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Denise Margaret S. Matias "Sustainability of community forestry enterprises: indigenous wild honey gathering in the UNESCO Man and Biosphere Reserve Palawan, Philippines", University of Bonn / ZEF, 2017

Summary

Achieving food and nutrition security is of particular importance to indigenous peoples who often have limited financial resources and directly depend on natural resources for their subsistence needs. With increasing pressures and stresses on ecosystems, food availability and access for indigenous peoples decrease. Highly biodiverse areas, especially forests normally occupied by indigenous peoples, become no-go areas once conservation decisions are made to declare these as protected areas. Neither farming nor collection of food resources is allowed, resulting to compromised food, nutrition, and livelihood security. Alternative approaches have been sought to conserve forests while providing means of livelihood through integrated conservation and development projects (ICDPs). Development organizations and local governments were quick to support ICDPs because it seemed to concomittantly address forest conservation and rural development. After this initial enthusiasm, it eventually became apparent that this approach has limited conservation and development gains, partly because conservation will always be undermined unless poverty and hunger are alleviated. Yet, ICDPs continue to be part of local land international initiatives for forest communities. It is, therefore, necessary to continue assessing its results to move beyond the proof-of-concept phase and build an evidence base for ICDP as a legitimate approach for conservation and poverty and hunger alleviation.

In South and Southeast Asia, several ICDPs have been established in the form of community forestry enterprises (CFEs), which commercialise traditional indigenous non-timber forest products. In the Philippines, one such enterprise focuses on the honey gathered from the wild giant honey bee (*Apis dorsata*). Indigenous peoples of Tagbanua ethnicity traditionally hunt giant honey bees for its honey and brood (bee larvae) to be used as food and medicine, and beeswax as a ritual material. The giant honey bee is one of nine honey bee species of the genus *Apis* and is an open-nesting species that cannot be domesticated in Langstroth boxes like the European honey bee (*Apis mellifera*). The giant honey bee can be found in South and Southeast Asia, with large open nests reaching 1.5 m wide nesting on the underside of branches of tall trees, clifffaces or on ceilings of buildings. Swarms of giant honey bees migrate between two or three areas during the year and regularly occupy the same nest sites in each area even after seasonal migration. How the giant honey bees do this is unknown, as honey bee workers live for only a few weeks. One giant honey bee hive can provide an equal, if not larger, amount of honey than one hive of European honey bee can produce in one season.

This research was shaped through a transdisciplinary process/ with problem framing and team building implemented through initial field visits and discussions with the stakeholders, (i.e., indigenous Tagbanua wild honey hunters and gatherers and the organizations assisting them). The primary motivations of each stakeholder engaged in a wild honey CFE were taken into consideration: forest conservation, indigenous development, and sustainable livelihood opportunities. The challenges that persist in forest communities are most likely due to a lack of understanding of dynamic ecological and social interactions or of suitable research mechanisms during implementation.

Given the substantial commitment of time and resources required to effectively research indigenous forest products, it was necessary to prioritize research on species that are (1) under threat, (2) identified by users to be of critical local and regional use, or (3) non-domesticated and involved in large-scale commercial trade. The giant honey bee fulfills all three criteria and provides a basis for an innovative transdisciplinary research. Focusing on this species is not only relevant for agricultural economics research, but also for biodiversity conservation and anthropological research. Honey hunting and gathering is not only a discrete economic activity, but also an indigenous socio-cultural practice. Anthropological work on the Tagbanuas by Manuel Hugo Venturello (1907) and Robert Fox (1982) mention wild honey bee hunting and bee hive products as culturally important. Their use, existence, and cultural function in the Tagbanua tribe render the giant honey bees as cultural keystone species. Whether this still holds true today is further evaluated in this dissertation.

In addition, the global existence of bees is constantly under threat and, so far, only modest attention has been given to wild and feral honeybee populations. In the honey bee genus *Apis*, most scientific investigation has been done on only one species, the European honey bee. While the European honey bee (also referred to as Western honey bee or managed honey bee) has been said to be the most important bee species for man due to its economic contribution, the importance of wild honey bee populations in other aspects cannot be overlooked. Wild populations are “important reservoirs of local adaptations” that will decisively establish the survival of honeybees in nature. Wild native bees pollinate native flora and these bees occupy keystone positions that can determine the eventual collapse of ecosystems or, as suggested by the concept of cultural keystone species, culture. This dissertation makes a case for the importance of wild bees by establishing system knowledge not only on the economic but also on the ecological and cultural contributions of the giant honey bee.

