

Comparative Analysis of Traditional and Commercial Apiculture

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Abstract- The study was conducted to document traditional practices in managing wild honeybees; to evaluate the adaptability of commercial apiculture; and, to assess the profitability of traditional and commercial apiculture in Ifugao. Keepers of wild honeybee were interviewed on the various aspects of its traditional management. An apiary was established using commercial honeybee (*Apis mellifera*). Two wild honeybee species, *Apis cerena* with two sub species, the dark-brown and the brown-colored species, and the *Apis dorsata* are being managed by beekeepers. Keepers of wild honeybees apply traditional management techniques to ensure future harvest and to increase the yield of harvest. Natural hive improvement to contain more honeycombs and proper harvesting are the most widely practiced management technique for *Apis cerena*, while putting shade to the nest site/potential nest site and proper harvesting are the common management techniques applied for *Apis dorsata*. Commercial apiculture trial using *Apis mellifera* showed no conclusive results due to pesticide effect from nearby farms. Traditional apiculture however showed minimal but sustainable source income for wild honeybee keepers. Interventions were outlined to improve traditional apiculture.

Index Terms- Apiculture, *Apis* sp., Commercial apiculture, Traditional Apiculture,

I. INTRODUCTION

Ifugao is an agriculture-based economy but majority of the people are subsistence farmers. The rugged terrain and sub-tropical environment however provides opportunity for cultivating agricultural crops and vegetables and other livelihood opportunities such as beekeeping. Commercial Beekeeping as a livelihood alternative had been introduced in some parts of the Cordillera a few decades ago and there are some families already engaged in beekeeping in the region. In Ifugao, efforts were exerted by the Department of Agriculture to introduce commercial apiculture but for unknown reason, apiculture did not prosper in the province.

Meanwhile, wild honey is being harvested by some Ifugao beekeepers every year from what they claim as their own beehives. Gathering information as to how they sustained their harvest from wild honeybee is worth pursuing.

Honeybees are social insects that thrive best in a colony and belong to the family Apidae, Order Hymenoptera, Class Insecta. A colony is composed of a queen bee, drones, and workers. Each bee has an important task to perform in the growth and maintenance of the colony. Products derived from honeybees are

honey, pollen, propolis, royal jelly, wax, and bee anti venom. Bees are also good pollinators of crops and can act as biosensors for monitoring the health of the environment.

Beekeeping or apiculture is known to augment family income and can help promote environmental protection because of the need to protect and/or plant more flowering plants to support the culture of honeybees [1]. It was pointed out by [2] that beekeeping will also ensure good quality yield of crops through pollination that leads to an improved regeneration of trees and promotes a good floral diversity. [3] also stressed the importance of honeybee's integration to agroforestry systems that helps improve crop yield. Properly managed pollination by honeybees results in larger, well-formed fruits, berries, vegetables, nuts, and seeds. At the same time, the honeybees produce honey and a wide range of other products that are potential sources of income.

Conversely, decline in honeybee population is affected by destructive harvesting and the continued destruction of flowering vegetations [4]. The decline is aggravated by the use of pesticides to agricultural crops being frequently visited by bees. In some parts of Ifugao, some farmers are managing wild honeybees primarily for food unaware that they are also conserving the bees. Traditional management techniques are not as complicated as commercial apiculture management but ensure continuous harvest although the amount or harvest maybe far less than commercial honeybee. Traditional management of wild honeybee only requires courage, patience, and hard work and practically, no other capital is needed in managing wild honeybee except labor.

Documentation of traditional or indigenous methods of managing honeybee is important in the preservation of its knowledge and as database for possible replication in other areas. Evaluation of commercial honeybee production in Ifugao is also vital as potential additional source of income for the Ifugao farmers. Beekeeping or apiculture is the practice of intentional maintenance of honeybee colonies, commonly in hives, by humans. A beekeeper (or apiarist) may keep bees in order to collect honey and beeswax, or for the purpose of pollinating crops, or to produce bees for sale to other beekeepers [5].

Apiculture can be practiced in orchards, home gardens, plantations, and many agroforestry systems including coconut, coffee, pineapple, and others. Beekeeping is also a relatively low-impact activity that can increase local people's income from native forest or conservation areas [3], [6].

