HIVE MANAGEMENT AND BEEKEEPING

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CHAPTER 1
BRIEF INTRODUCTION OF HIVE MANAGEMENT AND BEEKEEPING

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ABSTRACT:

Beekeeping and hive management are age-old traditions that have recently attracted fresh interest because of their vital contribution to the preservation of biodiversity, pollination services, and honey production. This succinct introduction gives a quick overview of these related fields while highlighting the significance of bees and their hives to our ecology.Beginning with an explanation of the importance of bees as pollinators and a focus on their critical position in the world food system. The fundamental elements of hive management are then covered, including hive types, tools, and bee behavior. To guarantee the health of bee colonies, the significance of thorough hive inspection, upkeep, and disease treatment is emphasised.

KEYWORDS:

Beehives, Beekeeping Equipment, Colony Collapse Disorder, Hive Inspection, Honey Extraction.

INTRODUCTION

Beekeeping is concerned with the practical management of social bee species, often within farming systems, and significantly contributes to food and nutrition security, poverty alleviation and economic growth. An innovative, sustainable, integrative approach that considers all steps of the beekeeping value chain, from ensuring a sustainable floral resource base and breeding bees, to harvesting hive products and enhancing bee services (mainly pollination services), is critical to sustainable beekeeping enterprise development. The main pillars to consider for sustainable beekeeping are the environment, genetics, practices, and education and extension services. Environment: The external environment, including environmental parameters and biodiversity, constitute the "external" factors that may influence aspects such as foraging activity, availability of flowering plants, physical stressors and ultimately, the products and the services provided by bees[1], [2].

These external factors include the natural environment (climate conditions). The quality and quantity of nectar and pollen sources and the diversity of the plants available to bees are fundamental to the success of beekeeping systems and are, in some cases, able to be influenced and managed by human interventions. Genetics: Bee genetics are a critical factor for production, health, and sustainability of beekeeping systems. Other than choosing local bees that can cope with the natural and managed environment, certain characteristics can be improved by breeding activities. For this reason, the conservation of indigenous bee species and local genetic diversity is important to the long-term viability of bee species and beekeeping enterprises. Locally adapted stock may also be better suited to specific environmental pressures and so more productive and sustainable in these environmental systems than introduced bee species or genotypes. In most cases, autochthonous bees should be favoured over allochthonous species. Practices: These include all the beekeeping activities carried out to manage bees for a particular outcome (such as honey production, conservation or pollination services), including appropriate housing, the application of technologies and innovations, good beekeeping practices (GBPs) and biosecurity measures in beekeeping (BMBs)[3], [4].

Used in combination, these practices are fundamental to resilient and productive beekeeping systems. GBPs are all those general activities that beekeepers apply in on-apiary production for optimal health of humans, bees and the environment. They are the basis for application of the BMBs, which include all those operational activities implemented by beekeepers to reduce the risk of introduction and spread of specific bee disease agents. Education and extension: These services are fundamental to improving beekeepers' skills on sustainability, helping them to acquire appropriate knowledge and technical skills on GBPs.

Effective and ongoing training activities and extension are important to uptake and success in beekeeping systems and can also provide opportunities for beekeepers to build partnerships with researchers, extension units and other relevant authorities to strengthen the honey value chain and collectively answer the sector's new challenges. In conclusion, an impactful approach to beekeeping should consider all these pillars to ensure the development of a sustainable, resilient and competitive apicultural sector which will allow beekeepers to improve the productivity, profitability and sustainability of their enterprises. In this way, the beekeeping sector can become more resilient to shock, seasonality, and stressors, provide income-generating opportunities without exacerbating environmental degradation, enhance crop production, and become more efficient in providing profitable bee products and services[5], [6].

DISCUSSION

Bees are a critical component of ecosystems. They significantly contribute to the preservation of biodiversity, the survival of many plants, the regeneration of forests, sustainability, and climate change adaption, as well as the expansion and improvement of agricultural production systems. In reality, pollinators are essential to the continued growth, quantity, and quality of almost 75% of the world's crops that produce fruits and seeds for human use. Apiculture, another name for beekeeping, is the practice of managing social bee species in a practical way. Honey-hunting, which entails "plundering wild nests of honeybees to obtain crops of honey and beeswax," is distinct from beekeeping. We've known for thousands of years that encouraging bees to build their nests inside of artificial hives makes it simpler and more easy to harvest honey. It is also feasible to govern the colony to some level, depending on the kind of hive and the species and subspecies of bees[7], [8].

