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Preface

The evolution of beekeeping as an industry dramatically changed in Eastern Europe with the invention of the removeable comb frame by Prokopovych, which several decades later was patented by Langstroth in the USA. It was a game changing invention for the world of beekeeping through the identification and understanding of what is now known as the 'bee space'.

The Rev. Langstroth's 409 page, 1878 4th Edition of '*A Practical Treatise on the Hive and Honey-Bee*' is still held up as a how to do it book that is being reproduced today and published as '*The Classic Beekeepers Manual*'.

I was advised to read it by an expert beekeeper who uses no protection in the apiary yet it appears to me, and numerous other people at this

year's (2021) National Honey show, that some content of the book has had a detrimental effect on beekeeping and some of its advice is now being questioned.

The doctrine that humans know best, probably as a result of his religious beliefs, comes out in his book which lays down 61 "commandments" of beekeeping, a lot of which are still true today but others are incorrect, justified by anecdotes that don't withstand examination. It is these flawed instructions that have created an industry of gizmos designed to address the resulting problems, which have made modern beekeeping an unnecessarily complicated pastime.

The following observations will get you thinking so you can make your own mind up about how beekeeping best works for you and your bees.

Norman Guiver

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Introduction

At our apiary, we are no different to other beekeepers who have struggled to keep colonies alive in spite of all the equipment and advice we have access to. There are numerous books, *how to* courses and internet pages about keeping bees, the majority reproduced without questioning the assumptions contained in Langstroth's patent.

Needless to say, we can't blame Langstroth as he wrote what he believed to be true.

The Upstairs Downstairs Hive Intranche came about when we were suffering the devastating effects of Colony Collapse Disorder in South Oxfordshire and were trying to devise a method of shutting up hives quickly when farmers were spraying. 31 of our 44 hives died out over the winter of 2019-20.

We drilled entrance holes in our hives and turned pegs to fill them quickly, and it worked, but during the winter the bees propolised the entrances. I got to work on the 3D printer and produced the *Upstairs Downstairs Intranche* (entrance on the inside) that fitted in the bee space inside the round entrance hole to block any draught.

I remember comments made when we launched it at on our stand at the National Honey Show by two ladies who had seen my short demonstration as to how the Intranche worked.

The first asked "*can it be installed in the floor to help combat the Asian hornet?*". I replied, "*I don't know, there are few rules in beekeeping, try it*".

The second commented "*I have been on the official ... beekeeping course and this is not how you are supposed to do it*". I asked if she had discussed it with the bees? I got a quizzical look and she walked away.

Langstroth and Prokopovych

The internet provides various chronologies for the evolution of beehive design culminating in the removeable comb frame, it sets out how it has evolved to require the numerous accessories we think we need today.

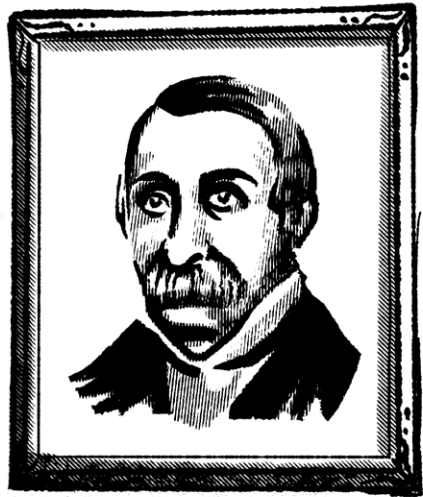
Cushman lists key movers and shakers on his website; however, he interestingly omits Ukrainian Petro Prokopovych 1775–1850 who had already developed a hive with removeable comb frames in 1817 before Langstroth was born. He set up a school of beekeeping in Baturyn in 1827.



Rev. L. L. Langstroth, 1810-1895

Prokopovych published numerous academic papers on apiculture and is understood to have set up bee farms with upwards of 6,600 hives.

Langstroth also omits Prokopovych in his references to other eminent beekeepers in his 1853 book *'The Hive and Honey-bee'*, no doubt there were many beekeepers developing new ideas as they tried to improve the efficiency of commercial beekeeping and harvesting honey.



