Stingless Bee Farming:
A Guide for Farmers

ICAR - Krishi Vigyan Kendra, North Goa

ICAR - Central Coastal Agricultural Research Institute

Ela, Old Goa, Goa

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Preface

This technical bulletin provides scientifically-backed information on using stingless bees in sustainable agriculture as efficient pollinators and hive product producers. Due to the decline of traditional pollinators like honeybees, the global agricultural sector needs alternative pollination solutions. Despite their small size and lack of a venomous sting, stingless bees can pollinate many crops and help natural ecosystems.

It covers stingless bee biology, including their life cycle, colony structure, nesting habits, and pollination, which boosts crop yields. It also discusses honey, propolis, beeswax, and pollen production, highlighting their economic and medicinal value. The document offers advice on managing stingless bee colonies, building artificial hives, and integrating them into agriculture.

This bulletin encourages farmers, researchers, and industry professionals to adopt stingless bee management as a profitable business. The technical knowledge and benefits of stingless bee farming are presented to encourage their widespread adoption in diverse agricultural settings, improving pollination services, crop yields, and biodiversity.

We hope this technical bulletin helps farmers optimise pollination and reap the many benefits of stingless bees.

Authors

Introduction

Pollination is crucial for food security and livelihoods, with bees playing a key role in pollinating about 70-80% of flowering plants. However, the decline of honeybee populations, due to factors like pesticide misuse, diseases, pests, habitat destruction, and logging, is impacting crop yields and natural ecosystems. This has led to the exploration of stingless bees as an alternative for managed pollination. Stingless bees are small, non-stinging bees found primarily in tropical and subtropical regions. Unlike honeybees, they do not have a venomous sting, but they still play a crucial role in pollination, contributing significantly to the fertility of plants and agricultural crops. These bees live in colonies with a queen, worker bees, and drones, often building their nests in tree hollows or underground. In addition to their pollination services, stingless bees produce valuable hive products such as honey, propolis, and Beebread, which have medicinal and health benefits. Despite their importance, stingless bee populations are under threat from habitat destruction, pesticide misuse, and other environmental challenges.

Conservation efforts are underway to protect and cultivate these bees, where their pollination and hive products hold potential for sustainable livelihoods.

The Life Cycle of Stingless bees

The queen bee mates with single drone from another colony during a mating flight and collects enough sperm to fertilize eggs for the rest of her life. After returning to her colony, she starts laying two types of eggs: fertilized eggs that will become workers or queens, and unfertilized eggs that will become drones. Queen larvae are only fed royal jelly as they develop.

Queen

The queen serves as the mother of all members of a colony and controls the day-today organization and activities of the nest. This is done by releasing chemical substances called pheromones. By releasing different pheromones from her body, members of the colony interpret and act accordingly.

Drone

Drones are the male members of the colony and are important in colony reproduction. They are developed from unfertilized eggs. Drone larvae are fed with larval food just like workers. Drones can be distinguished from worker bees by their larger eyes, slightly smaller mandibles, and often a lighter face color.

Worker

Workers are the female bees in the colony, other than the queen, and they develop from larvae that hatch from fertilized eggs. When the larvae are first hatched, they are fed royal jelly for three days. After that, they are switched to a diet of worker jelly. As the larvae grow, they reach the pupal stage, at this point their cells are sealed by worker bees.

Once they emerge as adults, worker bees take on various essential tasks within the colony. These duties include foraging for nectar and pollen, cleaning the hive, defending the colony from threats, and feeding the developing larvae. Workers are the backbone of the hive, carrying out most of the day-to-day activities necessary for the colony's survival.

Nesting Sites

Stingless bees typically build their nests in dark, protected spaces, such as hollow tree trunks, underground cavities, or in crevices of rocks. These nests are often found in tropical and subtropical regions, where the bees construct intricate, multi-chambered structures made from wax and resin. The nest's location is carefully chosen to offer safety from predators and stable environmental conditions, crucial for the colony's survival and productivity. These cavities could be found in the following:

