# Stage 1: Research & Awareness:

## 1. Bee species and ecological importance:

India is a biodiversity hotspot for bees, home to many biodiversity-forming bee species.

**Apis dorsata (Rock Bee):** Large and wild, nesters in open spaces.

There are two types of Rock Bee:

1. The Giant Rock Bee (Apis dorsata):

- This is the most common type found across India, from the plains to the lower hills.
- Size: They are among the largest honey bees in the world with a length of up to 20mm.
- Nesting: They build a single, large open-air comb which they attach to high-rise buildings, water tanks, or tall tree branches.
- Behaviour: Highly defensive and they do the famous "shimmering" where a wave-like movement is done synchronously across the hive to scare predators.
  Climate: They are fond of tropical and subtropical climates and known to migrate hundreds of kilometers during different seasons.

2. The Himalayan Giant Honey Bee (Apis laboriosa):

- It is also referred to as the “Himalayan Rock Bee,” this subspecies has a close, specialized cousin in Apis dorsata, which inhabits high-altitude areas.
- Range: Primarily found in the Himalayan regions (North India, Nepal, Bhutan) between 2,500 and 4,000 meters.
- Appearance: They are slightly larger in size compared to the regular ‘Rock Bee’ to cope with the low temperatures in the mountains, along with being much “hairier.”
- Nesting: They construct their nests only on sheer, inaccessible rock faces and never on buildings.
- Honey: They make a specialty honey called ‘Mad Honey’ out of the rhododendron flower, which is quite rare and requires extreme care because excessive intake can be poisonous.

Ecological Role: Bees are considered crucial to the pollination of more than 70% of the world’s most cultivated crop species. Rock Bees are known to be "forest giants" that range long distances to guarantee the cross-pollination of the tree species within the forests.

# 2. Rock Bees (Apis dorsata) behaviour:

Understanding behaviour helps create the logic of detection.

- Aggression & Defence: Rock Bees are very sensitive to other insects, including their own kind, apart from honey bees and people in their area. They release an alarm

pheromone named Isopentyl Acetate. Once a single bee stings, this chemical stays on the victim's skin, signaling the rest of the colony to attack that specific spot.

- Shimmering: To keep predators like birds away, bees have a “shimmering” dance where thousands of bees wave their wings in sync. They create this effect of shimmering.

- Nocturnal Foraging: Contrary to most bees, “Apis dorsata” is known to be nocturnal during nights when there is moonlight, meaning they are at a greater risk of human encounters

## 3. Colony patterns and risks:

Think of a Rock Bee colony like a “Seasonal Guest” that arrives at the same hotel every year.

- The “Single Giant Sheet” Pattern: Instead of many small honeycombs being created within a box or hole, like other honeybees, the Rock Bee creates a single massive flat surface of wax in exposed areas that is bigger than a big screen television, vertical in position.

- Height Lovers: They always look for “high-rise” sites. In their natural habitats, this would be Mountain Cliffs. In

an urban setting, they identify the tallest buildings, balconies, or water tanks to ensure they are protected from ground predators.

- “The Returning Traveler,” or Site Fidelity: These bees possess an incredible internal GPS system. Even if they travel away for 6 months, they usually return to the same balcony or tree branch next year because they remember the location as well as the scent that lingered there.

- Night Owls: Most bees sleep at night, apart from Rock Bees, who get to work during moonlit nights. They take advantage of the moon light to eat while other bees are sleeping.

- Migration: They are migratory. A colony will occupy a site for 4–6 months and then move to a different climatic zone, often returning to the exact same spot the following year.

## Risks:

- Rock Bees aren't "mean," but they act like highly protective soldiers defending their home.

- The "Pheromone Tag" Risk: The moment a Rock Bee stings, it leaves an "invisible smell" or pheromone on the person or animal. This smell acts like a GPS tag for the

rest of the colony-informing thousands of other bees exactly where to attack.

