

Traditional beekeeping shows great promises for endangered indigenous bee *Apis cerana*

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Nagaland dwellings plentiful bee flora is as a natural endowment. Indigenous techniques, equipments and traditional beekeeping knowledge are goldsmith due to simplicity and low cost input, shows great promise to visionaries for their envisage. The suitable agro-climate, plenty bee flora and immemorial practice with rich traditional knowledge offers enormous potential for development and success of apiculture in this state. The outfit survey accomplished in six districts of Nagaland revealed that 26% beekeepers were rearing both species (*Apis cerana* and *Tetragonula iridipennis*) and rest only *A. cerana*. The 74.67% peasantry indulged in apiculture and average number of beehive/ beekeeper was 3.78 where as highest beehive/ beekeeper was observed in Kohima. The 65.33% beekeepers were interested to rear in indigenous box and 34.67% beekeepers were interested to scientific beehive. A keywords: majority of beekeepers responded, the wax moth attack is higher in scientific box, while literate new generation, and trend beekeepers were interested with scientific beehive. The *Naga* tribes know different indigenous methods of colony capture, different types of traditional bee hives and indigenous methods of pest management. Simultaneously gruesome traditional honey harvesting method and *jhoom* cultivation direct threaten to bees which require scientific intervention for conservation to *A. cerana*. Honey bee role as a pollinator to enhance the crop productivity and conserve the plant biodiversity are more valuable than bee hive products.

Keywords: Traditional knowledge, Indigenous methods, Indigenous beehive, Honey bee, *Naga* bee dance

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Traditional knowledge is a wealth of beekeepers and he is a goldsmith of this practice, these practices imitate due to its simplicity, with locally available resources and low cost input. Nagaland has a vast wild forest area with plentiful bee flora from natural endowment. *Naga* tribes have immemorial practice with rich traditional knowledge and skill about beekeeping, which offers enormous potential for development of apiculture in this state (Fig. 1). The bee forage area estimated 13, 493 km² and about 25000 *Apis cerana* bee hives in Nagaland and mostly rears in traditional method¹.

A. cerana is a part of the natural heritage of mountain community which is known as indigenous bee. This bee prefers nesting habitat in closed condition with low light intensity and usually builds multiple combs in different type of bee hives, viz. modern bee hive, underground, simple wooden box, wall crevices, road culverts, bamboos and tree hollows (log hive)^{2,3}. The traditional bee hive and equipments reflects the remnants of ancient bee

keeping knowledge and their relics of honey collection techniques being practiced by hilly region farmers through the centuries⁴. Beekeeping is an important tool for sustainable agriculture and conserving the biodiversity especially in hill area. The indigenous technologies require scientific assessments and there is huge scope for their refinement through techno-scientific inputs.

In agricultural ecosystem, many agricultural crops are dependent on insects for their pollination, and assisted pollination may have to be done when natural pollination is insufficient in order to reduce potential yield loss (Klein *et al.*, 2007)⁵. About 80% of the world's flowering plant species are dedicated on animal pollination, mostly by insect (FAO, 2007)⁶. The worldwide economic value of the pollination services provided by insect pollinators in 2005 was estimated about €153 billion (Gallai *et al.* 2009)⁷. Many plants have evolved intricate relationships with many insect pollinators, without which they would not reproduce and maintain their diversity. At the

global level, the convention on bio-diversity has identified the importance of pollinators with the establishment of the International Initiative for the Conservation and Sustainable Use of Pollinators (International Pollinators Initiative-IPI) in 2000, facilitated and coordinated by FAO.

Amongst insects, undoubtedly honey bees are ultimate pollinators because they are active the whole year for pollination; do not hibernate, works longer periods daily than other pollinators, number of worker bees per colony is also higher than the other insects, dense hairs on the corbicula for carrying abundant pollens and their average foraging rate and meticulous handling of flowers are much advance than other pollinators. About 75% of genetically bio-diverse agricultural crops have been lost since the beginning of 20th century from the earth and 25% of the world species were endangered in 1980 and which will be extinct by 2015 (FAO 1993)⁸. Honey bee are declining rapidly, causing global concern for pollination services (Biesmeijer *et al.*, 2006) probably utilized for at least 90% of managed pollination services⁹. So many factors are threatening to bee, *viz.* global warming, habitat destruction, indiscriminate use of hazardous pesticides, monoculture, etc.