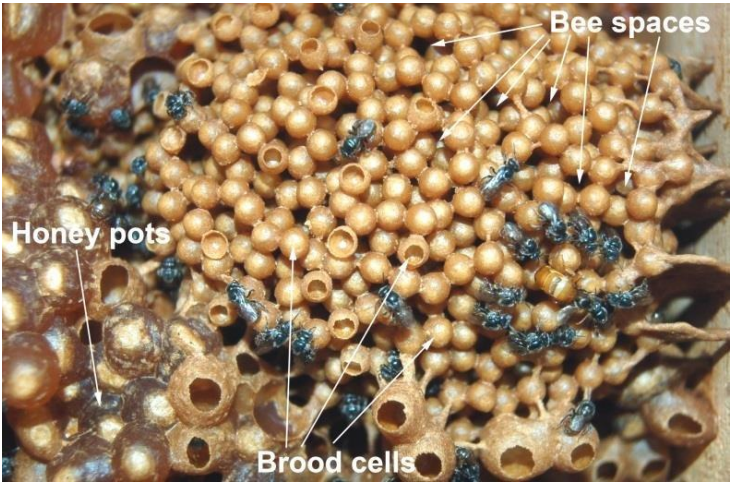
- Stem and branches of living trees including bamboo.
- Dead logs (either standing or lying on the ground).

- Old and abandoned ant hills.
- Cracks in walls of houses.
- Cavities in unused panel doors of buildings (accessed by cracks and key holes).

Materials for Nest Building

Stingless bees utilize a variety of natural materials to build their nests. After finding a suitable cavity, the worker bees use gums, resins, and wax to create the structure. In some species, they also incorporate sand and mud along with propolis and wax to reinforce the nest.

Nest Structure



The Passageway – This is an extension of the nest entrance, connecting the outside environment to the nest. Around the entrance and in various other areas inside the nest, the bees deposit resin, which they frequently use.

The Brood Section – Most stingless bee species construct brood cells and storage pots using cerumen, a mixture of wax and plant resin, while others use pure wax. The brood section is surrounded by several layers of cerumen membranes, known as the *involucrum*, which helps regulate the temperature inside the nest. Brood cells are arranged in layers, suspended and separated by connectives and pillars.

Honey Pots – These are specialized storage pots used by stingless bees to store honey within the nest. These pots are typically made from cerumen, a mixture of wax and resin. They are often oval-shaped and designed to hold the honey that the bees collect from nectar. The honey pots are part of the storage section of the nest, where the bees keep not only honey but also beebread (a mixture of pollen and nectar) for nourishment. These pots are crucial

for ensuring a steady food supply for the colony, especially during times when nectar sources are scarce.

Pollen Pots – These are storage containers used by stingless bees to store pollen, which is mixed with nectar to create beebread. These pots are typically made from cerumen, a combination of wax and resin, and are located in the storage section of the nest. The pollen pots are crucial for the colony's nutrition, as the beebread provides essential proteins and other nutrients for the developing brood.

Nest Location

The ideal location for your apiary would be as follows:

- Away from areas subjected to pesticides, pollution, smoke, etc.
- Close to fresh water source or means of providing fresh water.
- Easy access for the beekeeper, if possible with easy vehicle
- Near food sources throughout the changing season: for the area should be near or should have access for

the bees to plants like Coconut, Drumsticks, Rubber, Tamarind, Soapnut, Coffee, Sunflower, Ginger, Barseem, Coriander, Mustard, Litchi crops, Eucalyptus, Jamun, Karanji, etc. A good mix of these nectar / pollen yielding blooms should ensure a healthy productive colony of bees.

- On the upper sides of slopes to improve air drainage away from hives.
- Away from heavy tree canopy.
- Away from wet bottom land.
- In open fields with protective cover from the prevailing winds and noontime summer shade.
- With entrances oriented to the south, east or south-east.
- Not overlooking or with main flight lines crossing public thorough fares or footpaths.

Colony Defence

Although stingless bees cannot defend themselves with stingers, they have developed various effective strategies to protect their colonies from threats. These threats

include predators like lizards, birds, toads, spiders, ants, and intruders such as robber bees, hive beetles, wax moths, flies, other animals, and even humans.

To defend against these dangers, stingless bees station several workers at the nest entrance, where they act as guards. At night, the guard bees retreat into the nest and seal the entrance with propolis, effectively blocking access to ants, beetles, and other intruders. The propolis seal is removed each morning, and a fresh seal is applied in the evening.

