Honeybees, Pollination and Livelihoods

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Afghanistan is one of the most important fruit and nuts producing countries in the region, with enormous and diverse plant and animal resources. Its agriculture and plant biodiversity is highly dependent therefore on pollination services provided by honeybees and other pollinators. Afghan beekeepers are well known for their beekeeping skills, commercial beekeeping having started here 56 years ago. At present, around 100,000 colonies of *Apis mellifera* honeybees are being maintained by Afghan beekeepers. More than 30,000 bee colonies are transferred to Pakistan every year for the flow of honey from Zizhyphus, a desert bush producing precious honey. This is one of the largest transboundary beekeeping operations for the mutual benefit of both countries. On average, 100 metric tons of honey is produced by migratory beekeeping enterprises in Afghanistan. *Apis cerana* beekeeping, which is confined to mountain areas bordering Pakistan, service the pollination needs of mountain horticulture and other plant resources, strengthening biodiversity at local levels and contributing in mitigation efforts to stabilise the impact of climate change in the country and the region. According to estimates of the Agriculture department 50,000 colonies are being maintained by mountain people in these areas.

Basic beekeeping is easy to learn, and Afghanistan's 29 million hectares of rangelands and forests need 'pollinator intensity' (a required number of pollinators to pollinate an area or certain plants) in order to rejuvenate biomass cover and bring better livelihoods to the poor and the landless). This enterprise based in nature contributes to strengthening the food chain and increasing wildlife diversity.

Honeybees of Afghanistan

The giant honeybee (*Apis dorsata ,see photo*)
Dwarf honeybee (*Apis florea*)
Asian hive bee (*Apis cerana*)
European honeybee (*Apis mellifera*)

The Economics of Beekeeping in Afghanistan: A Ten-Year Operation

Beekeeping opens livelihood opportunities and offers important ways of reducing poverty. This chapter gives some basic economics of migratory beekeeping with *Apis mellifera*, stationary beekeeping with *Apis cerana*, and managed beekeeping with *Apis cerana*. The table on the next page explains the three beekeeping related business options.

Table 1: **Economic analysis of honeybee businesses in Afghanistan under three different scenarios***

Migratory beekeeping with *Apis mellifera* (based on 100 colonies)			**Stationary beekeeping with *Apis cerana* (based on 10 colonies in log or wall hives)**			**Stationary beekeeping with *Apis cerana* (based on 20 colonies in frame-Newton or top bar hives)**		
Items	**Cost**	**Total**	**Items**	**Cost**	**Total**	**Items**	**Cost**	**Total**
Fixed Costs								
100 colonies	100	10,000	10 colonies	40	400	20 colonies	60	1200
Bee equipment (Smoker, hive tool, veil, brush, hand capping etc)	LS	100	-	-		Bee equipment (smoker, hive tool, veil, brush, hand capping etc)	LS	50
Empty hives (40)	40	4000	-	-		Empty hives (10)	20	200
Extractors (2)	200	400	-	-		Mini extractor	50	50
Total		14500			400	Total	-	1500
Operational cost								
Wax sheets	LS	1000				Wax Sheets	LS	200
Sugar for winter (7 kg/ hive /year	.5	3500	-	-		Sugar for winter (10 kg/ hive / year)	.5	1000
Equipment repair	LS	500	-	-		Equipment repair	LS	100
Transportation	LS	3000	-	-		Transportation	-	-
Labor	LS	5000	-	-		Labor	LS	500
Miscellaneous	LS	2000	Miscellaneous		100	Miscellaneous	LS	200
Total operational cost		15000	Total operational cost		100	Total operational cost		2000
Total compounded Interest @ 12%		41,910			890			4886
Total cost		71400			1390			8386
Benefits								
Estimated production of honey (20,000 kg)	5	100,000	Estimated production of honey (500 kg)	10	5000	Estimated production of honey (2000 kg)	10	20000
Colony multiplication (500 colonies)	50	25000	Colony multiplication	-		Colony multiplication (100 colonies)	40	4000
Wax (1000 kg)	6	6000	Wax (10 kg)	6	60	Wax (30 kg)	6	180
Queens (500)	2	1000	Queens	-		Queens (100)	2	200
Pollination services(100)	LS	1000	Pollination benefits to owned orchards	LS	1000	Pollination benefit to owned orchard	LS	1000
Total benefits from products and production		133000	Total benefits from products and production		6060	Total benefits from products and production		25380
Value of investment after ten years depreciation		7250	Value of investment after ten years depreciation		400	Value of investment after ten years depreciation		750
Total value of benefits and investment after 10 years		140250	Total value of benefits and investment after 10 years		6460	Total value of benefits and investment after 10 years		26130

