Quezon (Bagamanok) (124.22912°E, 13.9371°N). A total of 6 colonies were sighted in four (4) municipalities with a mean distance of 5.719 between each nest of stingless bees.

Identity of the Stingless Bees

Morphological characteristics of the collected colonies of stingless bees were measured which served as basis in the identification of the species. The closed nesting colonies and spherical brood types were identified to belong to the genus *Tetragonula , carbonaria* group while the open nesting types with clustered brood belong to the same genus but the *laeviceps* group. Samples from Albay and Sorsogon which were in closed nesting type were positively identified as *T. biroi* while the open nested found in hollow trees with clustered brood were identified as *T. sapiens*. Abu Hassan Jalil (2017) reported in Chapter 10 of his book the meliponiculture activities in the Philippines as contributed by Mostoles (2017), specifically showcasing the diversity of bee species in different ecosystems and landscapes in Bicol.

Pollen Sources of Stingless Bees and Bloom Pattern

Pollen collected from plants found in the different survey areas, particularly in meliponaries is presented fully in the brochure entitled "Pollen Sources of Stingless Bees in the Bicol Region" which is the output of this research. Some of these plants, the raw and acetolyzed pollen are presented in Figures 3 and 4.

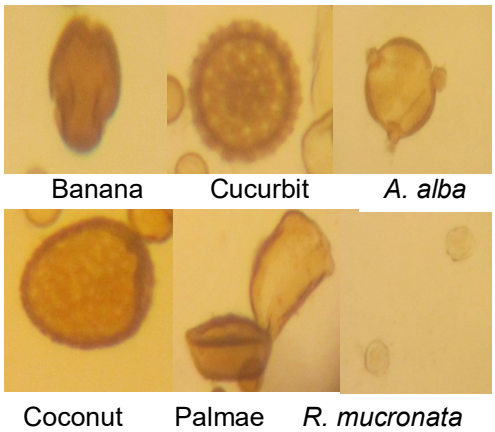

Fig. 3. Some of the acetolyzed pollen collected from meliponaries.

Camarines Sur. In four meliponaries, minor differences were observed on the kind of plants visited by the stingless bees. Bee bread obtained from the hives showed a variety of pollen foraged by the worker bees and brought inside the hives. At MTB meliponary located at San Vicente (Pamplona), the pollen sources were: coconut (*Cocos nucifera*), as most dominant, papaya (*Carica*

Coconut (*Cocos nucifera*)

Citrus (*Citrus maxima*)

Fig. 4. Plant foraged by stingless bees in the meliponaries.

papaya), banana (*Musa* sp)., Ipil-ipil (*Leucaena leucocephala),* balingbing (*Averrhoa carambola)*, lemon (*Citrus sp),* avocado (*Persia americana)*, squash (*Cucurbita maxima)*, kamias (*Hedychium coronarium)*, Lipote/ baligang (*Syzygium polycephaloides),* tubog (*Ficus nota*). At San Jose (Pili), pollen sources were banana, papaya, coconut, guava (*Psidium guajava),* pili nut (*Canarium ovatum),* acacia *(Acacia mangium)*, santan (*Ixora grandiflora)*, corn (*Zea mays)*, eggplant (*Solanum melongena),* bitter gourd (*Momordica charantia)*, kurikuri (*Wedelia biflora*), shanghai beauty, mango, lemon and palm tree (*Palmea sp.). C*olonies at Gainza had foraged pollen from coconut, santan, "mambog", acacia, and mango (*Mangifera indica*). Similar pollen was found in the bee bread from the colonies at Bula with sampaloc and pigeon pea as additional pollen sources. Other pollen types were observed but require further identification.

Albay. At Rafael's apiary at Paulog, were corn, jackfruit, coconut, kuri-kuri, squash, ampalaya, Euphorbia, *Mimosa pudica*, santan, legumes and eggplant. Corn and coconut were the most abundant source in the area. Palconitin's apiary at Magcasili, Guinobatan also had coconut, vegetables, and fruit crops pollen found in its bee bread. However, because the area is surrounded by coconut, most of the pollen observed in the bee bread was the coconut pollen.

Sorsogon. The PHI or Tim de los Reyes' apiary at Cumadcad, Sorsogon had coconut, mango, avocado, star apple, papaya, banana, jackfruit, and flowering plants as its sources of pollen. Examination though of the bee bread showed a dominance of coconut and avocado pollen types. At Barcelona's apiary (Pilar, Sorsogon), coconut, mahogany, gmelina , mango, narra, cacao, and pili were found in the area. However, pollen types collected from the bee bread were from coconut, narra, and mango. Other fruit-bearing trees were found in the apiary, but no indication of its pollen types was observed in the acetolyzed samples. Grajo's meliponary located at Casiguran, Sorsogon had coconut, pineapple, corn, and lemon as pollen sources of their stingless bees. Other fruit trees were likewise found in the area, but no confirmation could be made whether their pollen is being foraged by the bees.