Some species of stingless bees also use sticky plant materials, such as resins, to further secure their nest entrances. If an intruder manages to get inside, the bees may use large amounts of resins and propolis to entrap and suffocate them.

Few certain species build long, winding tunnels leading to the nest's entrance, which helps in colony defense. Any disturbance to the nest will trigger a response from multiple worker bees, which attack the perceived threat by

targeting vulnerable areas such as the eyes, nose, ears, and mouth.

In cases where nest disturbance is significant, some stingless bee species use biting as another form of defense. These bites can cause painful and lasting skin lesions, serving as a strong deterrent to potential predators or intruders.

Pollination

Stingless bees visit flowers of plants including crops and forest trees as well as shrubs and herbs to collect nectar, pollen, wax, resins, oils and other plant substances. In so doing, they effect the transfer of pollen grains onto stigmas resulting in pollination of these plants which lead to fertilization and eventually fruit and seed production. The frequency of their visit to the flowers and efficiency (ability to deposit pollen collected on body of bees on stigmatic heads) in effecting pollination result in high quality and quantity yields of fruits and seeds. Stingless bees can be employed in pollination of greenhouse plants/ crops in both temperate and tropical regions.

Pasturage Sources of Stingless Bees

Sl. No.	Common name	Scientific name	Family	Source
I.	**Field crops**			
a.	**Cereals**			
01	Finger millet	*Eleusine coracana* Gaertn.	Poaceae	P
02	Pearl millet	*Pennisetum typhoides* Stapt an Hubb.	Poaceae	P
03	Maize	*Zea mays* L.	Poaceae	P
04	Sorghum	*Sorghum bicolor* Linn. Mocch.	Poaceae	P
b. Pulses				
01	Cowpea	*Vigna catjung* Walp.	Fabaceae	N
02	Blackgram	*Phaseolus mungo* L.	Fabaceae	N
03	Greengram	*Vigna radiate* var. Nilezek	Fabaceae	N
04	Redgram	*Cajanus cajan* L.	Fabaceae	NP
c.	**Oil seeds**			

01	Sunflower	*Helianthus annuus* L.	Compositae	NP
02	Niger	*Guizotia abyssinica* Cass.	Compositae	NP
03	Seasamum	*Sesamum indicum* L.	Pedaliaceae	N
04	Mustard	*Brassica juncea* Corr.	Brassicaceae	NP
05	Castor	*Ricinus communis* L.	Euphorbiaceae	P
01	Coriander	*Coriandrum sativum* L.	Umbelliferae	NP
02	Curry leaves	*Murraya koenigii* Spreng.	Rutaceae	P
01	Drumstick	*Moringa oleifera* Lamk.	Moringaceae	P
02	Onion	*Allium cepa* L.	Liliaceae	NP
03	Brinjal	*Solanum melongena* L.	Solanaceae	P
04	Chow-chow	*Sechium edule* (Jacq.) Swartz	Cucurbitaceae	NP
05	Pumpkin	*Cucurbita pepo* Dc.	Cucurbitaceae	P
06	Cucumber	*Cucumis sativus* L.	Cucurbitaceae	P
07	Ridgegourd	*Luffa acutangula* L.	Cucurbitaceae	P
08	Bittergourd	*Momordica charantia* L.	Cucurbitaceae	P
09	Bottlegourd	*Lagenaria vulgaris* Sr.	Cucurbitaceae	P
10	Ashgourd	*Benincasa hispida* Cogn.	Cucurbitaceae	P

IV.	**Fruits and plantations**			
01	Mango	*Mangifera indica* L.	Anacardiaceae	NP
02	Papaya	*Carica papaya* L.	Caricaceae	P
03	Grapes	*Vitis vinifera* L.	Vitaceae	P
04	Pomogranate	*Punica granatum* L.	Punicaceae	P
05	Simarouba	*Simarouba glauca*	Simaraubaceae	NP
06	Jack	*Artocarpus integrifolia* L.	Moraceae	P
07	Banana	*Musa paradisiacal* L.	Moraceae	N
08	Arecanut	*Areca catechu*	Arecaceae	NP
09	Coconut	*Cocos nucifera* L.	Arecaceae	NP
10	Guava	*Psidium guazava* L.	Myrtaceae	P
11	Gooseberry	*Phyllanthus emblica*	Euphorbiaceae	NP
12	Acid lime	*Citrus meica* var. acida	Rutaceae	NP
13	Singapur cherry	*Muntingia calabora*	Eleocarpaceae	NP
14	Tamarind	*Tamarindus indica* D.C.	Caesalpinaceae	NP
V.	**Ornamentals**			
01	Tuberose	*Palianthus tuberose* Linn.	Agaraceae	NP