Methodology

The randomly surveys were accomplished during 2011- 12 in outfit to know the current status of indigenous technology about *A. cerana* beekeeping in different 6 districts (Dimapur, Peren, Kohima, Mokokchung, Zunheboto and Wokha) of Nagaland. This geographical area lies between 25°06'' to 27°04'' N latitudes and 93°21'' to 95°15'' E longitudes. Topographically landscape varies and depends upon the degree of slopes with elevation, can be divided into 3 groups foothill varies less than 100 msl, lower to mid-ranges 100-1000 msl and hills/ mountainous regions varies above than 1000 msl altitude. The questionnaire was prepared on the basis of different questions, *viz.* how to get the bee colony, which types of bee hive using, which methods adopted for honey harvest, which indigenous precaution /pest management technique adopted if infestation was there and have you got any scientific training, if yes give name of organization. The 150 questionnaires were furnished from 100% village area, on the basis of the beekeeper's interview in above mentioned districts. Beekeepers selections were taken on the basis of different socioeconomic and literacy background.

Results

In these six districts (Dimapur, Peren, Kohima, Mokokchung, Zunheboto and Wokha) of Nagaland only two bee species *A. cerana* and stingless bee were reared¹⁰. All the beekeepers were having *A. cerana* while 26% beekeepers were rearing both species. Out of six district's villages surveyed 74.67% family indulged with beekeeping part time or full time and 25.33% families were not having bee hive, during survey all families were not having live colony. The average number of bee hive/ beekeeper was 3.78 where as highest bee hive per beekeeper was observed in Kohima 6.48 followed by Wokha, Dimapur, Peren, Mokokchung and Zunheboto. Out of 150 beekeepers surveyed only 65.33% beekeepers were interested to rear in indigenous box and 34.67% beekeepers were interested to rear in scientific bee hive¹¹. A majority of beekeepers responded, the wax moth attack is higher in scientific box due to many joints as crevices while literate new generation, and trend beekeepers were interested with scientific bee hive, they were knowing an indigenous method, how to close the crevices. In this surveyed 64% beekeepers were learning beekeeping from their parents and 34.67% by other government agencies, *viz.* NBHM, KVIC, KVK and SASRD Nagaland University. The government agencies were facilitated training to beekeepers how to integrate the scientific and indigenous beekeeping.

Indigenous methods of colony capture

Swarm catches

The bee swarm colony is observed by the beekeepers, they follow to swarm and throw soil dust or water or beat drums to scare till the swarm settle down at a nearest as possible suitable place. Once a swarm became settled down, they were closely observed to the queen. When the whole swarm was settled down the queen always came out to walk around the settled swarm and so they could easily catch the queen at that meticulous moment. If the queen couldn't be caught at that time, the other method was that, the queen was usually hidden between the worker bees. Beekeepers were slowly moved the worker bees by hand and search the queen, when the queen had identified at once caught the queen and bound the propodium by long hairs or caged in a traditional queen cage, till the suitable arrangement was made for the swarm. The queen cage was an indigenous tube like structure which made from bamboo strips and upper side covered by a net.

They were installed the queen gate at the entrance and release the queen inside the bee hive. This bee hive entrance gate was kept near and towards the swarm colony. After some time few workers were going inside the hive and came out and communicate to each other slowly-slowly all the workers went inside the hive.

Catch the established bee colony

Beekeepers were caught the established bee colony from tree trunk, bamboo grooves and road culverts. Bee colony was shifted from a natural place in their own hive only at dusk. They were making a fire which produced smoke to tame the hostile bees and cut the comb one by one with a small machete/ knife and bind on the frame of bee hive by a fiber of banana stem as a rope, after fixed the comb in the frame the rope was easily bitten and removed by bees because that was very soft rope and easily available everywhere in the forest.