Wangdali (2005) reported that apiaries using *Apis mellifera* were established in Tocuan Mountain Province and initial success were noted with a net income of P2, 836.00 for the first season and is expected to rise for the second season as colonies

are expected to increase. He further pointed out that, integrating Apiary in fruit and vegetable production can contribute to the quality of organically grown fruits and vegetables. The challenges are for farmers to plant more trees or any flowering plants to support the insects, and to avoid the use of pesticides or selectively do spraying at the proper time, if spraying pesticides is unavoidable.

On the other hand, EPA (2008) posted that because of biological and economic considerations, native honey bees are more suitable to be reared by small farmers. Less capital is needed in raising these honeybees. Compared with the exotic European honeybee (*Apis mellifera*), native honey bees are more resistant to pest and diseases.

Also, colonies of native bees are available everywhere and so it is easy to start with one or two colonies of this kind of bees. Native bees which adhere to tropical nature are smaller and could produce 2 to 6 kg of honey per year while the European bees yield 50 kg of honey per year [6], [7]. Native honey bees also have greater tendency to abscond or leave suddenly, deserting their hive [6].

Transferring wild honeybee to wooden beehive was also posted by [4]. Some specific traditional management practices such as colony management were also documented and reported by [8].

Generally, the study aimed to document indigenous apiculture management practices, and to test viability of commercial apiculture technology as a potential additional source of income for Ifugao farmers.

The study specifically documented the *in-situ* indigenous practices of managing/ conserving wild honeybees; validated the adaptability of commercial honeybee technology in Ifugao condition; and, compared the profitability of the indigenous and commercial honeybee cultures.

II. MATERIALS AND METHODS

Survey through interview and documentation were used to determine the traditional conservation and management of wild honeybees. Six beehive keepers from different barangays in Ifugao served as key informants. They were interviewed in all aspects of in-situ management of wild honeybee from construction of beehives, maintenance and protection to harvesting, processing and marketing wild honey. The actual practices in the management of wild honeybee were shown to the researchers at the beehive sites.

An apiary was established and maintained at the vicinity of the Ifugao State University with the assistance of an apiculture expert [9]. . Eleven bee colonies, each with one mated queen were bought from a credible supplier. The colonies were maintained through supplemental feeding, when necessary and protection against predator were provided until honey flow or until honey can be harvested. The average yield per colony was recorded during harvest. Other data gathered included the kind and abundance of predators.

The general procedures in establishment of an apiary using commercial honeybee *Apis mellifera* was based from published article of [4] and manual published by [1].

Data on production/maintenance and sale of wild honey and commercial honey were compared using return on investment (ROI) economic analysis tools.

III. RESULTS AND DISCUSSION

Wild Honeybee Species.

The wild honey bees found in Ifugao are composed of three species which can produce honey juice for food consumption. The first species is locally known as *Lucutan* (*Apis* sp.) with two subspecies the brown-colored and the black-colored. This species is very small in size and looks like a wasp. They construct their honeycomb inside hollow trunks of trees or hollow spaces underneath rocks and boulders. They produce very small amount (0.1-0.3 kg) of honey per year. The second species is locally known as *Alig* (*Apis cerana*) also with two subspecies distinguished through their brown and dark-brown color. The former is said to be more aggressive in stinging human during harvests. Similar to *Lucutan*, *Alig* make their beehive on hollow trunk of tree locally known as *lungog* or on hollow spaces between or underneath rocks and boulders. This species produces about 3-7 kg of honey per year.

The third species of wild honey bee is the *Iyokan* (*Apis dorsata*) which are bigger in size than the *A. cerana*. They have white-colored rings in their dark gray bodies. This kind of bees make their beehives on bended trees or branches in thickly forested areas and on open caves in rocky mountains which are far from disturbance by people and other animals. They yield 5-25 kg of honey per year. When disturbed, they are the most dangerous because they attack and ran after intruders even inside the water.

Wild Honeybee Colony Management

There is no well-defined step-by-step procedure or cycle in the traditional or indigenous colony management for wild honeybees in Ifugao. Traditional management starts as soon as a natural beehive is located. Beekeepers knows that they should inspect the hive and determine if the honey is harvestable or not and wait for the appropriate time before harvesting. They must apply proper way of harvesting and after harvest they remove debris to increase the volume of the hive so that it can accommodate more honeycomb in the future. Indigenous beekeepers are aware that sometimes the hive is empty due to absconding and must re-bait it but they are not aware of other causes of absconding except water entrance to the hive so they have to provide shade. Beekeepers also visit what they claim as their own beehive (*hukip*) during summer time to check presence of colony and to inspect harvestable combs.