*All item costs in US$ at rates based on Afghanistan prices in 2008

LS= lump sum

Migratory beekeeping with *Apis mellifera* gives a return of US$2 for every dollar of investment. High investment costs at the initial stage, compounded interest, high operational expenses, and little returns on pollination services result in comparatively low returns for this type of beekeeping. Stationary beekeeping with *Apis cerana* in log hives gives a return of US$4.5 for every dollar invested. Despite low honey productivity, compounded interest, actual returns on per unit investment are higher with this type of beekeeping because of small investments at the beginning stage, negligible operational costs, and additional pollination benefits to farmer-owned orchards. Return for every US dollar is more than US$3 with *Apis cerana* stationary beekeeping within moveable frame hives. The maximum number of colonies to operate the business with this type of beekeeping is 20 colonies in frame hives and 10 colonies in log hives. In the case of migratory *Apis mellifera* beekeeping, the minimum number of colonies should be at least 100 in order to be profitable. Financial analyses show that all types of beekeeping are economically profitable, but stationary beekeeping with *Apis cerana*, because it requires very little investments, is an option suitable for small, resource-poor farmers.

Beekeeping Management

Beekeeping management is easy and profitable but requires some basic skills, investment, and dedication. The following are some ways of managing the enterprise.

Training Afghan beekeepers in Kabul

Colony inspection

It is important to keep vigil and regularly inspect the bee colonies to be aware of the presence of a queen, eggs, and food stores such as nectar and pollen, to check and monitor the space for bees within the colony, and to note colony status (colony health and hygiene, presence of queen cells and drones, any signs of absconding, and presence of stores of honey). Colony inspection time varies depending upon location. It is advisable to inspect colonies only on sunny and clear days.

Uniting and dividing bee colonies

The queen bee is the centre of the beekeeping enterprise. Colonies need to be united if a queen gets injured or dies and there are no immediate possibilities of providing a new queen. It is also necessary to unite weak colonies as they cannot survive the rainy and winter seasons and are more susceptible to different kinds of stress conditions. Colonies can also be united to make a strong colony for honey production and pollination purposes.

Table 2: **Seasonal requirements in colony management**

Spring (March-April)	Summer (May-June)	Rainy season (July-August)	Autumn (Sept-Nov)	Winter (December-February)
• Inspect colony once a week • Clean the bee hives once in two weeks • Spring being a swarming season, colonies make a number of queen cells and rear a lot of drone brood • Destroy unnecessary queen cells and drone brood to avoid unnecessary swarming • Divide the colony if necessary • Open hive ventilation • If necessary, replace the old queen with a new one • Place honey super • Harvest honey if colony has stored some. • Put all the frames in the hive	• Provide ventilation • Place the colonies in shade • Make provisions for water for the bees • If necessary feed the colony with sugar syrup	• The rains wash away pollen and dilute nectar. Also during the rains bees cannot go out to collect pollen and nectar, creating a shortage in food for the colony. Therefore, it is necessary to feed the colony with sugar syrup and pollen substitute every week during this season. • Protect the colonies from rain. • Dry the hive from inside with the help of a dry cloth to protect it from fungus and harmful insects.	• Inspect the bee colony once a week • Clean bee hives during sunny hours of the day once in two weeks • Place honey super • Harvest honey if colony has extra store.	• Make arrangements to keep the colonies warm during winter – close the ventilation, reduce the size of hive entrance, cover the hive with newspaper • Feed the colonies with sugar syrup • Open the hive for inspection once in 2/3 weeks or only if it is absolutely necessary during warm and sunny days • Take out the empty frames, the super chamber and reduce hive size by putting in a dummy board • Place bee colonies in a sunny location