The capture of scout bee

The scout bee searched the suitable place to shift the bee colony before the swarm. The scout bee sound was changed during the searching of new suitable place, so experienced beekeepers were easily identified there sound and caught to scout bee. The caught scout bee was released inside the vacant hive; she might be survey inside the box and after 2- 3 minutes it was released. If the scout bee found that was a suitable place for them, after release certainly she would return back with some others scouts for confirmation and eventually they were shifted with whole colony members in the same hive.

One surprising thing was coming from beekeepers; numbers of colony swarm were reduced year by year. About 2001 they were caught highest swarm more than 10 in the month of November and December whereas minimum swarm about 5 in both month. During 2010-11 they caught highest swarm 5-6 and minimum 2-3 colonies only during November and December.

Used bee hives install at suitable place

The beekeepers of these districts were installed old and empty bee hive in the forest or old apiary¹². These bee hives were cleaned and closed all internal/ external crevices of the bee box, internal crevices were filled by cerumen or plant gum while external crevices by a mixture of mud and cow dung. These bee boxes kept under the big forage trees which are

free from natural enemies. The 82% bee keepers were preferred at his apiary nearby his residence and 18% were kept bee hive in the forest under blooming plant. In Dimapur, highest (24%) beekeepers were installed hive in the forest while in Mokokchung 97% nearby his residence. In Mima, 94% beekeepers were kept clean box at his village bee zone and rest 6% at his residence. Beekeepers were told, we feel lucky if we find a bee colony by this method. Bees always preferred already used hive, they attracts due to the smell of bee hive products residue and also preferred the old place where earlier bees were residing.

Types of bee hive

Indigenous underground bee hive

Underground bee hives of *A. cerana* were observed in the Mima village of Kohima district, it has been existed since time immemorial and this was a unique indigenous method of beekeeping known as Mima's style¹³ (Fig. 2). This method was most suitable in cold area to avoid the low temperature; this practice was usually started during winter. This type of bee hive construction observed underground cavity in the terrace. The hive was constructed by digging a pit which internal size-length, width and height were 1.5 ft, 1 ft and 1.5 ft, respectively. The bee hive pit walls were constructed of stone slabs and roof were arranged by split wood or bamboo frames. The plastic or bamboo tube about 0.5 inches diameter was used as an entrance tube. About 6- 7 pieces of wood or bamboo were used as a frame which allowed building the comb by honey bees. Beekeepers were used polythene sheet, as a roof cover above the wood/ bamboo frames to protect the infiltration of water and soil in the hive. In the underground hive wax moth and wasp attacks were rare but red ant attack was high. The honey is harvested 4- 5 times in a year with 2.2 kg/ bee hive average honey production.

Log hive

Log hives were observed in all 6 districts were studied; this hive was more in practiced of Zunheboto district (Fig. 3). Their sizes varied hive to hive, it was depending upon the hollow tree trunk⁶. The highest size was observed in Emlo village of Zunheboto with 1.5 ft diameter and 3.3 ft length. Log hive woods were preferred according to bee prefers to Gamhari, slow match tree and alder tree. The log hive was prepared from tree trunk by making a deep hollow through chisels and machete, some time cutting was initiated by insect. Both open sides were closed by wooden

disc as a lid and a small hole was made in log hive as an entrance gate. The gaps of log hive and lid were closed by a mixture of cow dung and mud. Usually it was hung by wire from the roof or pole or wall in shaded places. The honey harvesting was tough from log hive, they were removed the one side lid and combs were taken out one by one for honey extraction.

Rectangle wooden box

This box was observed in all 6 survey districts of Nagaland. This box was prepared by wooden strip and the strip was joint with nails and wood of the strip was depends upon availability¹⁴. The size was varied from box to box because there was not any standard size (Fig. 4). The highest size was observed in Diezephe in Dimapur district with size length, width and height were observed 2ft, 1.5 ft and 1.5 ft, respectively. A small hole was made in this hive as an entrance gate. The bee hive was opened by removed the nails and opened from one side and combs were taken out one by one for honey extraction.