Improved hives located below a big rock free from dripping rain are the only sites harvested every year. When the hives are more than half or nearly full of honey combs, keepers used to gather some of the combs full of honey leaving behind those full of brood (pupa) and empty white combs. According to one of the keepers interviewed, this practice will tend to make the bees more active in making more combs and gather more nectar to store as honey. When he was asked why not also gather those combs with brood so that the queen will be encouraged to produce more brood? He answered with a smile and said "I will try."

Traditional Management by Maintaining Beehives

Maintaining Beehive of *Apis cerana* (Alig). Over the past centuries, some Ifugao farmers maintain what they call as their own “*Hukip*”- a well maintained beehive where they harvest honey every year. The *Hukip* or natural beehive is either constructed intentionally or improved beehive from newly discovered or abandoned natural beehive on tree trunks and rocky areas. Strictly speaking, the term *Hukip* refers to a concealed cave-like beehive that was carefully improved by somebody using stones. However, today this can also refer to improved hollow tree trunks as beehive. Traditionally, *hukip* are improved natural wild honeybee beehive purposely to increase harvest the following year. When a natural beehive is improved, the one who improved it is the rightful owner and has the right to harvest honey the following year and every year thereafter. Keepers usually leave signs that indicate that the beehive is already theirs so that honey hunters will not harvest without the owner’s permission.

Steps in Making Beehive (Hukip) for *Apis cerana* (Alig)

1. On rocky areas where wild honey beehives have been found, locate an area, usually underneath a big rock/boulder that is naturally hollow and water does not seem to enter or drip inside.
2. Make a small horizontal cave about 45-60 cm deep and 30-40 cm opening. Make sure that the upper portion of the cave is made out of stone. Clean the stone nicely because it is here where the honeycomb will be attached. Riprap the sides and floor of the hive with clean stones. If old beeswax is available, rub the wax at the upper portion and walls of the hive and scatter the remaining wax at the hive floor. This will serve as bait.
3. Stone wall carefully the opening of the hive and cover the holes in between the stones with moss. Before the last stone is placed, put sugar cane or honeycomb with honey inside the hive. This will attract swarming honeybees. Make sure the bait is suspended so that ants will not occupy the hive.
4. Leave a small opening enough for honeybee to enter usually at the second layer of the stone wall from the ground.
5. For easy harvesting, prepare the stone wall in such a way that a portion usually opposite the entrance could easily be removed.
6. For newly discovered natural beehive and after harvest,
 - Carefully widen the space if possible by removing debris and stones/rocks to make the hive more spacious so that it can accommodate more honeycombs.
 - Return cover stones carefully as if in its original situation and seal spaces except for the bee entrance.
7. For beehive on hollow trunk of trees
 - Make an opening opposite the bee entrance for harvesting. If not possible, widen a little the entrance just enough to allow the gathering of honeycomb.
 - Similar as above, do not collect the entire honeycomb.

- Carefully restore the opening using stone or tree branch and seal other openings except a small bee entrance.

Managing *Apis dorsata* (Iyokan)

The giant wild honeybee locally known as *Iyokan* (*Apis dorsata*) could not be managed directly similar to *Apis mellifera* but can be manage in some ways to conserve the species and to ensure future harvest. Key informants revealed that its management is only limited to improving the nest site or potential nest site where the colony may settle, and avoiding destructive harvesting.

The bees usually settle in a very quiet, undisturbed place under a leaning (almost horizontal) large tree or under a large branch in horizontal position. In some instances, they settle underneath high rock formations that caved-in. In all cases, they settle on an area where there is sufficient protection from rain and strong wind and far from human settlement areas.

To attract the bees to settle, key informants narrated what should be done:

- a) Look for large trees that have leaned almost horizontal or large horizontal branches in forested area where it is seldom visited by people.
- b) On top of large horizontal branch, place shade made out of runo (*Miscanthus chinensis*) leaves or other materials such as leaves of palm species that could provide shade from rain. Place it in such a way that it will look natural but firm enough to withstand wind blows.
- c) Scrape the lower portion of the branch to remove the loose outer bark, and using previously harvested beeswax of *Iyokan*, rub it at the scraped surface so that some of the wax will be left behind. This will serve as bait.
- d) Visit and check the shaded place especially near summer time for presence of *Iyokan* colony. Approach the place quietly, avoiding too much movements and noise. If a colony is present, never go near the place during the visit because the bees are very sensitive and may abandon the place at once or you may get hurt by their sting.
- e) At a safe distance, observe the size of the colony and the behavior of the bees. The larger the size, the more the honey that can be harvested. If the bees are flapping their wings as if to fly but are clinging in the beehives then it is said that there is enough honey.
- f) If the size is small, wait for 2 to 3 months before harvesting.
- g) For newly discovered nest/hive, and after harvest, provide a firm shade.