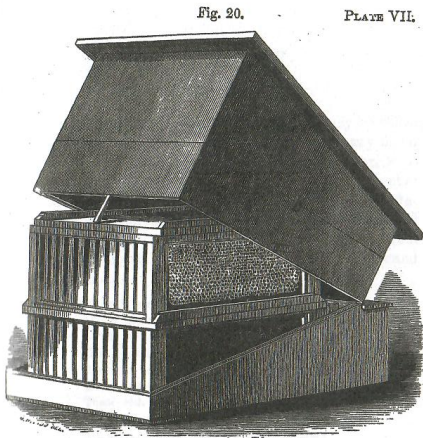
Petro Prokopovych, 1775–1850

The flawed 1852 patent

Ultimately, it was Langstroth who took out a patent for a removeable comb frame hive in 1852, documenting his observations, assumptions, anecdotes and detailed instructions in his 1853 and subsequent books.

He made specific reference to the space between a frame and the walls and floor of a hive as needing to be $\frac{3}{8}$ th of an inch. In addition he approximates the space between the 1" wide frames *"...about half an inch apart"*.

These dimensions, although not called the bee space in the patent, gave carpenters and beekeepers something they could work with, and replicate, and this one paragraph changed the world of beekeeping.



The Hive and The Honey Bee,
L. L. Langstroth, 1853, p66: perhaps the liftable hive cover is the real reason for the bottom entrance.

Unfortunately, there are several other elements of his design where the justification should have been questioned but the rest of the world copied the Reverend's full design religiously, without question.

Flaw # 1: to clear out dead bees

The patent referred to the entrance and was specific about its location, this design is still accepted 170 years later. He justifies bottom entrances by stating: *"Bees must, at great disadvantage, drag uphill their dead"*, and so he dictates that *"No, part of the interior of the hive should be below the level of the place of exit"*.

We now know that insects can carry up to 20 times their own weight and can easily carry dead bees. Feral bee colonies have evolved over 1000's of years in rotten tree trunks and survive wherever the entrance may be.

Flaw # 2: remove detritus

Langstroth noted dead bees and mouldy detritus on the solid floor of his hives, which he insisted needed to be on the same level as the entrance for efficient cleaning, yet he does not explain why the bees did not keep the floor clean when using his design.

Flaw # 3:
easy access for predators

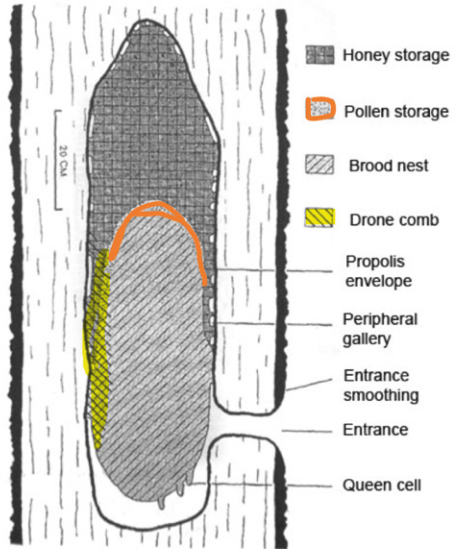
Langstroth observed the ease with which wax moth could get in through the entrance and contrived various ways of trying to stop it, yet bees in a feral colony exist perfectly well in harmony with wax moth, which is a very important relationship for biodiversity.

In addition, the geometry of the Langstroth hive entrance disadvantages the guard bees, a problem covered later.

Flaw # 4:
too much ventilation

Langstroth justifies his assertion that hives need ventilating when he is hot by repeatedly referring to “*foul air*” in the hive, but I have yet to experience *foul air* in any hive I have opened up.

- When we feel uncomfortably warm Langstroth insists we ventilate the hive, (at 25°C?) while we now know that bees prefer to keep the queen at 36°C.
- Unlike us, insects don’t have lungs and can survive with very little oxygen.
- ...and too much ventilation causes other issues.



A Typical Natural Bee Nest from: Seeley, T. D., Morse, R. A. (1976). The nest of the honey bee (*Apis mellifera* L.). *Insectes Sociaux* 23: 494-512.

To counteract the lower temperature caused by over ventilation bees consume honey stores to generate heat to restore the temperature to the level they prefer, and often the queen moves up the hive to where it is warmer. Bees are able to fan to reduce temperatures or humidity if they decide it is a problem.

For thousands of years bees have existed in rotten tree trunks, hollows in the ground and anywhere dark and draught free. They keep warm, and use just one rotted out branch hole as an entrance, which provides enough ventilation.