Overall, this dissertation aims to evaluate the contributions and shortcomings of an indigenous-led honey CFE through a triple bottom line investigation: ecological (natural resource management), socio-cultural (indigenous development), and economic (sustainable livelihood opportunities). To fulfill this aim, this dissertation has six objectives corresponding to six manuscripts, which address both telecoupling of local and global scales and multiple types of knowledge: (1) review ecosystem service benefits from wild bees across social contexts on a global scale; (2) identify local ecosystem service benefits from giant honey bees in the Tagbanua community and analyze links with those of the global scale; (3) characterize the habitat of giant honey bees and local management practices prior to and after CFE establishment; (4) analyze social-ecological dynamics and feedback within the social-ecological system (SES) of giant honey bees in the Tagbanua community; (5) assess profitability of commercializing wild honey vis-a-vis traditional gathering through an integrated value chain analysis; and (6) examine the roles of relevant institutions and regulations in the wild honey CFE's fulfillment of its conservation and indigenous development goals. These objectives were addressed through data gathered from 251

household surveys in an indigenous Tagbanua forest community in the UNESCO Man and Biosphere Reserve Palawan, Philippines, global positioning system (GPS) coordinates of giant honey bee nests in the community forest, samples of honey from the giant honey bees, key informant interviews with value chain actors, sales balance sheets, and archival research. These data were gathered during a field research stay from June 2014 up to June 2015 and an exit interview in November 2016.

Majority of honey bee research is comprised of ecological studies, overlooking the direct relationships of humans with honey bees. Because of this, I undertook a systematic global review to examine the role of wild honey bees in both ecological and social systems. This corresponds to the first objective of my research and I used qualitative and quantitative review methods using statistical packages in R version 3.0.2 and Stata 14.0 to analyse peer-reviewed literature from the years 1916 up to July 2015.ln line with this, my second objective is to examine ecosystem service benefits from the giant honey bee on the local level empirically through gathering honey samples and analysing its pesticide residue through the University of Hohenheim and pollen content (melissopalynology) in collaboration with IRD-Sorbonne. Melissopalynology can identify floral resources potentially pollinated and/or visited by giant honey bees up to the species level and the pesticide residue analysis detect presence of pesticides in honey up to the Residue Limit Ordinance of Germany (RHmV or Rückstands-Höchstsmengenverordnung v. 21.10.1999) consistent with the maximum residue limits for honey established by the World Health Organization and Food and Agriculture Organization of the United Nations Codex Alimentarius required for food safety. Melissopalynology provides a snapshot of floral biodiversity, important in supporting food security of giant honey bees and, consequently, the indigenous peoples depending on it; pesticide residue analysis not only show safety of honey for human consumption, but also the ecological integrity of the giant honey bee habitat. I supplemented this with a survey of household use of pesticide and fertilizer and key informant interviews with relevant institutions on their knowledge on giant honey bees. Given the influence of these institutions on the indigenous Tagbanua and their management of giant honey bees and their hive products, it was important to know the basis for the regulations (e.g. protocols during honey gathering) they set.

To further investigate ecological integrity of the community's forest within a longer time span as set out in my third objective, remote sensing of ground-truthed geographical coordinates was applied. To gather this data, a collaborative mapping was conducted with indigenous honey hunters and gatherers. Interested community members were invited to a skills training on how to use a GPS unit and digital camera. The equipment and a solar panel home system as electricity source were left in the community and volunteers brought them during their honey hunting and gathering and took GPS coordinates and photos of giant honey bee nests. This approach contributes a replicable long-term participatory methodology that respect autonomy and self-determination of indigenous peoples, which is different from the common participatory mapping process wherein local communities are often reduced to guides while the researchers solely use the equipment. The resulting GPS coordinates from this mapping were inputted and analysed in ArcGIS 10.1 and QGIS 2.16. Landsat satellite data were downloaded from the United States Geological Survey EarthExplorer website and, together with the GPS coordinates taken by the hunter gatherers, were analysed for its a normalized difference vegetation index (NDVI). The social component was addressed through data gathered from in-depth interviews and survey questionnaire methods, which included an exercise where photos of all known honey bees (Koeniger et al. 2010) were shown to respondents for identification of common names of species. GPS coordinates of the