Masbate. Stingless bees at the meliponary of Mr. Ostia at Aroroy foraged pollen from coconut, mango, chico, 'bangkal', and some mangrove plant species. Bee bread analysis showed more of the coconut, mango, and the mangrove plant pollen. Similarly, found at Mr. Servilla's meliponary at San Pascual, Burias was pollen from mangrove plant species and other crops such as coconut, corn, banana, jackfruit, and mango.

Catanduanes. The only meliponary evaluated for its pollen sources was Balmadrid's at San Andres, Catanduanes with coconut as the major pollen source of stingless bees. Other pollen types in the bee bread were acacia, golden shower, mango, banana, papaya, guyabano, avocado,

santol, mango, corn, guava, and some flowering plants. At the coastal areas of Catanduanes, coconut and vegetable crops were in bloom for three months. Baligang and santol had flowers from Januanry to February while balimbing bloomed in February. Bloom pattern was limited to three months due to abiotic factors and lack of cooperation from the apiary owners to monitor the flowering plants. Year-round monitoring is recommended for comprehensive data as a guide to the beekeepers in every province.

Camarines Norte. A newly established apiary at Lorenzo Ruiz, Camarines Norte owned by Mr. Borromeo showed coconut, mango, and lemon as the major pollen sources. Based on the 3-month calendar, it was observed that in mangrove areas, six plants bloomed from December to February while only miyapi (*Avicennia rumphiana*) bloomed in February. In meliponaries located in an agroecosystem , 12 plants bloomed for three months while star apple and avocado had flowers only in February and January-February, respectively. In apiaries in upland and semi-forest areas, there were 4 plants in bloom from Dec.-Feb., narra and santol from Jan.-Feb. and mahogany in February.

Pollination of Pigeon Pea

There was a significant difference among the treatments in terms of the number of flowers pollinated by stingless bees in pigeon pea. The highest number of flower pollinated was in the cage containing 15 individuals of the stingless bee with a pollination of 96.88%, followed by open -pollination with pollinators around the area with 81.46%, 10 individuals of stingless bee in a cage with 68.81%, and 5 individuals of stingless bee in the cage with 54.23%. The lowest percent of pollination is a closed condition with no pollinator. Pollination of pigeon pea could be achieved successfully using 15 individuals of stingless bee per branch but using 5 to 10 individuals of stingless bee or with at exposure of the flower to the various pollinators (open pollination) could yield similar results. In Thailand, Anchalee Sawattum in the book edited by Abu Hassan Jalil (2017) listed ornamentals, trees and weed species which are food sources of the stingless bees. Bob Luttrell as cited by Abu Hassan Jalil (2017) identified plants and trees as sources of nectar and pollen as well as resins in various regions in South America, Mexico and North America. Stingless bees are particularly important pollinators of tropical plants, visiting approximately 90 crop species. Some habits of stingless bees resemble those of honeybees, including their preference for a wide range of crop species, making them attractive for commercial management.

Food and Cosmetic Products from Stingless Bees

Refinement of the Skin Care Product developed by the Regional Apiculture Center (RAC). The moisturizing cream developed by the RAC for the past year used a different base cream (Van Cream), added with propolis, virgin coconut oil, and scent. The product is a soft cream that is soothing to the skin, dirty white with odor being mild with the addition of a natural scent to mask the smell of the propolis. The texture is smooth and particles of the propolis are not evident. In the preparation of the moisturizing cream- a predetermined volume of the honey, propolis, wax, van cream, virgin coconut oil were mixed aseptically. The wax was first melted in a beaker with the propolis to allow the ethanol to evaporate. This was allowed to cool down then mixed with the van cream with continuous stirring. Several drops of honey and virgin coconut oil were added with stirring. A scent was likewise added for the moisturizing cream. Once the materials were thoroughly mixed, these were transferred to a 5 g container using a small spatula, covered, and then

labelled. The developed moisturizing cream was evaluated for its physical attributes particularly the color, odor, and consistency. Improving the cream made use of pure propolis extract replacing the ethanolic extract. Using the pure extract made it easier to mix thoroughly the propolis with the van cream. Instead of using VCO, the oil added to the cream was Pili Pulp Oil (PPO) which is a product in the region. No scent was used. Just like the previous preparation, the color of the cream is cream/dirty white due to the propolis. This is however slightly lighter in color compared with the previous mixture. The smell of the PPO is distinct giving it a scent of pili nut.