The development of the *UD Intranche* and patent

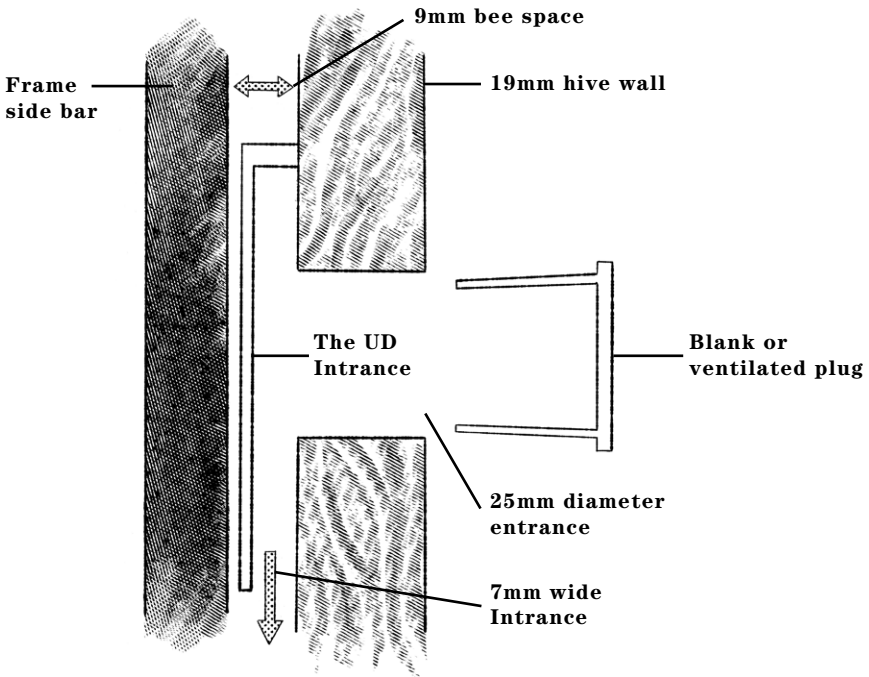
After installing 3D printed *Intranches* in a few of our own colonies and watching them perform well over a whole season we applied for a patent and commercialised production through injection moulding.

I called it *The Upstairs Downstairs (UD) Hive Intranche* (intranche on the inside) as it can be fitted in both brood and super boxes and we were thrilled that it was given an Innovation award at the National Honey Show in 2019.

The UD Hive Intranche enabled us to better replicate how hives functioned pre Langstroth and how bees live in the wild. It is an intranche backed by an *Intranche* that moderates ventilation while allowing access, and is something that bees can easily defend against predators, but more was to come.

On researching historical references, it is clear that intranches NOT at the bottom of the hive were predominant in the centuries pre Langstroth's patent, except with some types of skep.

Cross section of *The UD Intranche*



Unfortunately, the winter of 2019/20 was devastating for us: samples tested from the stores of 31 dead hives showed up to 560 times the legal food limit of pesticide. As a result, we lost the will to try to keep a large apiary alive, so it is now a modest 12 hives.

In 2020, with a full season's use and interest from outside the UK we were realising that while the invention was very simple, it had many benefits:

- *The Intranche* can be retrofitted to any single walled hive, including poly hives
- Wasps will not go in
- It allows bees, drones and the queen to pass through but excludes mice and the large hive beetle (Africa)
- It affords the bees two points at which to defend their hive, at the entrance and then inside where the *Intranche* allows access into the hive
- *The Intranche* points downwards which moderates ventilation so the bees do not propolise it
- It is made of smooth ABS plastic rather than a porous material like wood (which the bees could firmly attach to a frame making it difficult to remove)
- The entrance can be used to administer atomised treatments without opening the hive
- Vented and blanking plugs allow the hive to be shut up during spraying, or overnight, so work like mowing can be done safely in the apiary
- *The Intranche* makes *cold way* warm. Combined with frames with part foundation, the bees movement within the hive is far less restricted

The Upstairs Downstairs Hive

Over the 2020 and 2021 seasons other apparent benefits were observed and we adopted a hive configuration to better mimic a feral colony in a tree: completely at odds with Langstroth's instructions, we moved the entrance up.