Traditional Management of Wild Honey Bees by Proper Harvesting

It had been noted through experience by Ifugao honey hunters that summer time usually in the months of March to June are the time when bees have harvestable honey in their honey comb. It is prior and during these months that trees and other plants are bearing flowers where bees get pollen and nectar to fill

the honey comb in their beehives. The same months is also harvest time for honey juice as noted by beekeepers. However, if it had been raining, bees have very little amount of honey juice. The juice comb has served as their food. Ifugao beekeepers have experienced and noted some signs in determining if there is honey juice in the beehives or *Hukip*. Among common signs are the bee waste drops on the leaves of plants near their hives which they called it "patty". If the waste is yellow green the juice is very little, if it is dark yellow the beehives have enough juice. This is common to all of the three species. Another noted observation in the *Iyokan* are the reaction of the bees climbing in the beehives, if the bees are flapping their wings as if to fly but are clinging in the beehives then it is said that there is enough honey.

Steps in harvesting *Apis cerana*

1. On the bee entrance, observe the bees entering for signs if there is abundant honey that can be harvested.
2. Use protective jacket, mask and gloves.
3. Open at the opposite side or any side of the beehive but not in the bee entrance. Apply smoke to move bees away from the honeycomb to be harvested.
4. Slowly pullout the honey combs that are packed inside and put it in a clean container. Be careful not to kill the queen bee by accident. Every time a comb is pulled, it should be inspected for the presence of the queen bee (one with the biggest size and longest abdomen). The queen must be returned to the hive after harvest.
5. Leave some honey comb especially those with brood and those with and without juice so that the bees will not abandon their hive. Never gather all honeycombs.
6. Return properly the stone or cover removed.
7. Use good container so that juice will not be wasted.

Steps in Harvesting *Apis dorsata*

1. Observe if the honey is matured based on some given signs.
2. Wear protective gear like jacket, mask and gloves.
3. Go slowly near the beehives. Apply smoke to drive away the bees from the comb.
4. Using a long sharp stick cut honeycomb attach to the tree or rock. Make sure you leave some portion of the honeycomb attached. Get the honey comb and place it on good container. Normally the bees will swarm away upon disturbance but the remaining honeycomb will serve as bait to attract the same or other colonies to nest in the same area.

Do not use the destructive method of harvesting where a fire is set underneath the honeycomb to kill all the bees just to get the honey. If there are no protective gadgets available, do the following:

- a. Prepare 3-4 bundles of dried runo sticks and leaves. Place bundles of green leaves around the bundled dried sticks and leaves. The green leaves will produce the needed smoke.
- b. Go slowly near the beehive and make fire using the prepared bundle of sticks. Make sure all the bundles of

sticks will produce too much smoke enough to drive the bees away.

Caution: the bees will attack the source of smoke/fire and try to put it off. Thus, make sure too much smoke is produced instead of fire coming out from the bundles of sticks and leaves.

- c. Once the bees move away from their beehives, harvest immediately and move out quickly from that place and be sure to put off the fire.
- d. Make sure that not all the comb are cut or harvested. Always leave about 1-2 inches of the honey comb and the entire white portion of the comb without honey so that it will attract the bees to return after harvest.
- e. In most cases, the bees will abandon the site so that after 3 to 4 days the site can be fixed again by putting firm shade.

Traditional Processing and Marketing Wild Honey

Harvested honey is processed by extracting honey manually. Using a clean cloth, the honey in the comb is squeezed out. Extracted honey is placed in a clean bottle with cap. Each bottle contains 1 liter or 1 kilogram of honey. The volume of harvest varies per colony and the size of hive and ranges from 2 to 7 liters. Harvest from *Apis dorsata* may reach up to 24 liters. Honey is highly marketable locally so bee keepers do not have any problem on marketing their harvest. The prize of honey varies depending on customer. Honey sold to neighbors or within the locality is prized at Php300.00 per bottle but when brought to market or sold to outsiders the prize is Php350.00.