Traditional methods of honey harvest

Out of 150 beekeepers, 86% were adopted the traditional method of honey harvest. They were made a fire which produced smoke to tame the hostile bees and cut the comb one by one with a small machete/ knife and were segregated the honey area, pollen area and brood area. Beekeepers were smeared honey on hands and eat garlic, ginger or any other naturally available leaves, fruits, etc. to remove the smell of mouth, and after that blow inside the bee hive to tame and make the bees docile. Sometime they burned the whole colony to chase the bees away and easily take out the combs. Honey is extracted by hand or thin net or sometime crushed between two timber strips. They were filtered to the honey by fine cloth or net or kept for two three days, honey became settled down and wax became upper side, and the wax was removed from honey. In this method honey quality was poor, due to presence of pollen in the honey.

However in Kohima district only 45% beekeepers were using this method, they were blowing smoke by smoker for tamed to bees and took out the super's frames of ripened honey. The combs were squeezed and extracted the honey afterward honey was processed by the processing plant.

Indigenous methods of pest management

In all six districts an interesting result was observed in the context of indigenous methods of pests and

their managements. Beekeepers never observed any disease and mites in these districts while; wax moth, wasps and lizards were major natural enemies. Bee eater birds could rarely be seen in these districts by dint of huge birds were hunted and the population became negligible.

Wax moth

Wax moth was observed as a serious pest of honey bees¹⁵. In this area for wax moth management in *A. cerana* beekeepers were applied some preventive measures, viz. internal crevices of bee hive were closed by stingless bee cerumen (Fig. 5) and outer crevices were closed by a mixture of cow dung and mud (Fig. 6). The entrance gate was kept smaller to prevent the entry and egg lay of female wax moth (Fig. 7). These preventive measures were observed very viable to reduce the wax moth infestation.

Wasp

Wasp is a serious pest of the honey bee¹⁶ if its attacks become high than wasp through dirty material on the entrance gate of honey bee (Fig. 8). The highest wasp attack was observed during rainy season, beekeepers were used cow dung around the entrance gate as a deterrent to reduce the attack. They were manually sprayed cow dung paste around the entrance gate of the bee hive and entrance gate also reduced by the cow dung (Fig. 7). Beekeepers were caught the wasp and wreath a white paper as an indicator by long hair and released to wasp, beekeepers were followed the wasp to locate the wasp nest. *Naga* people were hunted to wasp colony especially brood for making a dish; brood comb was also available in the market (Fig. 9).

Lizard and tree frog

AICRP (honey bees & pollinators) SASRD was developed an indigenous method to prevent the lizard till reach the bee colony. The polythene sheet was spread on the platform which was hanged 9 inches around the platform and bee hive was placed above the poly sheet. Lizard were not able to climb till the bee hive due to slippery and softness of polythene sheet (Fig. 10).

Bee dance of Naga ethnic

This is one of the most popular dance of *Zeliangong* community, they perform during festivals and special occasions since immemorial. This dance is just like bees dance for communication within



Figs. 1-10: Fig. 1—Naga tribes have both log and scientific boxes around his residence, Fig. 2—Underground rearing of *Apis cerana* (known as *Mima's* style), Fig. 3—*Apis cerana* rearing in Log hive, Fig. 4—*Apis cerana* rearing in Rectangle wooden box, Fig. 5—Internal crevices of *Apis cerana* bee hive closed by stingless bee cerumen, Fig. 6—Outer crevices of *Apis cerana* bee hive closed by cow dung and mud, Fig. 7—Entrance gate kept smaller to prevent the entry of female wax moth, Fig. 8—Wasp through dirty material on the entrance gate of *Apis cerana* bee hive, Fig. 9—Hunted wasp brood comb sold in the vegetable market for food consumption, and Fig. 10—Use of poly sheet on platform bottom for prevent the climb to lizards and frog

the community, this dance as a medium of communication especially between male and female at the time of the marriage proposal and in the quest for one's life partner and soul mate¹⁷. Always the male proposes to female for marriage and promises to give land, wealth, properties, mithuns, even to such extent promises, viz. moon, and stars. Through the song he suggests the girl to run away with him and get married the next day to live together like related to the swarm nature of honey bees. Flattered by such wooing the girl relents and responds positively in the process able to please her pursuer. A separate group of singers around 20-30 persons sing on the background with the sound of drum.

