

CHALLENGES AND OPPORTUNITIES IN BEEKEEPING AND HONEY PRODUCTION DURING COVID-19 PANDEMIC – A SHORT REVIEW

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Submitted final draft: 28 February 2023 Accepted: 25 March 2023

<http://doi.org/10.46754/jssm.2023.05.015>

Abstract: Honey bees in beekeeping are commonly involved in honey production and as planned pollinators worldwide. However, at the beginning of the COVID-19 pandemic, the hardworking little creatures suffered many difficulties. The entire supply chain was blocked. Consequently, the challenges directly affected honey and crop production worldwide. The pandemic issues like travel restrictions and limited access to apiaries had a detrimental influence on beekeepers' activity. Earlier sales decline during the crisis had an economic impact, with some beneficial impacts, like a rise in demand for health-related goods. However, the challenges come with opportunities, which lead to a pointy surge in demand for honey which paved the way for many women entrepreneurs as beekeepers to meet the local demands, which helps the rural economy to be sustained. Another intriguing benefit is that a drastic drop in pollution helped bees get back to their normal routine, which led to a drastic increase in honey production during the pandemic as opposed to what they experienced in normal times. This article briefly outlines such challenges faced by the beekeepers and the honey producers and also focuses on the new opportunities that rendered many values to the producers during the pandemic.

Keywords: Beekeeping, global honey market, pollination service, food security, women beekeepers.

Introduction

Beekeeping is the science of rearing and managing honey bees for commercial purposes. Humans are cherished with valuable hive products like honey, beeswax, propolis, and bee venom through beekeeping. It is often misunderstood that honey production and bee by-products are the only business of beekeeping (Das & Bhuiya, 2020). Beekeeping offers another business related to the agriculture sector through pollination services, which contributes as one of the solutions in food security towards zero hunger (Sustainable Development Goal, SDG 2 by UNESCO). For instance, beekeepers in and around the USA started supplying pollination services commercially, particularly by the end of World War I. The pollination services were not merchandised before the war since small farms had adequate flowering plants and trees to attract wild insects. This beekeeping

activity is one of the most important factors at the economic level of the developed agricultural structure (Pilati & Prestamburgo, 2016).

There are two ways to perform beekeeping: stationary and migratory. Stationary beekeeping is performed in one location throughout the year without moving the hives to other areas. On the other hand, migratory beekeeping involves transporting bee colonies to different areas with more favorable pollen and nectar resources, resulting in higher productivity (Al-Ghamdi *et al.*, 2017). Since crops do not flower simultaneously, it is necessary for beekeepers to constantly move bee colonies from one forage site to another to meet the demand for pollination from growers (Couvillon *et al.*, 2015).

Pollination services rendered regularly at the economic level have elevated migratory beekeeping, moving bee colonies from one location to another, which is thought to be a

replacement sort of management field (Simone-Finstrom *et al.*, 2016; Altunel & Olmez, 2019). Works of literature narrate the tracks followed by migratory beekeepers in the USA, who conduct many hives *via* a tractor-trailer. Because honey bees are important agricultural pollinators, producers and farmers get more money. They create the lucrative and sought-after commodity of honey. Bees create additional goods including beeswax, royal jelly, and propolis that can be marketed for revenue. Through ecotourism, when visitors visit bee farms and learn about the bees and their products, beekeeping may also be a source of revenue (Khalifa *et al.*, 2021). However, the commercialisation of pollination services is not a good substitute for honey production, as many crops allow dual outputs to churn out simultaneously. Moreover, the bee colonies can drive them out in series during the yearly migration. Therefore, honey production and pollination services may be commercially complementary in the structure of migratory beekeeping.