Traditional Uses of Wild Honey

Part of harvested honey is used for household consumption. Small amount is directly taken in and mostly honey is used as sauce for sweet potato (*Ipomea batatas* (L.) Lam.) and rice (*Oryza sativa* L.).

Honey is also used as medicine to treat common colds, cough and sore throat. It is diluted in lukewarm water and taken in. It is also used to treat dysentery and stomach ache. Harvested brood (pupa) is also boiled or fried as viand. The beeswax is reserved as bait but occasionally when boiled with the brood, it is also eaten.

Problems Issues and Potential Interventions on Traditional Apiculture

The problems and issues encountered by wild honeybee keepers and the potential interventions are summarized in Table 1.

Apiculture Technology Trial

Yield of Commercial Honeybee. Table 2 shows the actual yield per colony for 2 years. In the first year, there were 11 colonies but one queen died. Of the 10 colonies left, there were 3 colonies with very minimal honey thus these were not harvested. Only 7 colonies had harvestable honey in first year with a total yield of 20.5 kilograms.

In second year, the colonies were maintained by regular monitoring, even feeding them during rainy season. Towards the mid of September, it was noticed that the bees were declining rapidly in some of the bee hives and dead bees were scattered on the ground below the bee entrance. When the beehive was

opened, it was found out that almost half of the bees were dead and after three days after opening the beehives, almost all the bees were dead with very few remaining but they were very weak to fly. When this event was referred to a bee expert, it was found out that it was due to sprayed insecticide that may have been sucked by the bees. The use of pesticides, to which bees (including honey bees) are very sensitive, is one of the most serious problems in practice of apiculture near commercial agricultural farms [6]. Pesticide poisoning of bees are caused by the application of insecticide to crops that are in bloom or on flowering plants contaminating nectar and pollen. The symptoms of pesticide poisoning is exhibited by the large number of dead bees in front or near the hive entrance that result to sudden dwindling of adult bee population [1]. This symptom was observed in this study.

This event happened for five (5) colonies one after the other, but the other two colonies survived but with serious reduction in their number. The other two colonies were also affected but with few bees dead after a week. Only three colonies were left for honey flow but their number was severely reduced. The yield in 2011 was only 6.7 kilograms.

Observed Predators of Commercial Honeybee

a. Wasps (*Vespa* spp.) – There are two kinds of wasps that were observed who prey on the honeybees. One is with dark-gray color slightly larger than *Apis dorsata* with slightly visible thin white rings in their bodies. The other one is as large as a bumble bee with black body and orange wings. The average number of the species of predators caught per day using net was 21.8 or 22 and they attack especially right after sunrise and late in the afternoon before and after sunset.

b. Beemites – Beemites were observed that started infesting the colonies but were controlled on time.

c. Birds – Swift bird (*Chaetura dubia*) and "pirik-pirik" (*Merops* sp.) were observed to be flying above the colonies and were believed to be eating the bees from the colonies. One swift bird could eat as much as 300 bees. The best control so far is placing a net trap in the apiary but it is costly.

d. House lizards – House lizards were also observed to be eating the bees. They hide under the bee boxes and come out at night to feed on the bees.

e. Bullfrog. The bullfrog (*Bufo* sp.) popularly known in the locality as *Karag* was also observed to eat bees at the bee entrance during dawn and night time. Although the beehives were elevated, some jumped to reach the bee entrance.

Cost and Return Analysis of Traditional and Commercial Apiculture

A good alternative source of livelihood is indicated with an income or gain after some entrepreneurial operation. The cost and return analysis (Table 3) on the commercial apiculture trial did not show any positive income or indicates a negative Return on Investment (ROI). The unfavorable result of the technology

trial is heavily affected by the mass death of bees caused by sprayed insecticides and the presence of abundant predators.

On the management of wild honeybees specifically *Apis cerena*, key informants revealed they are maintaining an average of 3.8 or 4 beehives but some maintain as high as 6 beehives. The amount of harvest depends on the size of the beehive such that a 0.09 m³ beehive can yield an average of about 4 kilograms of honey (Table 4). The production cost consists of labor spent in maintaining the beehive was estimated to be P300.00 per beehive. While it appears that the income derived in managing wild honeybees appear to be too small with a mean gross sale of about P3400.00 per year, it only requires labor as the capital.