respondents' households were also gathered and analysed for its NDVI. Inferential statistics such as Chi-squared, Fisher's exact tests, logistic regression coupled with bootstrapping were run on these data sets through Stata 14.2 to check whether changes in local knowledge correspond with changes in vegetation, and to find which variables significantly correlate with these changes.

To examine the role of wild honey hunting and gathering in supporting livelihoods of the indigenous peoples as laid out in my fifth objective, a gross margin and integrated value chain analysis (VCA) incorporating socio-cultural analysis was conducted in order to see how commercialising traditional practices affect indigenous culture.1 introduced a conceptual framework for analysing indigenous value chains by combining elements of production-to consumption systems, strategic value chain framework (VCF), developing country VCA, smallholder farmer VCF, and socio-cultural norms. Data were taken from key informant interviews with different value chain actors from local up to the national level and harvest and sales record of the wild honey enterprise. Households were surveyed on their annual use of honey (amount and type of use, i.e. food, medicine, or material) and participation observation was employed during honey gathering to gain information on resource base use and management. My sixth objective was to situate this local information in the bigger picture of Codex Alimentarius or the global honey market standard as developed by the World Health Organization and the Food and Agriculture Organization of the United Nations. By examining 100 journal articles for the terms “honey bee”, “honeybee”, “*Apis*”, and “A.”, I learned that there is a huge lack of awareness of research on the diversity of honey bee species. Majority of the research (57%) solely identifies a honey bee as A. *mellifera* and, furthermore, erroneously attribute wild bees to bee species other than A. *mellifera* when there are clearly wild honey bee species such as A. *dorsata*. This prevailing lack of awareness led to the Codex Alimentarius for honey being based on A. *mellifera* and the European Union (EU) defining honey as "the natural sweet substance produced by A. *mellifera* bees", meaning that honey from other honey bee species are not considered honey in the EU. Europe is a potential higher-value market, because it is the world's second largest producer of honey but can only provide 60% of the region's consumption. Reaching higher-value markets with the safeguard of fair trade principles would greatly benefit the wild honey enterprise, as results of the value chain mapping and analysis show that it suffers from market failures. The market situation is a monopsony, where there are several honey hunter and gatherers selling honey but only the local non-government organization (NGO) is the consistent buyer. While the honey hunter and gatherers have a positive gross margin of Philippine Peso (Php) 30.74 per kilo of honey sold, the bigger picture suggests economic injustice as retallers have gross margins of Php 585.00 per kilo -roughly 19 times more. As of 2018, €1 == Php 64.

Commercialisation also seems to have negative impacts on the traditional practice of the indigenous peoples as they no longer keep beeswax because the local NGO only buys whole honeycombs, which they process through filtration. To comply with the sustainability regulation of the local NGO, the indigenous honey hunter and gatherers leave the brood to enable the beehive to regenerate after honey gathering. This means that the traditional practice of eating brood which the indigenous peoples claim to be very nutritious -is no longer followed. Moreover, an inquiry on local knowledge on giant honey bees show that only 2% of the non-honey hunters and gatherers could correctly identify locally-extant honey bees and only 29% could correctly identify the giant honey bee. A logistic regression was run on categorical and continuous research variables ethnicity, marital status, household role, formal educational level, community role, year of residency in the community, age, gender, and filial connection to a hunter gatherer to see which variable significantly correlates with a

correct identification of at least one honey bee species. The logistic regression confirmed that the formal level of education predicts the likelihood of a correct identification of at least one honey bee species at $\alpha = 0.05$ $p = 0.024$. The odds ratio of 0.48 shows that for every unit increase in formal education, the likelihood of correctly identifying the giant honey bee decreases. To test the robustness of this result, I performed bootstrapping at 1000 and 10,000 replications with seed one, two, three, four, and five. Both bootstrapping operations remained highly significant $\alpha = 0.05$ $p = 0.005$, showing that the level of formal education as predictor of correct identification of honey bees is not data-dependent and would hold true in replications of this study.