- The "Chase" Risk: If you disturb a normal honey bee, it may chase you for 5 or 10 meters. A Rock Bee is a "pursuit flyer" and may chase a person for more than 100 meters-the length of a football field.

- The "Vibration" Trigger: Rock Bees are very sensitive to vibrations. Loud construction work, the hum of a nearby Air Conditioner, or even a bird landing too hard on the comb can make the whole colony "explode" into an attack.

- Livestock Danger: The major risk at villages would be to animals like cows or goats, which are always tied up. If bees attack, the animal cannot get away, which eventually results in the death of the animal due to hundreds of stings. Public Health: Mass stinging can cause anaphylactic shock or death.

- Agriculture: Disturbed bees can kill tethered livestock that cannot run away in villages.

# 4. Importance of Colony Monitoring:

Why build an app?

- Pre-emptive Safety: If a colony is anticipated early, building authorities can be alerted to fit safety nets or

relocate residents until a fully formed colony is achieved (50,000+ bees).
- Conservation: Colonies are not eliminated via ‘pest control’ methods of burning or poisoning when monitoring allows for live relocation.
- Migration Tracking: Assists researchers to gauge the influence of climate change on Indienne bee migration patterns.

# 5. Existing Detection Technologies:

Our research shows that currently, there are three approaches taken by technology:

- Acoustic Sensing: Microphone detection of the ‘buzz’ pitch between 180Hz to 250Hz with a Fast Fourier Transformation.
- Computer Vision: Deep Learning models like YOLO(You Only Look Once) or CNN(Convolutional Neural Networks) identifying the ellipses formed by colonies on building walls.
- Thermal Imaging: Infrared sensors detecting the temperature differential, due to a constant temperature of colonies irrespective of surrounding temperatures.

# 6. Village-Specific:

- Connectivity: The connectivity component involves Detection that must occur Offline and via On-Device

## Livestock Protection & Safety:

- In rural areas, bees not only pose a threat to human life, they also threaten a farmer’s livelihood.
- Grazing Zone Alerts: Identifying the "Red Zones" where Rock Bees are nesting to prevent farmers from grazing their cattle in the area.
- Panic Button for Swarms: Emergency alarm with quick trigger to alert the village to bring tied-up animals inside in the event of a swarm being disturbed.
- The 100-Meter Rule: Guides in the app illustrating that cattle must be at least 100 meters away from an upset colony in order to be safe.

## Solutions with Low Connectivity (Offline First):

- Rural areas frequently feature “dead zones,” where 4G or 5G reception isn’t possible.
- Reporting through SMS: Without any information, there is a system that automatically changes a colony report into a simple SMS carrying the coordinates to raise an alarm.
- Local Data Sync (P2P) – Farmers can sync the latest locations of bees using Bluetooth connections when they

get together at a local market or tea stall. Offline First-Aid Vault: All medical and treatment information is stored on the phone so that it remains functional even in the middle of a forest or a field.

## Acoustic “Farm-Noise”:

- Filtering Village areas are noisy due to tractors, water pumps, and harvesters.
- Smart Frequency Filter: The mobile app’s acoustic sensor is set to filter out low engine noise and remain active in only the 180Hz-250Hz band in the Rock Bee’s frequency dispersement pattern.
- Visual Alert Light: Farmers can't hear their phone ringing above tractor noise; thus, they will be alerted using their phone’s flashlight in a blinking pattern for quick notice

## “Medicure” & Home Remedies:

- Traditional villages might be too far from urban centers; thus, treatments must be quick and reliable in their own right.
- Vernacular Language Support: Information on mobile screens in common regional languages (e.g., Hindi, English, Kannada, and Marathi) for effective data understanding.
- Natural Ingredients: Informational tutorials on using natural resources close to home, such as “Mud (Clay), Honey, or Papaya,” to reduce pain by cooling the area

inflicted before entering a medical clinic for further treatment.'

- “Bee-Mitra" Network: A list of home honey-exterminators in their regions who understand handling Rock Bees safely without killing them.