Empirical studies show that commercial pollination is mostly done in spring, whereas honey production is performed in summer. Apart from beehive products, they perform the major ecological role as pollinators and additional yield obtained due to bee pollination alone is 15 - 20 times more valuable than the other hive products altogether. By keeping bees in the field, crop yield can increase to 20 – 80% in most cultivated crops through cross-pollination (Das & Bhuiya, 2020). Depending on the crop, the region, and the presence of other pollinators, honey bees pollinate between 15 and 30% of the world's food crops. However, the precise amount fluctuates. In certain areas, honey bees may be the predominant or the sole pollinator, whilst in others, they may have a lower function and be supplemented by other pollinators such as wild bees, butterflies, moths, and beetles. Because it is impacted by weather, habitat loss, and pesticide usage, the contribution of honey bees to crop pollination can change from year to year and place to place. Hence, in addition to the four basic inputs, viz., seed, fertiliser/pesticide, water, and machinery, nowadays

honey bees are considered the fifth input for agriculture production which can also regulate the efficiency of other inputs. Beekeeping has been practised with two types of honeybees that can be domesticated, namely, native one, *Apis cerana* or Asiatic or oriental honeybee, and introduced one, *A. mellifera* or European honeybee, and the rests of the bee species are wild, therefore untameable. The introduction of stingless beekeeping in the tropical region, e.g., Malaysia, may provide more benefits in beekeeping (Ismail, 2016).

Honey production is a valued commodity with significant market demand. Beekeeping may give farmers a reliable income, lessening their reliance on volatile crop harvests and enhancing their standard of living. It is an inexpensive, low-maintenance, agriculture-based enterprise that may significantly improve income and food security in sparsely populated agricultural areas.

Since 2006, there has been a steady decline in the bee population because of a lack of economic sustainability, habitat loss, climate change, and colony collapse disorder (Covaci, 2020). Since the bee's existence has a huge impact and influence on human food production, its future is crucial. The whole human existence and our global ecosystem will be in question constantly if the threat against this small but mighty creature continues in addition to the current pandemic related to COVID-19 infection. To observe the effects of COVID-19 pandemic on beekeeping, this short review was conducted to understand the challenges and might be opportunities related to beekeeping, especially in honey production.

Global Honey Production

One of the most well-known bee products, honey was evaluated as worth \$ 9.21 billion in 2020, and it is predicted to expand at an annual pace of 8.2% in the global market. The rising demand for highly nutritious foods such as honey is the market expansion. Honey is high in calcium, minerals, vitamins, and antioxidants, making it a wonderful nutrition

source. It also offers several medical benefits, including the ability to control blood pressure, improve metabolism, lower diabetes risk, and heal wounds (Ullah *et al.*, 2021). Thus, honey has a wide range of applications in food and beverages, pharmaceuticals, and cosmetics, thus augmenting market growth.

Owing to the COVID-19 pandemic, there is a decline in global trade in both volume and value. However, few products hold back their trade volume and value as they are sold out in their natural state, e.g., honey, since they do not offer any negative impact on human health that any processed foods do (Covaci, 2020). Annual production from these beehives is about 1.85 million tons. A quarter of all honey produced around the world is traded. India has the most beehives (12.2 million hives), but China has 9 million hives and is the world’s leading honey producer, producing roughly 466,000 tonnes of honey annually (Figure 1). Turkey comes in second with 144,000 tonnes with 8 million hives, followed by Argentina with 80,000 tonnes with two million hives. The world average honey production was estimated as 22 kg/hive. Honey production in different countries was compared to the world’s average production and listed below (Table 1) (Bixby *et al.*, 2020).

Turkey is ranked 12th in the world for honey production, and while having a large hive population (number third in the world),

Table 1: List the amount of honey produced per hive in different countries (Bixby *et al.*, 2020)

Countries	Quantity of Honey Production
Canada	56 kg/hive
China	52 kg/hive
Mexico	39 kg/hive
Argentina	27 kg/hive
USA	26 kg/hive
Turkey	15 kg/hive

The table represents the statistics of honey produced per hive in different countries worldwide.

production per hive is poor due to low honey production efficiency. A similar observation in honey production in India. Despite having the most hives globally, India ranks the lowest in honey output per hive, producing about four kg per hive.