The logic for this change was reinforced when I was called out to a fallen apple tree in a garden where I had previously collected swarms. We blocked up the entrance, carefully cut out the length of trunk in which the colony existed and stood it upright in another place in the garden. The entrance was half way up the 1.3m tall colony and the log 500mm in diameter.



Relocated apple tree colony with entrance 1/3 of the way up

The hive configuration we now use has developed as follows:

a. The Solid Floor

12mm plywood with a cedar frame.

b. The Basement Box

This extension of the brood nest raises the entrance up and is created by placing another super or brood box (without entrances) below the traditional Brood box. The basement box has frames, and encloses the bottom part of brood nest. If you use 14 x 12's then simply fit the Intrancess at the top of the box to achieve the same configuration.

As bees are no longer forced upwards by a cold draft entering the bottom of the hive, they are active here all year round and keep the solid floor clean.

c. The Brood Box

Three Intrancess are fitted to provide adequate access when there is a flow on.

The queen is no longer forced upwards by drafts and with the 'super' size basement box this has effectively created a brood and a half.

With the entrance higher up in the hive worker bees have significantly less distance to carry the nectar to the supers (presumably spending less time chatting as well!!)

d. No Queen Excluder

If the queen lays in the supers, then clearly there is an issue below. Either the brood capacity is too small, the comb is unusable or there is a cold draft forcing her upwards. The solution is to identify and resolve the root cause.

e. The Super

An entrance fitted to a super increases foraging efficiency during a flow.

f. The Crown Board

This maintains the bee space at the top of the hive and prevents comb being built in the roof. To prevent unnecessary drafts any bee escape or feeder holes should be taped up when not needed.

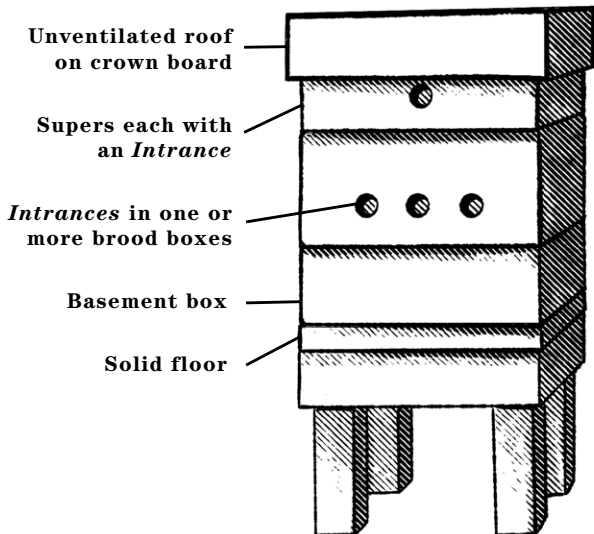
g. Unventilated Roof

The ventilated roof was a later British invention to increase ventilation! As a feat of human ingenuity this has been designed perfectly to allow wax moth to lay their eggs in a warm area, inside the top of the hive, protected from predators by the roof metal, so when the grubs hatch, they drop through the mesh into the hive, perfect!

I previously fitted mesh on the outside of the ventilation holes to prevent this and we have never had wax moth on our hives since 2017, but now I simply block up the vents.

We should also conclude that when bees propolise the vent mesh inside the roof it is because they do not want the ventilation, so we should not scrape it off!

Diagram of the basic UD Hive



h. Foundation

New beekeepers are shown how to build frames and install foundation yet it is rarely explained that:

- fully waxed frames make navigating the hive very inefficient for bees
- we are forcing the bees to conform to our ideas about the appropriate cell size

Bees build comb from the top downwards and foundation is installed to ensure that bees do not build their comb all over the place. A part strip of foundation at the top of the frame will ensure the bees build straight and they can then build the cell size they prefer.

I wire my frames and use unwired foundation but most beekeepers use wired foundation, so if you do, cut some of it out leaving the wire intact.



This frame was put in the hive with 1/3 foundation.

Varroa & predators

Feral colonies exist successfully in the wild in spite of varroa yet the most common beekeeper reasons for colony losses are either down to varroa, or “*I must be doing it wrong*” or winter losses!

Our apiary has been inspected by the NBU for the past 2 years and virtually no varroa has been found, yet we have not treated for it for three years, why?