- Start moving the weak colony towards the colony to which it is to be united and destroy the queen of a weaker colony a day before uniting.
- Remove the outer and inner covers of the stronger colony, cover its brood chamber with newspaper, punch small holes on the newspaper and spread honey on it.
- Place the brood chamber of the weaker colony over the newspaper and put the inner and outer covers. After 1-2 days when bees of both colonies mix, remove the newspaper and brood chamber of the weaker colony.

Table 3: **Life cycle of a honeybee**

Stages	Queen	Worker	Drone
Eggs	3	3	3
Larvae	5	6	7
Pupae	8	12	14
Adult	16	21	24

When queen cell formation stimulates much activities in the colony and bee forage resources are abundant and weather conditions conducive (normally in springtime), beekeepers divide their colonies. This is to increase production of honey and income from its sale and the sale of colonies.

To divide colonies:

- Move the colonies to be divided a foot (0.3048m) away from their original position at night.
- Place a new, empty hive about a foot away from the original position, take out the queen with three to four brood combs from the old colony and give the brood new hive, leaving the remaining combs in the old colony with a sufficient number of eggs and larvae.

- If queen cells are available, select the best one, leave it in the old colony and destroy other queen cells.
- Provide the required number of frames for both hives; make sure that the number of adult bees is equally divided in both hives.
- Close the covers of both hives and observe whether the returning bees are entering both hives in almost equal numbers. If more bees are returning to one hive, the second hive should be placed closer to the original position.
- When bees are more or less settled, move the beehive gradually by 1-1.5 feet a day and put in a desired place.

Swarming

Swarming is the departure of a portion of the adult worker bees from the colony together with the queen during the active brood rearing period in search for a new nesting site. Swarming generally occurs between the months of March-June, depending on climate conditions. Signs that a colony is preparing for swarming is the construction of drone cells and the appearance of a drone brood, followed by the construction of queen cells.

Swarm of *apis cerana*

To prevent swarming:

- Assess the strength of the colony; if it is strong enough, destroy all queen cells except for one and divide the colony.
- If the colony is strong and the bees are congested but you don't want to divide it, provide more space by placing a 'super' (a store place within the hive where bees store excess honey) over the brood chamber and remove queen cells and the drone brood.
- If the colony is not strong but is still preparing for swarming, destroy all the drone brood and the queen cells.

Absconding

Absconding is the departure of adult bees from their nest, leaving behind whatever brood and food stores are in it. Bees abscond their nests for a number of reasons including a shortage of food supply in the nest, disturbance to the bees, excessive heat and cold or poor ventilation, old and defective combs, and attack by pests and diseases. A colony preparing for absconding does not defend itself against pests, ceases brood-rearing (although the queen continues to lay eggs), has a small, scattered brood or no brood at all, has little or no food stores. Bees also stop cleaning the hive, cannibalism is observed

(that is, adult bees first devour young larvae, then older larvae, and finally the pupae) and a progressive reduction in the relative number of pollen carriers entering the hive is noted.

Absconding can be prevented by:

- Feeding sugar syrup (prepared by dissolving two parts sugar in one part water) into the colony every evening;
- Providing shade during summer, warmth during winter, and adequate ventilation;
- Removing old and defective combs from the hive and keeping the bottom board clean; and
- Finally, taking up measures to control diseases and pests.