These variations in the amount of honey produced in each country depending on one of the important factors of honey production: The type of honey bees used for production. Each country uses different species of honey bees for pollination and production, such as *A. mellifera* (European Honey Bee), which has been broadly used in Europe, Australia, North America, and other parts of the world, *A. mellifera ligustica*

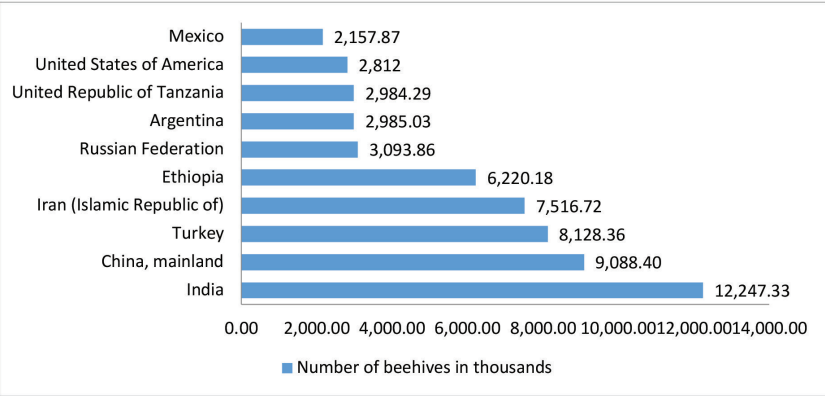


Figure 1: Number of beehives in leading countries worldwide in 2019 (in 1,000 units) (Shahbandeh, 2021a). The chart explains the number of beehives maintained in each country for the production of honey and other bee products, showing that India has the highest number of beehives worldwide

(Italian Honey Bee), mostly used in Italy, South America, and Spain, *A. mellifera caucasica* (Caucasian Honey Bee), commonly prevalent in the Caucasus region and used in Russia and other Eastern European countries, *A. mellifera carnica* (Carniolan Honey Bee) commonly used in Germany, Austria, and other central European countries, *A. mellifera breviceps* (Russian Honey Bee) used in colder regions, like Russia, and is reputed for being more resistant to disease and pests, *A. cerana indica* (Indian Honey Bee) in India and most parts of South East Asia like Myanmar, Thailand and Vietnam which produces less quantity of honey significantly compared to other species of *A. mellifera* and Chinese Honey Bee species., *A. cerana cerana* and *A. cerana fabricius* Chinese Honey Bees being the largest honey producers in mainland China, Korea, Afghanistan and Ussuria (Chantawannakul, 2022). All 12 nations that export 80% of the world's honey and bee products have separate rules and principles, making international production impossible. For example, the most significant thing about European countries is GMO-free honey (Graef

et al., 2012; Gezu, 2014). Meanwhile, North Americans prefer pasteurised, filtered, and liquid honey.

Moreover, crystallised honey is considered fake by people in the Middle East. Emphasising BRICS (Brazil, Russian Federation, India, China, and South Africa) and the EU28 (European Union 28) contributions to global market competitiveness, more than half of the world's honey production is produced in the countries listed, making them major players in the global market. Some are developing nations gaining a stronger foothold in the global trade system. Natural honey's market value does not decrease during the current pandemic crisis (Covaci, 2020). China is the major producer of honey. Countries like Turkey, Argentina, Ukraine, the Russian Federation, the USA, and India have considerable honey production, whereas countries like Spain and Canada have very few (Figure 2) (Shahbandeh, 2021b). The country's climatic conditions play a vital role in the production and supply of honey. So, some regions like Europe, Asia, and northern South America hold the majority of production. Still,