A tall man within them dressed in white garment act as a queen bee, who is the leader, heads the colony and 12 other dancers composed of 8 females and 4 males' swirls around him. The Queen (leader) dance is highly energetic, he sways all the directions to cover the entire circular area of the colleague dancers and keep together them. This movement resembles how to worker bees hover to nearby queen and how the queen bee ensures to the worker of colony unite together till could locate a new nesting site. The movements of other dancers include raising their hands and joining to each other by making a chain like formation. This activity resembles to the movements of bees when the queen bee takes nuptial flight. The making of the chain system before the end of dance signifies that mankind should live like bee unity and perfect harmony without departing to each other during and after swarm.

Discussion

Indigenous methods and appliances of apiculture is an incredible heritage of Nagaland. A different type of traditional bee hive, viz. log hive, rectangle box and underground method were suitable by dint of low cost, solid and safe against natural enemies in comparison of scientific bee hive. The scientific boxes were having several joints with crevices while traditional bee hives were having least crevices which minimize the attack of natural enemies, viz. wax moth, wasp, ants and lizard. The underground bee hive constructed without any cost by himself is safer against wax moth and wasp in comparison to other bee hive. It's also able to maintain the internal temperature due to the specific heat of soil property and provide stenothermal habitat during extreme weather conditions. However, routine inspection of

the colony and honey harvesting were tough with traditional bee hives. In Nagaland honey harvesting process has not been good since immemorial, they were hunted and burned to bee and their broods unnecessarily. Injudicious harvesting methods were bound to abscond of the bee colony and in further future they wait to again capture the swarm or established colony. Due to this wrong practice colony stability and honey yield become poor, so more awareness and training should be required regarding honey extraction.

Indigenous pest management methods and inputs were undoubtedly the most effective against wax moth, wasp and lizard. Inputs are widely available, which have been wasting in nature at worthless place, like stingless cerumen is having antixenosis property against wax moth and antibiotic property. The cow dung easily available everywhere which has a deterrent effect against wasp and were also used for close the external crevices to prevent the entry of wax moths in the hive. The polythene sheet available at negligible prices in the market prevents to lizard till reach the bee hive due to soft and slippery property.

Nagaland is suffering from *jhoom* cultivation, which is destruction of natural habitat and global warming might be affecting the *Apis cerana* population, colony division and ultimately swarms. In Nagaland mostly beekeepers were not adopting scientific honey harvesting process, they were usually hunting the colony and squeezed and extracted the honey, this gruesome honey harvesting killing brood, workers and queen also, this traditional method might be affect the bee colony and their population.

Traditional significance of study to the beekeepers/society/researchers and some constructive recommendations

In present study, indigenous methods of enemies management were more effective and extenuate the cost without any chemical application whereas gruesome honey harvesting method direct threaten to honey bees and as well as poor quality of honey production. These traditional methods come with envisage for researchers to improve and innovate for traditional management of their enemies and assert scientific intervention in honey harvesting methods. These both approaches will be lucrative for beekeepers to come out with the challenge of

enemies, bee colony threatening and poor honey production in Nagaland as well as nation. I would like to recommend disperse the traditional management of *A. cerana* key enemies and educate the scientific honey harvesting method to conserve the declining *A. cerana* which play key role as a pollinator to maintain the plant biodiversity and production of good quality bee hive products.

Conclusion

Traditional beekeeping is a heritage of tribes and some incredible techniques beyond envisage, because they have learned by practice since immemorial or by themselves. Indigenous methods of enemies' management were effective and cheaper, whereas some traditional methods, viz. honey harvest is gruesome and directly threaten to bees. The scientific interventions essential in harvesting method for improve honey quality and bee conservation. Integration of indigenous techniques, innovation and envisage can give best result. Apiculture is a tool for maintaining wild biodiversity through bee pollination and exploits to the nectar, pollen, resin etc. which have been wasting in nature due to un-utilized. Nagaland has huge scope to harvest the bee hive products and employment to the rural people. Training and encouragement of small scale beekeeping lead to greater success in apiculture. Indigenous beekeeping has advantage, viz. low input cost in the context of bee hive and safer against natural enemies. These techniques show way to visionaries for envisage to innovation and intervention.

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