Robbing

Robbing is the condition where bees of one beehive try to rob the bees of another of their nectar and stored honey. Uncontrolled, robbing can lead to the death of many worker bees. Robbing occurs because of lack of food in one of the colonies, especially at the end of the spring and winter seasons and happens when honey and sugar syrup drops from the hive tools while inspecting the colony and bees of both hives try to eat the honey.

Robbing can be prevented by:

- Supplying brood frame from strong colonies to save weak colonies from robbing
- Uniting the weak colonies
- Preventing honey droppings while handling the combs
- Cleaning all equipment and tools after honey harvest
- Placing sugar syrup carefully inside the hive and always feeding the colonies at evening time.

Major bee diseases, parasites and predators

Better understanding bee diseases, parasites, and their control is important to manage beekeeping operations successfully. Selection of bee colonies to prevent the occurrence of bee disease is also vital. According to recent reports, in Badakhshan alone, more than 4000 colonies of *Apis mellifera* died from the attack of parasitic mites. Importing infested colonies and selecting the wrong types of colonies and weak colonies are seen as the root causes for such a phenomenon.

European foul brood is a common contagious bacterial disease which usually infects up to three-day old larvae in weak colonies. Its symptoms include scattered or irregular pattern of the brood, dead yellow and pale larvae that later turn dark brown and emit an acidic, sour smell. Dead larvae are found attached to the side of the cell and the worker bees are seen removing dead larvae from the hive.

This disease can be prevented and controlled by:

- Keeping the colony strong and healthy, feeding the colony with sugar during the dearth period, and keeping it warm in winter
- Removing the comb in which more than 50% of the brood is infected
- Caging the queen for 48 hours to break the brood cycle, and replacing the queen
- In extreme cases, feed the bees with Oxytetracycline or Teramycine at intervals of 3 – 4 days at least three times.

Thai sac brood viral disease is a highly contagious brood disease that first infects weak colonies and later spreads to the whole apiary. This disease normally occurs before spring. Symptoms include change in the colour of larvae from pearly white to grey, and finally black; death of the infested larva during pupation period, therefore the worker bees do not completely cap the cell, leaving small, poor, and infected larvae appearing like a sac filled with water, with their abdomen facing the opening of the cell.

Prevention and control measures include:

- Maintaining strong colonies
- Keeping colonies warm during winter
- Feeding sugar syrup immediately after the first symptoms are seen
- Removing the infested combs
- Caging the queen for 5-7 days to break the brood cycle
- Replacing the queen of the infested colony with a new queen, and
- Encouraging artificial absconding by putting the queen and worker bees in a new hive

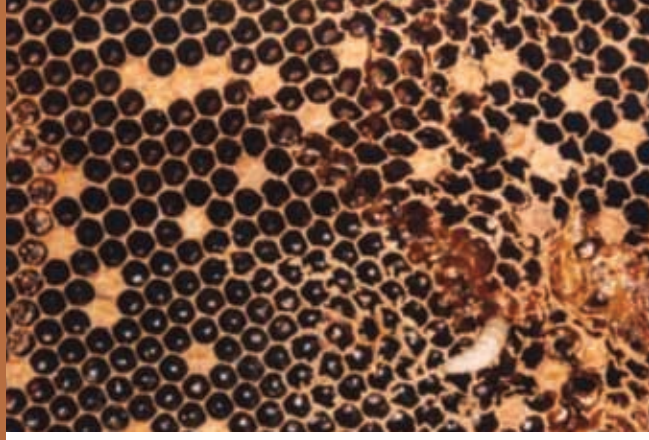
Acarine is caused by a tracheal mite called *Acarapis woodi*, which breeds in the trachea or breathing tubes of adult bees and infects the tubes. The mite derives its nourishment from the bee's blood, blocks the respiratory channels, and ultimately causes death to adult bees. The disease normally occurs in the winter and after the monsoon season. *Acarapis woodi* is invisible to the naked eye. Disease symptoms include inability of adult bees to fly due to imbalanced wings; a number of adult bees can also be seen crawling to the hive entrance and on the ground; adult bees make unsuccessful attempts to fly but fall on the ground after a small flight. Folbex strip, Perizin and Frow mixture can control this mite.