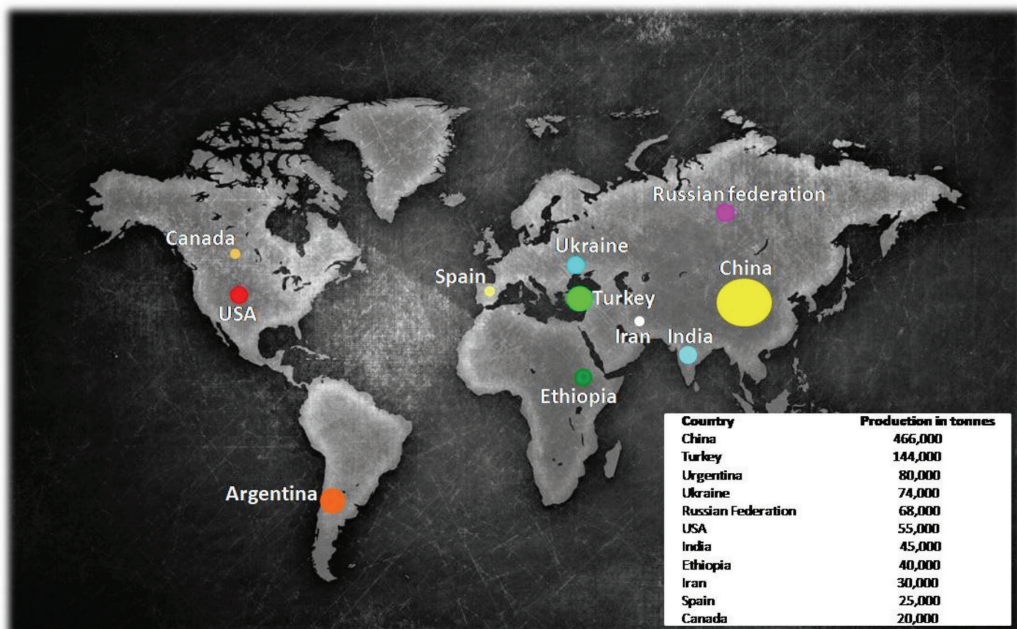


Figure 2: Major producers of honey worldwide (Shahbandeh, 2021b). The map shows the honey producers in the world with the quantity of honey produced (in tonnes) in each country

in the past few decades, China has become the potentate in exporting honey to North America and Europe (Pippinato *et al.*, 2020).

In terms of the world’s leading company (Table 2), the global honey market is highly fragmented because it is largely dependent on environmental conditions, with even little changes in the climate having a significant impact on production. They use strategies to develop their business, including releasing new organic goods, collaborating with beekeepers, and mergers and acquisitions. Hilltop Honey Ltd., situated in the United Kingdom, debuted a unique and rich variety of kinds of honey, including Organic Fairtrade Honey and Raw Honey, at the national Farm Shop and Deli Show in April 2019 (Market analysis report, 2021). Table 2 lists the top honey-producing companies in various parts of the world.

Challenges and Opportunities in Beekeeping during Pandemic

The lockdown during the pandemic dispensed peculiar problems to the bees and the beekeepers. The extended curfews in many countries moved unnecessary vehicles to a standstill. In developing countries like India, the restrictions made it difficult for farmers to manoeuvre a huge number of beehive boxes from one location to the other, making the bees starve to death (Meyer *et al.*, 2021).

The farmers, especially in northern India, go across states with their bee boxes during the summer, from February to July, to feed the bees known as *A. cerana indica* on seasonal flowers of litchi and mango trees. Honey bees prey on flower honey for nourishment and nutrition, which they store in their hives that the farmers sell. Honey bees collect nectar and help pollinate the litchi and mango trees, thereby expanding the assemblage of these cash fruit crops (Shuma, 2020; Sirali, 2002). Apart from litchi and mango trees, other host trees such as lavender, clove, rosemary, and eucalyptus are used as nectar sources for the honey bees. The colour, flavour, and aroma of the resulting honey can be influenced by the host type which is used as the nectar source (Tangtorwongsakul *et al.*,2017).

At the onset of the global outbreak in early March 2020, the supply chain management faced huge problems surviving with an unexpected demand for certain logistics of the beehive. Beekeepers are inaccessible for certain products from the beehive and some types of equipment. This brings about to loss of colonies of new-age news for the beekeepers (Meyer *et al.*, 2021). Pollinator services are threatened by bee and beehive transit limitations, undermining food production. This is certainly relevant in major food-exporting countries like the USA and China, where beekeepers import bees from

Table 2: List of top companies in honey production in the world (Market analysis report, 2021)

Leading Companies	Countries of Origin
Lamex Food Group Ltd.	England
Nuxten Health Ltd.	New Zealand
Barkman Honey LLC	United States
Groeb Farms Inc.	United States
Dutch Gold Honey	United States
Beeyond The Hive	United States
Rowse Honey Ltd.	England
Zhejiang Jiangshan Bee Enterprise Co. Ltd.	China
Bee Maid Honey Ltd.	Canada
Dabur India Ltd.	India
Caprilush International	Italy

other countries and move them thousands of kilometres in truck hives to harvest crops owing to a scarcity of local bees (Attia *et al.*, 2022). Beekeepers often import queens and other bees to re-establish their colonies in the spring. Queen bees are imported from Australia and New Zealand by beekeepers in the USA and Canada, whereas queen bees are imported from Italy by beekeepers in the UK. COVID-19 lockdowns, quarantine, and other restrictions obstruct queen importation (World Bank, 2020).