02	Bottlebrush	*Callestemon lanceolus* D.C.	Myrtaceae	NP
03	Railway creeper	*Ipomea cairica*	Convolvulaceae	NP
04	Rangoon creeper	*Quisqualis indica* L.	Combretaceae	N
05	Berleria	*Berleria cristata* L.	Acanthaceae	NP
06	Hibiscus	*Hibiscus rosa sinensis*	Malvaceae	P
07	Rose	*Rosa indica* L.	Rosaceae	P
08	Salvia	*Salvia splendenus*	Lamiaceae	P
09	Garden balsam	*Impatiens balsamina* L.	Balsaminae	P
10	Marigold	*Aster* sp.	Asteraceae	P
11	Cosmos	*Cosmos suphureas* Cav.	Asteraceae	P
12	Golden rod	*Salidago* sp.	Asteraceae	P
VI.	**Medicinal plants**			
01	Honey plant	*Ammi majus*	Umbelliferae	NP
02	Bishops weed	*Ammi vasnaga*	Umbelliferae	NP
03	Ajwan	*Trachysprmum amni*	Umbelliferae	P
04	Indian acalypha	*Acalypha indica*	Euphorbiaceae	NP
05	Physic nut	*Jatropha curcas*	Euphorbiaceae	P
06	Kalama dye	*Mallotus philippensis*	Euphorbiaceae	P

07	Indian liquorice	*Arbus precororius*	Fabaceae	P
08	Babchi	*Psoralea corylifolia*	Fabaceae	P
09	Neeligida	*Indigofera tinctoria*	Fabaceae	P
10	Alfalfa	*Medicago sativa*	Fabaceae	P
11	Tube flower	*Clerodendrum serratum*	Verbanaceae	P
12	Dioscorea	*Dioscorea composita*	Diascoreaceae	P
13	Prim rose	*Ocnothera lamarkiana*	Onagrceae	P
14	Sweet worn wood	*Artemisia annua*	Asteraceae	P
15	Sylibium	*Sylibum marianmum*	Asteraceae	P
16	Rauvolfia	*Rauvolfia tetraphylla*	Apocyanaceae	P
17	Ocimum	*Ocimum sanctum*	Lamiaceae	NP
18	Lea	*Lea indica*	Vitaceae	P
19	Garden	*Ruta graveolens*	Rutaceae	P
VII.	**Weeds**			
01	Tenners cassia	*Cassia auriculata*	Ceasalphinaceae	P
02	Lecuas	*Leucas aspera*	Lamiaceae	N
03	Tridax	*Tridax procumbens*	Asteraceae	P
04	Congress weed	*Parthenium hysterophorus*	Asteraceae	P

05	Ageratum	*Ageratum conyzoides*	Asteraceae	P
06	Bidens	*Bidens pilosa*	Asteraceae	NP
07	Touch me not	*Mimosa pudica*	Fabaceae	P
08	Brahmi	*Bacopa monniera*	Scrgshulariaceae	P
09	Mexican poppy	*Argemone Mexicana* L.	Papavaraceae	P
10	Lantana	*Lantana camera*	Verbanaceae	P
VIII.	**Trees**			
01	Eucalyptus	*Eucalyptus globosa*	Myrtaceae	NP
02	Jamun	*Syzgyium fruticosum*	Myrtaceae	NP
03	Jakaranda	*Jacaranda acutifolia*	Bignoniaceae	NP
04	Tecoma	*Tecoma stans*	Bignoniaceae	NP
05	Indian coral tree	*Erythrina indica*	Fabaceae	P
06	Babul	*Acacia arabica* W.II.d.	Fabaceae	P
07	Gulmohr	*Delonix regia* Ref.	Fabaceae	NP
08	Dhiancha	*Sesbania grandiflora* Pers.	Fabaceae	NP
09	Mesquite	*Prosopis juliflora* DC	Fabaceae	NP
10	Pride of India	*Lagerstromia indica* L.	Lythraceae	P