- Moving the hive entrance, up and away from a solid floor reduces ventilation further
- The bees are better able to generate the heat needed to keep the colony warm
- This in turn reduces condensation but the humidity in the hive will be higher because of the higher temperature the bees can sustain

Whilst we do not fully understand why we have so little varroa, this research may explain what could be happening in feral colonies and in our hives:

Researcher Zachary Huang suggests that (Varroa) mite reproduction drops significantly when the relative humidity is high. In one study (Kraus and Velthuis, 1997) at 59-68% relative humidity, 53% of mites produced

offspring, whereas at 79-85% relative humidity only 2% of the mites produced offspring. Zachary explains that he has also had experience with this phenomenon in his lab.

'Varroa Mite Reproductive Biology' Bee Culture (October 2012, Volume 140, Issue 10, p. 22)

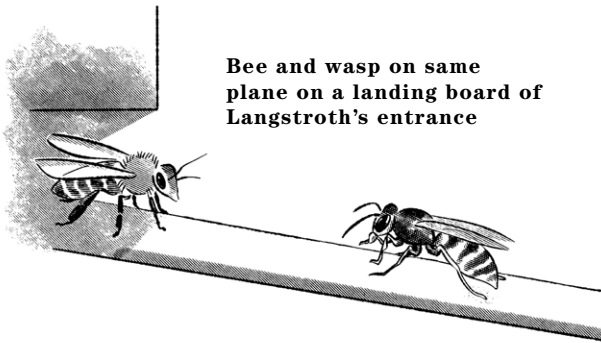
Wasps will not go in

If a wasp and bee meet face to face on Langstroth's flat landing board, I would put my money on a wasp. However, with *The Intranche* fitted, the wasp is on a different plane to the bee and has to show its underbelly before being able to turn into the entrance.

With the round entrance the wasp is on the face of the hive, vulnerable from all directions, while the bee can easily move through 360 degrees within the 25mm hole, to defend, within the entrance.

If the wasp does gain access, then it still has more guard bees at the *Intranche* to deal with.

Like me, beekeepers using the *UD Intranches* in some of their apiaries have observed that once the wasps have learned the hard way, they don't bother trying to get into the hives that have *UD Intranches* fitted.



Bee and wasp on same plane on a landing board of Langstroth's entrance



Wasp on different plane to bee is vulnerable showing its underbelly at the entrance hole



Video: Bee.Watch on Youtube *Bees easily defend against wasps*



Zachary Huang's research *'Varroa Mite Reproductive Biology'*

The future for *The UD Hive*

We continue to observe our thin walled hives with *The UD Intranche* fitted and a solid floor, to address the now obvious to us (and many other beekeepers at the 2021 National Honey Show) issue of too much ventilation. In late 2020 when preparing hives for winter we noticed that the cleanest floors were in those hives on solid floors with higher entrances.

To see if this was a chance observation, we re-configured half of the hives by taking the super with its stores and putting it below the brood to raise the entrance up, calling it a basement box.

While we had already replaced all mesh floors with solid ones, on inspection the following spring the hives with the basement boxes had consistently cleaner floors.

Needless to say, all our 12 hives now are of the *UD Hive* configuration going into the winter of 2021 with a basement box on a solid floor with a brood box on top and in two large colonies another brood box or super on top of that.

Each has a single entrance for the winter with the rest fitted with bungs.



***UD Hives* in our South Oxfordshire apiary.** In these pictures we are using a super with a blanking plate installed as a basebox

Thin-walled hives

The UD Hive eliminates the need for many of the human interventions and gizmos we are sold for beekeeping, but there is still the issue of thin-walled (19mm) wooden hives v the better insulated (65mm +) hollow tree trunks found in the wild.

Insulation cannot compete with the slightest draft so eliminating those is the first priority and here we should work with the bees. They will propolise up cracks and we can eliminate the other mechanisms we have invented which cause drafts like ventilated roofs and mesh floors.

All that is left is to replicate the better insulation that thicker wood offers, if you think we actually have a winter to worry about any more.