The COVID-19 pandemic crisis has affected nearly 30.3% of beekeepers worldwide (Market analysis report, 2021). As most beekeepers sell their bee products through direct interaction with people such as relatives, friends, markets, and fairs, the lockdowns and curfews made an inhibition for their direct interaction, thereby putting a roadblock to selling their products (Pocol *et al.*, 2021). Many people in urban areas buy honey and other bee products in supermarkets/hypermarkets, accounting for about 60% of the revenue share (Figure 3). The lockdown and closed shops steadily declined the revenue made by this supermarket/hypermarket in urban areas (Market analysis report, 2021).

Discussing the opportunities, in general, shows that beekeeping during a pandemic can generate income in rural areas for marginal group populations who do not own crops or farms. It can also generate income and improve

food security in areas with minimal agricultural production. As the lockdown has made several beekeepers lose their marginal income, some people still declared that there are some positive aspects due to the crisis, as there is an increase in order and demand for high-quality honey, which made them hike prices and made people show more interest in these high-quality products (Mishra & Pattnaik, 2021).

Manitoba beekeepers create and sell nuclear colonies, popularly known as “nucs” which are one of the major honey producers in Canada. These colonies are unavailable until mid-May because of the province’s lengthy, cold winters, and honey producers who rely primarily on them risk losing bee stock. Imported “packaged bees” are usually ready to honey producers by April, giving them a head start on the season. Commercial honey makers are now turning to local beekeepers for stock to replace the gap COVID-19 has made in the supply of imported bees. This paved the way for local beekeepers to make more money than in normal circumstances (Bixby *et al.*, 2020).

In the hands of women, beekeeping offers the potential to reduce cross-border migration while still providing a viable source of income (Mwakatobe *et al.*, 2016). With the support of traditional backyard kitchen gardens, many rural women beekeepers have become entrepreneurs during this pandemic (Mishra & Pattnaik,

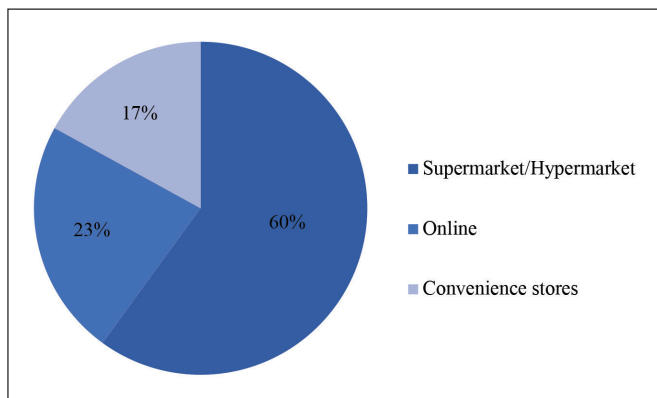


Figure 3: Distribution of global honey market share in terms of revenue (Market analysis report, 2021). The supermarket/hypermarket has the majority share, followed by the online share, and then the convenience store

2021). They are typically carried out in bee-safe areas, most frequently at the farmhouse. These methods offer several advantages, including ease of building and the lack of the requirement for specialist beekeeping equipment. This also aids in the long-term viability of the rural economy.

The research found that about 30.5% of women are involved in all beekeeping activities from hive making, hive sitting, harvesting, processing, and selling bee products. This might be because beekeeping activities are mainly done at homes effective in lockdowns (Dayya *et al.*, 2016). Income generated from beekeeping can be used as capital for beekeeping investment and other income-generating activities, including small business, tailoring, agriculture, and livestock keeping. There are many opportunities for women and marginal workers to become involved in beekeeping activities.