11	Camel foot	*Bahunia purpurea*	Lythraceae	NP
12	Mehandi	*Lawsonia inermis*	Lythraceae	NP
13	Henna	*Lawsonia inermos*	Lythraceae	NP
14	Copper pod	*Peltophorum petrocarpum (DC & Baker)*	Caesalpenaceae	NP
15	Pongamia	*Pongamia glabra*	Ceaesalpinaceae	N
16	Cassia	*Cassia javanica*	Ceaesalpinacea e	P
17	Sandal wood	*Santalum album L.*	Santalaceae	P
18	Teak	*Tectona grandis Linn.*	Verbanaceae	NP
19	Nevuladi	*Vitex peduncularis*	Verbanaceae	NP
20	Seme Nevuladi	*Vitex trifolis*	Verbanaceae	NP
21	Country almond	*Terminalia catappa*	Combretaceae	P
22	Kodasege gida	*Holarrhena antidenterica*	Apocyanaceae	NP
23	Ber	*Zygypus nauritiana*	Rhamnaceae	NP
24	White silk cotton	*Ceiba pentandra L. Gaertn*	Bombaceae	P
25	Neem	*Azadirichta indica Juss*	Meliaceae	N
26	Silver oak	*Gravellia robusta*	Proteaceae	P
27	Rain tree	*Samanea samon*	Mimosaceae	P

Source: Roopa, A.N., G. Eswarappa, Sanganna M. Sajjanar and Govi Gowda. 2017. Study on Identification of Pasturage Sources of Stingless Bee (*Trigona iridipennis* Smith.). *Int. J. Curr. Microbiol. App. Sci*. 6(11): 938-943.

Hive Products

Honey: Stingless bee honey offers farmers a unique product with a range of beneficial properties. This honey contains a high concentration of sugars, mainly fructose and glucose, contributing to its sweetness. It also contains a smaller amount of sucrose and may have higher levels of trehalulose, a rare sugar. Additionally, stingless bee honey has a higher water content, ranging from 25.88–40.07%, compared to traditional honey. Its composition includes organic acids, phenolic compounds, and smaller amounts of proteins, amino acids, enzymes, vitamins, and minerals, enhancing its nutritional value. With a low pH of 3 to 5, stingless bee honey is slightly acidic, and its color can vary from light amber to amber brown, with darker hues often indicating higher phenolic content. The honey's antioxidant and antibiotic properties make it valuable for local consumption and can be used in products like health supplements, cosmetics, and food

items such as bread, cookies, and beverages. For farmers, cultivating stingless bees offers the opportunity to diversify honey production, with an average yield of around 500 grams of honey per box per year.

Pollen: Stingless bee workers collect pollen grains from flowers and store them as *beebread* in pots within the nest. Beekeepers can harvest large quantities of beebread, and pollen can also be gathered in balls from the forager's pollen baskets using a pollen trap at the nest entrance. Rich in proteins, vitamins, and minerals, pollen provides essential nutrients to the bees. It is also packaged and used as a food supplement for humans and added to infant food. Additionally, pollen is widely used in cosmetic products.

Propolis: Stingless bees gather resins, gums, and other plant exudates to create propolis, which they use to seal cracks and openings in the nest, protecting it from external intruders. Propolis can be harvested by scraping it from the hive using a tool or knife. Scientifically proven to be effective in treating various health issues, propolis is a natural antibiotic known for healing wounds, infections,

and ulcers (both internal and external). Regular use of propolis helps regulate blood pressure and strengthens the body's immune system

Beeswax: Worker bees secrete wax from glands in their abdomen, which they use to construct pots for food storage and brood development. After extracting honey or beebread, the wax pots can be rendered into beeswax using hot water extraction. Stingless beeswax has various uses in health and beauty products, such as body and facial creams, lip balms, and skincare products. It is also used in industrial items like textiles, wood and floor polishes, leather treatments, and candles. In the pharmaceutical industry, beeswax is used to coat tablets and capsules.