Spatial analysis show that the mean NDVI values of vegetation cover within community households dropped from 0.56 in the year 1988 to 0.38 in the year 2015 and within giant honey bee nests from 0.61 in the year 1988 to 0.41 in the year 2015. A mixed-effects linear regression confirms a statistically significant drop in vegetation cover. Analyzing the correlation between these different levels of vegetation cover with the correct identification of honey bees by the non-honey hunter-gatherer members of the Tagbanua community through a Chi-squared test returned results that approaches but fails to achieve conventional significance levels ($\alpha = 0.10$) $p = 0.127$. The results, however, show that 94% of the respondents who correctly identified the giant honey bee live in an area with high vegetation cover.

Pollen analysis identified a total of 11 plant families from the honey samples: Arecaceae, Cunioniaceae, Euphorbiaceae, Fabaceae, Malvaceae, Myrtaceae, Rhizophoraceae, Rubiaceae, Rutaceae, Sapotaceae, and Sterculiaceae. Also of importance to human consumption are the families of Arecaceae (e.g. *Cocos nucifera* or coconut) and Euphorbiaceae (e.g. *Manihot eseulenta* or cassava), which are staples in the indigenous Tagbanua diet. The detection of Rhizophoraceae hints that the giant honey bees forage long distances from terrestrial to coastal areas. This emphasises the need to maintain the integrity of the forest landscape as it is the foraging area of giant honey bees. The pesticide residue analysis of honey samples from the giant honey bee did not detect ("not detected" or n.d.) any traces of bromopylates, coumaphos, fluvalinate, tetradifon, acrinathrin, chlorfenvinphos, thymol, dimoxystrobin, alpha-cypermethrin, lambda-cyhalothrin, iprodion, tolylfluanid, beta-cyfluthrin, myclobutanil, deltamethrin, boscalid, kresoxime methyl, esfenvalerat, chlorpyrifos-methyl, azoxystrobin, or paradichlorobenzene; this honey is, therefore, eligible for the prime and niche market of organic products and is safer for consumption than most off-the-shelf honey from A. *mellifera* commonly treated with miticides against the Varroa mite (*Varroa destruetor*). While this may mean that the foraging area of giant honey bees in the area is free from pesticides, household surveys show that a small percentage of community members use pesticides (20%) such as synthetic pyrethroids, organophosphates, and carbamates that are known to be harmful to bees. Some community members (4%) also use fertilisers, with majority using chemical ones with different ratios of nitrogen - phosphorus - potassium (0-0-60 /14-14-1 /14-16-0/16-20-0/50-50/21-0-0/45-0-0). Nitrogen deposition can affect flower morphology, phenology, f1ower sex ratios, and nectar chemistry (i.e., sugars and amino acids), which may alter the attractiveness of nectar to bees.

My global review of the role of wild bees in SES shows that wild bees occupy a central role in social contexts and provide services and benefits related to food, medicine, and pollination. On the indigenous local level, most of survey respondents (94%) use honey. Of those using honey, 85% use this solely as food, 77% as medicine or vitamins, and 2% as material (e.g. for selling). Several also have multiple uses for honey as food and medicine, food and material,

or food, medicine, and material. As the indigenous Tagbanua have geographically- and financially-limited access to healthcare, honey has become an essential nutritional substitute. This highlights the importance of a systems approach that not only looks at social and ecological systems in isolation but also of the interactions and connections between them.

With an increasing demand for honey worldwide, giant honey bees may continue to be an attractive basis for CFEs. From the results of this dissertation, such a strategy may provide income, but it may come at the expense of indigenous culture. lf CFEs are to alleviate poverty and guarantee conservation, it must not only focus on provisioning ecosystem services but also on cultural and regulating services. Otherwise, gross margins may be positive, but in the long run can only keep indigenous communities from falling into further poverty.