Beekeeping is part of the “green economy”, which is more visible during the COVID-19 pandemic. The green economy incorporates beekeeping and is vital to any economy’s long-term sustainability. It enhances economic activity and growth in various sectors and services, the integration of which necessitates investment. Funding is also required to ensure innovation and the development of high-value-added bee products and access to worldwide and regional markets (Lyubenov *et al.*, 2021). An Rs.500 crore budget was designated for infrastructure development in India to maintain the beekeeping chain of production, collection, storage, exporting, and marketing to secure income and livelihoods (Kumar *et al.*, 2021). Women entrepreneurs in beekeeping should use this designated funding for beekeeping development and enhance their business and production.

Challenges and Opportunities in Honey Production during Pandemic

Depending on huge bee pollination, global food production is predicted to be affected by pandemic lockdowns in several countries, as the yields of certain fruits, seeds, and nut crops are likely to decline by 90% without bees. It

has been reported that Canadian farmers are struggling to promote their beehive shipment from abroad (Bixby *et al.*, 2020). In China, COVID-19 has made honey production harder for China’s 250,000 beekeepers, who generate about a fifth of the world’s supply (Bixby *et al.*, 2020). Many of them are nomadic, travelling nationwide on vehicles for pollen and nectar. Restrictions put in place to stop the pandemic made this impossible for several days. This leads to the truncated honey supply, thereby hiking honey prices and other bee products in poor and developing countries like Asia and Africa making it inaccessible to low-income people. The lockdowns also hinder the evaluation of the damage by researchers, who cannot reach the affected areas.

COVID-19 may have disrupted businesses, but it led to a pointy surge in honey demand, paving the way for some exciting opportunities for the producers. However, a substantial number of beekeepers claimed that the crisis had some positive elements, that they had seen an increase in orders and a desire for higher-quality honey, and that some had even been able to raise prices due to the crisis (Pocol *et al.*, 2021). One of the main reasons is people clamouring for immunity boosters, which has made honey in demand and indirectly augurs well for apiculturists.

In India, the lockdown periods significantly raised the air quality and purity, thereby increasing the floral abundance in the surroundings and maintaining a peaceful environment which made the bees busy filling the hives with more honey during a pace. The honey collected in each bee box reached just about 40 kg each box during the lockdown, which usually reaches a standard of 10 to 20 kg. Furthermore, not only in India, during the lockdown, air quality improved, with lower pollution: In New York and China, air pollution and emissions declined by 50 and 25%, respectively in Europe, nitrogen oxides emissions decreased over the UK, Spain, and Italy (Ficetola & Rubolini, 2020). Some other advantages might include a bright sky, wild animals roaming the streets, pure water, and reduced pollution, particularly in urban areas.

Honey bees affect from fewer circulating vehicles in a variety of ways. Automobiles are estimated to kill 24 billion bees annually in North America (Baxter-Gilbert *et al.*, 2015). Because air pollution reduces the longevity of floral scents, the lockdown may boost bee foraging activity by inhibiting automobile emissions (Fuentes *et al.*, 2016). The pandemic period improved the bees' health leading to an increase in their colonies. There is a spike in bee colonies without any extra feeding or drug usage. At the sting of global widespread, honey bees set off as a lifeline, owing to a rise in courtesy of pollination and the kitchen gardens' food production (Jha *et al.*, 2020).

The pandemic has brought to light the significance of public health and healthcare systems, science and technology, globalisation, resilience and adaptation, community and human connection, and the necessity for social support in times of crisis. Additionally, it has emphasised how interwoven our world is and how crucial international collaboration is in addressing risks to the health of the entire planet. The need for flexibility and adaptation in times of uncertainty and change.

Conclusion

Beekeeping through honey production, pollination and related activities can bring about considerable income for people in rural areas who do not own farms or fields. It can also produce income and elevate food security in areas with minimal agricultural production. The pandemic developed more women beekeepers worldwide, which helps in women's empowerment. The best way to improve beekeeping is to adopt beekeeping in rural agricultural practices. Each land-holding farmer should incorporate beekeeping as a normal agricultural lifestyle practice, which helps him enjoy double the crop yield. Women and marginal group beekeepers should be provided with training on processing secondary bee products. Moreover, the global honey market will be enhanced with honey selection as one of the healthy food products regardless of any pandemics in the future.

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