Materials for Artificial Nests Construction of Stingless Beehive

Locally available materials and receptacles may be used for the construction of stingless bee hives. These may require modifications in one way or the other for the bee colony to accept to develop a nest. Materials for hive construction include:

- Sawn timber and planks
- Bamboo
- Burnt clay pots
- Gourds and calabash
- Shells of coconut, snails and other hard fruits
- Hollow logs
- Plastic bottles and gallons

Pests of Stingless Bees and Their Management Practices

1. Black Soldier Fly (Hermetia illucens)

- **Family:** Stratiomyidae
- **Nature of Damage:** Larvae feed on pollen, honey, brood, and cerumen deposits, causing colony destruction.
- **Management Practices:**
  - Maintain hive hygiene by regularly removing debris and waste.
  - Seal cracks and openings in hives to prevent larval entry.

2. Small Hive Beetle (Aethina sp.)

- **Family:** Nitidulidae
- **Nature of Damage:** The grubs and adults of nitidulid beetles tunnel through pollen pots, honey pots, and brood cells, feeding and defecating, which causes discoloration and fermentation of honey.
- **Management Practices:**
  - Reduce hive entrance size to limit beetle access.
  - Use traps or attractants outside the hive to capture beetles.
  - Regularly inspect hives and remove infested materials.

3. Cetoniid Beetles (Cetonia sp.)

- **Family:** Cetonidae
- **Nature of Damage:** Larvae feed on honey and damage wax structures.
- **Management Practices:**
  - Keep colonies strong, as weaker colonies are more susceptible.
  - Manually remove beetle larvae and adult if found.

4. Mites (Amblyseius sp., Carpoglyphus lactis)

- **Family:** Phytoseiidae; Carpoglyphidae
- **Nature of Damage:** Mites infest pollen stores and brood cells, leading to colony collapse.
- **Management Practices:**
  - Keep hives clean and dry to discourage mite infestation.
  - Introduce predatory mites as a biological control method.

5. Assassin Bugs (Apiomerus pillipes, Acanthaspis siva)

- **Family:** Reduviidae
- **Nature of Damage:** The nymphs camouflage themselves using bits of bee cadavers and remain near colony entrance tubes. They prey on adult workers by immobilizing and feeding on their body fluids.
- **Management Practices:**
  - Monitor hive entrances for assassin bugs and remove them manually.

6. Ants (Solenopsis geminata, Myrmicaria sp.)

- **Family:** Formicidae
- **Nature of Damage:** Ants rob pollen or attack adult bees, larvae, and eggs.
- **Management Practices:**
  - Place hives on stands with ant-proof barriers like sticky tape or oil-filled cups.
  - Destroy nearby ant nests to reduce the risk of invasion.
  - Relocate the hive.

7. Wasps

- **Family:** Megachilidae; Crabronidae
- **Nature of Damage:** Wasps hunt forager bees and damage colony entrances.
- **Management Practices:**
  - Protect hive entrances.
  - Destroy wasp nests near the apiary.
  - Relocate the hive.

8. Centipedes (Scolopendra sp.)

- **Family:** Scolopendridae
- **Nature of Damage:** Centipedes damage wooden hives, reducing colony strength.
- **Management Practices:**
  - Use treated hive to deter centipedes.
  - Inspect hives regularly and remove centipedes if detected.

9. Orb-weaving Spiders (Nephila clavipes, Argiope sp.), Crab Spiders (Thomisus sp.)

- **Family:** Araneidae; Thomisidae
- **Nature of Damage:** These spiders trap bees in webs near nest habitats, capturing foraging bees.
- **Management Practices:**
  - Clear vegetation and webs near hive entrances.

Conclusion

Stingless bees provide farmers with a valuable opportunity to diversify their beekeeping operations and enhance agricultural productivity. In addition to producing honey, pollen, propolis, and beeswax, these bees play a critical role in pollination, contributing to the health and yield of various crops. Stingless bee honey, rich in sugars, antioxidants, and antibiotic properties, is not only a nutritious food source but also a sought-after product in health and cosmetic applications. The bees' ability to produce propolis and beeswax further adds to their value, providing natural materials used for healing, immune support, and industrial purposes. With an average yield of about 500 grams of honey per box annually, stingless bee farming offers a sustainable and profitable venture. By supporting these colonies, farmers benefit from high-quality products and enhanced pollination services, leading to improved crop yields and contributing to the local economy.

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