The moisturizing cream was tested on the skin by 15 individuals used for a period of six months but was not compared with any control. They claimed that skin irritations were easily eased with a slight removal of scars from wounds. Likewise, some who used it for their face with a growing pimples said that applying the cream prevented further pimple to develop.

Other new food products using stingless bees as an ingredient are presented in Figure 5 and discussed below:

Macaroons with honey. Macaroons are a popular sweet food product basically from desiccated coconut. The tangy honey from stingless bees was used as a substitute for refined sugar to prolong the shelf life. Normally, the shelf life of macaroons is for only 3 days under ambient temperature and a week when refrigerated. Macaroons cooked using honey instead of refined sugar was found to be less sweet, based on the testimonies from the consumers. Reduced sugar substituted with honey in macaroons is preferred by consumers particularly the diabetics. Under ambient temperature, the texture of the macaroons remained the same after 10 days which can further be stored under the refrigerated condition for more than 2 weeks. Macaroon with honey is packed in small polypropylene plastics (4 pcs) and in a carton/box with 12 pcs. It could be packed in small plastic (hard) containers. A benefit that extended shelf life and the nutrients in using the tangy honey of stingless bees.

***Polvoron with pollen*.** Stingless bees' pollen is high in protein which could be given to malnourished children. However, the bee bread obtained from the hives of stingless bees after processing is not aesthetically acceptable to children and even the other age groups. Its granulated form taken directly from the hive is more often associated with animal food. Considering the nutritional benefits of the bee bread (pollen) from stingless bees, adding this to polvoron will be more palatable to the children. Particles of the bee bread were powdered and added as an ingredient in making polvoron. The proportion of which was first determined before mass production. A few drops of stingless bees' honey was used to reduce the amount of sugar granules which is used to bind the flour. The polvoron was packed in colored plastic and small plastic polyethylene bag. Sensory evaluation of the product was done and results showed preference and shelf life of polvoron extended to 26 days. Succeeding production had its size doubled with a corresponding increase in the price.

***Honey-Propolis Candies*.** Honey is a natural sweetener while propolis has antifungal and antibacterial properties. Thus, these were used in making the honey-propolis candies. The ingredients used in preparing the candies were: honey, propolis, sugar, and condensed milk of determined proportions. The mixture was cut based on the desired shape and then allowed to harden. The candies were packed in small PEBs. Several trials of the candy produced a chewable type but shelf life was too short. Individuals who ate the candy said that it relieved their throat and reduced odor from their

mouths.

Alco - propolis Sanitizer. With propolis having both antibacterial and antifungal properties, a cleansing product was done with the mixture of alcohol and propolis of predetermined proportion. This can be used to cleanse the hands or any part of the body which comes handy in the plastic container.

Propolis Spray. The propolis spray was formulated to be used as a throat spray. It is sprayed directly into the mouth to relieve the throat. It is composed of a predetermined proportion of ethyl alcohol and propolis. The spray was also used as astringent for wounds, skin rashes, insect bites/ venoms, boil, pimples, and other skin irregularities. . This is quite extensive since the materials used such as the propolis is expensive and the end product is the extracted propolis itself without any additive.

Bath Soap. The bath soap developed is a combination of oils and honey and propolis as additives. The standard method and ingredients in making a bath soap were followed but honey and propolis were added. These were moulded in a carton/plastic cells. The preparation was allowed to cure for a minimum of 3 weeks and the products were packed in small polyethylene bags . Several persons were requested to use the bath soap for sensory analysis. The bath soap was evaluated based on the lather, odor, moisturizing effect, color, and germicidal effect. In terms of lather, the respondents found it to be acceptable, for the odor some claimed it to be acceptable, but others rated it as slightly acceptable. For the color, moisturizing and germicidal effect, these were rated as acceptable in more than 50% of the respondents. Among the parameters rated, the odor was found to be less acceptable to the respondents. The overall effect, the product is acceptable. The products were sold to interested individuals and there was no negative feedback received.

Shampoo Bar. This product was formulated with the combination of different oils, glycerin, lye, guava wine, and propolis. The mixture was meld in cells made of thick boards. The shampoo bar can be dissolved in water to produce a liquid shampoo. The soap was claimed by one user that it helped control head louse, especially in children. In a recent training conducted at Sanchez-Mira, Cagayan, this product was promoted for such use. Shown in Figure 5 are the products developed by the researchers.

Cosmetic products

Food products

Fig.5. Cosmetic and Food Products.

Three (3) IEC materials were prepared on the following: Distribution and abundance of stingless bees in Bicol, Food and Cosmetic products from stingless bees, and Pollen Sources of Stingless Bees in the Bicol region (Fig.6). Though copies are

limited, these have been used in trainings, exhibits, and seminars/fora to encourage more individuals to venture into beekeeping using stingless bees. Likewise, these materials are also useful to students working on research on stingless bees.