Managing the natural beehives properly ensures the farmer of continuous harvest come next season. It gives beekeepers a minimal income but since they do not pay another person to do the maintenance for them, the labor cost will actually be added as their income. Because of biological and economic considerations, native honey bees are more suitable to be reared by small farmers [4]. Less capital is needed in raising these honeybees.

IV. CONCLUSIONS

Based from the results of the study, it is concluded that; the traditional or in-situ methods of managing/conserving wild honeybees especially *Apis cerena* is being undertaken by some farmers in their natural habitat to increase and ensure harvest every year. Management practices include care and improvement of beehive and proper harvesting. Traditional management of *Apis dorsata* relies on putting shade to bee nest sites and potential nest sites. Non-destructive method of harvesting also assures conservation of the species. Commercial Apiculture technology using *Apis mellifera* did not show good results due to effect of pesticide and predators hence another trial is recommended. Traditional apiculture or managing wild honeybees in their natural habitat appear to be profitable due mainly to labor as the only input. Minimal but sustainable income is derived from managing wild honeybees.

The management of wild honeybees in their natural habitat should be adopted by other farmers and honey hunters not only for economic reasons but for the conservation of the species. Apiculture technology using *Apis mellifera* or other species and other models of commercial apiculture should be tried in other areas in Ifugao especially in areas where there is minimal or no use of insecticide. Proposed interventions to address problems/issues raised by beekeepers should be implemented to help them increase their harvest.

ACKNOWLEDGMENTS

We wish to express our gratitude to the Administration of Ifugao State University for funding this study.

Table 1. Problems/Issues in traditional apiculture and potential interventions

Problems/issues	Potential Interventions
1. Collapse of beehive due to earthquake and wildlife; rainwater drip into the hive; and dirt/debris mixed with honey during harvest	1. Design and used of pre-fabricated beehive made of cement.
2. Absconding of bees	2. Putting in place of swarm traps,
3. Destruction of beehive by honey hunters and the use of fire to harvest <i>Apis dorsata</i>	3. Local government units (LGUs) to craft ordinances governing wild honey harvest focusing on prohibition of the use of fires, and respect to beehive keepers.
4. Timing of harvest unknown to new bee keepers	4. Beekeeper to beekeeper seminar on planned harvesting
5. Long distance of hives to community	5. Seminar on how to transfer wild colonies into wooden hive box so that it can be transferred to desired location.
6. Production is low/minimal	6. Use of larger prefabricated beehive - Planting and protecting flowering plants within the vicinity of hives - Constructing new hives in areas with abundant flowering plants and available water year round.
7. Bee sting and use of unreliable smoker (bundles of leaves/twigs)	7. Introduction of a more reliable smoker that can be made from scrap materials
8. Destructive harvesting method (use of fire to harvest <i>Apis dorsata</i>) by inexperienced honey hunters	8. Ordinance preventing destructive method of harvest (use of fire); Seminar on the use of smoker.

Table 2. Yield of harvested honey per colony in the commercial apiculture trial

Colonies	No. of frame w/ extractable honey	Yield (Kg)	Yield (Kg)	Total Yield
		Year 1	Year 2	
1	2	2.3	0	2.3
2	0	0	0	0
3	4	3.9	0	3.9
4	4	4.2	2.0	6.2
5	2	2	0	2
6	2	2.1	0	2.1
7	4	3.8	2.5	6.2
8	0	0	0	0
9	Queen died			0
10	2	2.2	2.2	4.4
11	0	0	0	0
Total	19	20.5	6.7	27.1

Table 3. Summary of the costs and return analysis for commercial honeybee

Year	Production Cost (P)	Gross Sale (P)	Value of remaining colonies	Net Income: Sale - Prod. Cost (P)	ROI
1st	61,855.00	5,125	41,125.00	(56,730.00)	(0.91)
2nd	6,625.00	1,675	13,500.00	(4,950)	(0.74)
Total	68,480.00	6,790			

Table 4. Cost and return analysis for managing wild honeybee (*Apis cerena*)

Key Informants	No. of beehives	Production/ Labor cost	Yield (Kg)	Gross sale	Income	ROI
1	2	600	7	1750	1150	191.67
2	4	1200	16	4000	2800	233.33
3	5	1500	15	3750	2250	150.00
4	3	900	12	3000	2100	233.33
5	3	900	10.5	2625	1725	191.67
6	6	1800	22	5500	3700	205.56
Total	24	6900	82.5	20,625	13,725	198.91
Mean	3.8	1150	13.75	3,437.5	2,287.5	200.93

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