**Video: Bee.Watch
on Youtube** *The
use of a basement
box – no draughts*



The honey bee's contribution to bio-diversity

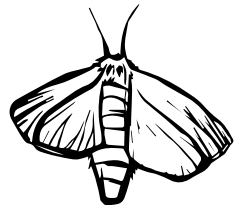
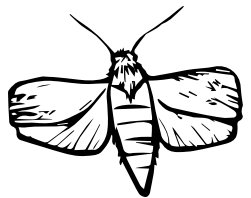
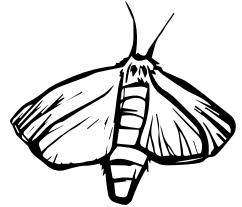
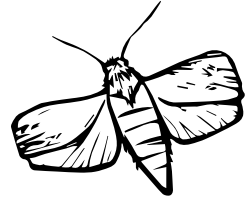
Beekeepers replace 'dark' comb with fresh foundation, as after repeated use the cells have become too small for the queen to lay in. A feral colony in a hollow tree is not afforded this service by beekeepers, except in Africa with log hives.

Eventually, when the space in the tree has been fully used up, the colony may move out or to another part of the hollow.

Now the wax moth moves in and breeds so its larvae can do their important house cleaning job.

They consume the wax and residual honey (carbohydrate) and remaining pollen and membrane left in the comb (protein) and importantly produce millions and millions of moths on which birds, bats spiders and other insects can feed. An important contribution to biodiversity and the food chain.

However, we beekeepers could load our dark comb into a redundant hive box and leave it in the corner of the garden for the wax moth to colonise.



A year in the life of a *UD* hive

Autumn

- Replace the frames in the basement box with good, part waxed frames including stores, or simply put your existing super with stores on the solid floor
- Replace any dark brood frames in the brood box with part foundation frames. This gives a space for the winter cluster
- Put bungs in all *Intrances* except one

Winter

- Check bees at least once a week to see if they are active. If they are not active on a warm day, especially after a two or three day spell of unseasonably warm winter weather then they may have suffered Colony Collapse Disorder. (You record they are flying then a few days later nothing, and the hive is empty except for the queen and a few bees)

Spring

- At the first signs of real activity, feed, so the bees will make fresh comb in the spaces you have provided before it is warm enough for them to be regularly foraging. As the stores in the basement box are being consumed the queen will lay in there
- Open up another *Intrance* as the weather demands
- Get inspected by your local NBU bee inspector

Summer

- Add additional super or brood box if there is any sign of the queen laying in the super
- On inspection you will find the solid floor is immaculately clean and all wax cappings will have been recycled



Video: Butts Bees, Mississippi, USA
Introduction to the Intrances and installation



Video: Butts Bees, Mississippi, USA
Update and hive inspection



Video: Butts Bees, Mississippi, USA
Helping bees to keep a clean hive

So...

The real skill in beekeeping is to observe, understand and to not impose our *human's know best* values onto our bees.

We all live in our own local environment, so believe in your own observations and don't accept "*this is how you are supposed to do it*" from anyone. Climate change is happening so fast that it has made books on beekeeping likely to become out of date very quickly.

However, there are plenty of beekeepers who successfully use all the various modern hive features on offer so you have to come to your own conclusions. Yet the *UD Hive*, without its bottom entrance, mesh floor, ventilation in the roof, landing board and queen excluder is a far less expensive proposition.

Bees enjoy a warm environment, and don't need air-conditioning when we are hot. They are not aeroplanes! So they don't need a runway or landing board, which provides a place for predators like mice and wasps to patrol.

We don't sell hives - we leave that to **National Bee Supplies** who will deliver you a *UD hive* ready to go - but we do sell the *Intrance kits* which will allow you to convert any single walled hive, including a polystyrene one, into a *UD Hive*.



A *UD Hive* available from **National Bee Supplies**



National Bee Supplies
our partner and UK distributor
www.beekeeping.co.uk



Bee.Watch, one app, multiple applications*

Applications include: Beekeeper, Non-Beekeeper, Bystander, Swarm Harvest and Mentor. Accessible on PCs, Smartphones and Tablets; works anywhere including at remote apiaries where there is no GSM Signal. Available in most languages.

Apiary Management (Beekeeper):

QR code identified hives enables easy inspection, ability to record colony loss and treatment, make To Do lists, manage multiple apiaries and pollination services.

Mentor: Association Inspector's records mirrored to Beekeeper's app.

Bee Farmer: The system includes pollination services i.e. create new location/apiary and move hives there.

Pesticide Management

(Non-Beekeeper): This application allows commercial pesticide users to report directly to spray co-ordinators and Bee.Watch app users.

Swarm Harvest: Easy to set up, efficient association swarm collection without telephone calls, with real time mapping for the Swarm Coordinator.

ApiTrace: Honey traceability for Africa.



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