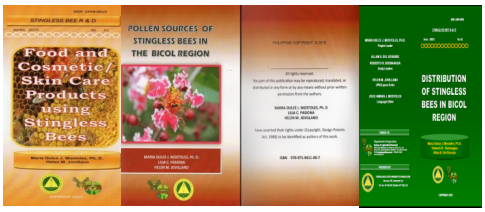

Fig. 6. IEC materials developed and utilized during trainings.

CONCLUSION

Positive occurrences of stingless bee colonies in the six (6) provinces in the Bicol region. These were sighted in Albay (Barangays of Dinoronan and De la Paz, Daraga), Camarines Norte (Barangay Matacong, Brgy. Dagotdotan, and Brgy. Mampurong, of San Lorenzo Ruiz), Camarines Sur (Barangay of San Pedro-Aroro, Goa and Sta. Teresita Iriga City), Catanduanes (Brgy. Quezon of Bagamanoc, Brgy. San Miguel of Panganiban and Brgy. Anannong and Ugbong of Viga), Sorsogon (Brgy. San Roque of Bulusan, Brgy. Del Rosario of Pilar, Brgy, Quidolog of Prieto Diaz and Brgy. Inlagadian and Brgy. Tigbao of Casiguran), Masbate (Brgy. Matalang-Talang, Brgy. Cabangcalan and Brgy. Pinanaan of Aroroy). Open nesting with clustered brood types and closed nesting with spherical brood types of colonies were collected which belongs to the genus *Tetragonula*, groups *laeviceps*, and *carbonaria*, respectively. Sightings of the colonies were mapped for its distribution per province. Mean distances between colonies were shortest in Albay (0.39km) indicating abundance while farthest in Sorsogon (28.993km), thus declared as least abundant for stingless bee colonies.

Pollen sources of stingless bees in the meliponaries surveyed were: In Camarines Sur: coconut (*Cocos nucifera*), papaya (*Carica papaya),* banana (*Musa* sp.), Ipil-ipil (*Leucaena glauca),* balingbing (*Averrhoa carambola)*, lemon (*Citrus sp),* avocado (*Persia americana)*, squash (*Cucurbita maxima)*, kamias (*Hedychium coronarim)*, Lipote (baligang) (*Syzygium polycephaloides),* guava (*Psidium guajava),* pilinut (*Canarium ovatum),* acacia (Acacia *mangium)*, santan (*Ixora grandiflora)*, corn (*Zea mays)*, eggplant (*Solanum melongena),* bitter gourd (*Momordica charantia)*, kuri-kuri (*Wedelia biflora*), shanghai beauty, mango, lemon, palm tree (*Palmea sp.),* santan, and "mambog"; Albay: corn, jackfruit, coconut, kuri-kuri, squash, ampalaya, Euphorbia, *Mimosa pudica*, santan, legumes and eggplant; Sorsogon : coconut, mango, avocado, star apple, papaya, banana, jackfruit, flowering plants, mahogany, gmelina , mango, narra, cacao, pili, pineapple and lemon; Masbate: coconut, mango, chico, 'bangkal', mangrove plant species, corn, banana and jackfruit; Catanduanes: coconut, acacia, golden shower, mango, banana, papaya, guyabano, avocado, santol, mango, corn, guava and some flowering plants were the pollen sources; Camarines Norte: coconut, mango and lemon. Meliponaries in all the provinces had their stingless bees found to forage on coconut plus other horticultural, agronomic, forest, and fruit crops and mangrove plant species. Stingless bees were found to be not host-specific and its floral preferences are diverse. The majority of the plants were in bloom in the apiaries from December to February except for some trees which were only at the flowering stage starting January.

Pollination of pigeon pea using 15 individuals of stingless bee in cages significantly differed with 96.88% while 67.36% for closed pollination.

Stingless bee products such as pollen, propolis, and honey could be sold as raw materials but could be used in developing value-adding food and cosmetic products. Refinement of the moisturizing cream was done with the substitution of VCO with pili pulp oil, improved packaging, and labelling.

Incorporation of bee products on food such as macaroons with honey, polvoron with pollen, and honey-propolis candies was found acceptable to the consumers including the packaging and labelling.

Formulated and developed cosmetic products using stingless bee products were: alco-propolis sanitizer and propolis throat spray, bath soap, and shampoo bar with propolis. All of the products developed were found to be acceptable.

ACKNOWLEDGMENT

The authors are thankful to the Department of Agriculture Bureau of Agricultural Research under the leadership of Dr. Nicomedes Eleazar for funding this research and continued support to the Stingless Beekeeping efforts of CBSUA. To the beekeepers of the Bicol region, for their cooperation and support to the authors. To Helen M. Jovillano, our research assistant and all the enumerators, thank you so much.

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