Varroa mites attack *Apis mellifera* and are capable of spreading and destroying entire colonies. Quarantine, efficient management, and selective use of Formic acid for treatment are the most important options for controlling the spread of these mites. In *Apis cerana* colonies this parasite is not a major threat as these bee species are resistant to this mite.

Two types of wax moth attack bee colonies: the greater wax moth and lesser wax moth. Wax moth larvae feed on wax combs and make tunnels and cover the combs with a web-like structure. They normally attack weaker colonies. To control this, it is important to keep colonies strong, hive entrance small, and repair hives and close holes and cracks. Besides these pests and diseases honeybees are

Bee products – honey, wax, pollen, royal jelly, propolis and bee venom

In Afghanistan, 100 metric tons of honey is produced from 100, 000 colonies of *Apis mellifera* annually. Another 20 metric tons of honey comes from 50, 000 colonies of *Apis cerana* every year. Except for small quantities of wax, other bee products are not being produced by Afghan beekeepers. The ecology of Afghanistan can support more than 500,000 colonies, raising the possibility of honey production to the level of 10,000 metric tons and providing jobs directly to more than 5000 people and indirectly contributing to the job market. A market focused cooperative model can be mobilised with the help of local Shura, communities and fruit growers associations to maximize Afghanistan's beekeeping potentials.



Damaged caused by wax moths to bee colonies

also predated by wasps, hornets, birds, and ants.

Queen Rearing

The productivity of a colony depends upon the quality of the queen bee. The queen bee produces pheromones, which help maintain cohesion in the colony. The queen also plays an important role in transferring the genetic characteristics of her colony.

Queen rearing is an artificial way of raising queens. The queen lays fertilised eggs in smaller worker cells and unfertilised eggs in larger drone cells. Fertilised eggs are capable of developing into a worker or a queen, depending on the types of cell it is developing into and the type of food it ingests. An egg laid in a worker cell can be moved into a queen cell and can develop into a queen and vice versa. The quantity and quality of food given to a developing larva determines whether it will rear a worker or a queen bee. By merely changing the queen in a colony, one can strengthen and change the characteristics of the colony.

Observing queen cups of *apis cerana* during queen rearing

Pollination, Productivity and Conservation

Pollination is the transfer of pollen grains from the anther to the stigma of the same flower, or another flower of the same plant, or another plant of the same species. An agent that helps in the transfer of pollen is a pollinator. Pollination leads to fertilisation, which results in the formation of seeds and fruits. In other words, the gene flow system in nature is directly dependent upon bees and other pollinators. By maintaining ample numbers of pollinators for perfecting fruit and seed set in entomophilous crops (crops pollinated by insects), quality and quantity of produce increases from 10% to 50%, depending upon the crop and ecological setting of the area. According to another estimate an investment of one US dollar in honeybees yields US$14, making beekeeping and managed pollination one of the most lucrative businesses in agriculture husbandry. Globally, the annual contribution of pollinators to agricultural crops is estimated at about US$ 54 billion. Some estimates show that the value of honeybee pollination to crop production in the US is US$ 14.6 billion. In the case of Afghanistan, where horticulture is a major source of income of poor farmers, and where rangelands provide necessary food and fodder to livestock, honeybees and other pollinators play an important role in providing essential pollination services. From the agricultural and economic standpoint the benefits of beekeeping are spreading to the poorest of the poor through increase in the productivity and quality of produce, besides benefits from honey and other bee products.

For Further Reading

Visit the ICIMOD website (www.bees4livelihood.icimod.org) and www.beekeeping.com
The hive and the honeybee (A DADANT publication)
All ICIMOD publications on indigenous bees and pollination.

To initiate a beekeeping business seek help from the Apiculture Resource Centre, Ministry of Agriculture and Livestock, Kabul, Afghanistan

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