Beekeeping is a common hobby that thousands of small-scale beekeepers rely on for their living in many rural regions of the globe. In addition to performing other significant economic, cultural, and social functions, social bees may provide humans valuable hive goods and services. Around the globe, beekeepers maintain a variety of bee species: Western honeybees are common in Europe, North America, and West Asia; native Eastern or Asiatic honeybees are kept in East and South Asia. Other social bee species, such stingless bees, are raised in the tropics primarily for the purpose of producing honey. In the meanwhile, bumblebees are retained as pollinators all throughout the globe. In certain places, there are other species retained. By offering helpful details and recommendations for responsible bee management globally, which can subsequently be applied to project creation and execution, these guidelines seek to make beekeeping more sustainable.

Apiculture, often known as beekeeping, is the practical management of social species of bees for agricultural and food production. These recommendations are centered on managing various social species of bees across the globe. Many rural communities and small farms might rely on apiculture as a source of revenue or a means of subsistence. A more sustainable and considerate agricultural method is becoming increasingly prevalent in modern apiculture. However, in order to maximize the natural systems and resources that beekeepers depend on, sustainable apiculture need adequate knowledge (and training) on bee management. Modern advancements and technology may also significantly improve beekeeping operations. The health of the ecosystem depends on bees.

The most significant agro-environmental service is provided by their pollination activity, which promotes biodiversity. In actuality, it's estimated that the value of bee pollination is 30–50 times more than the value of colony products like wax and honey. Indeed, for sustained production, yield, and quality, nearly 75% of the world's crops that produce fruits and seeds for human consumption rely, at least in part, on pollinators, with an estimated 10% of the total economic value of agricultural output for human food dependent on insect pollination. Unfortunately, external pressures often obstruct bee services and output. These include changes in land use, disease and pests, indiscriminate chemical usage (such as pesticides and veterinary medications), climate change, the growth of monocultures, globalization (which denotes the entrance of exotic species of diseases), and subpar management techniques[9], [10].

All of these stresses have a negative impact on bee health as well as the quality and quantity of bee goods and services they provide, which lowers beekeepers' revenue and the beneficial impact bees have on the environment. When deciding to start a new beekeeping activity or improve an already existing beekeeping activity to make it more effective and sustainable, policymakers, governmental organizations, and all those implementing development projects in beekeeping should be aware of the challenges, the benefits for the environment, and proper practices. For project design teams, national program managers, and politicians looking to increase beekeeping's sustainability globally, but particularly in rural regions, this booklet provides as a complete reference to beekeeping.

In order to minimize rural poverty, strengthen small-scale beekeepers' resilience, get high-quality goods, and preserve environmental biodiversity and agricultural yields through pollination, sustainable beekeeping is beneficial. In other words, sustainable beekeeping will aid in achieving the Sustainable Development Goals (SDGs) of the United Nations. A sustainable strategy is outlined in detail, along with the correct steps beekeepers should take to acquire high-quality and plentiful bee products (living bees, honey, pollen, wax, propolis, royal jelly, etc.). Of course, different bee species (Apismellifera spp., Apiscerana spp., Melipona spp. or stingless bees, and Bombus spp. or bumblebees), geographical regions, and beekeeping styles (the most pertinent technical specifications are provided for beehives and feeding) result in different beekeeping practices.

How to apply these rules

The guidelines, which take a One Health approach, provide details on the connections between beekeeping and sustainable development, the geographic distribution of social bees, best practices to be used in bee breeding and production lines, and methods to advance and support the industry. Additionally, they give an overview of the developments in beekeeping and the services offered by honeybees, including new tools and strategies for obtaining high-quality products while protecting consumer health. This section discusses how to use the recommendations if you want to create a plan or initiative to aid beekeeping, particularly small- and medium-scale beekeepers. Before you start a project or establish a plan to assist small- and medium-scale beekeepers, you should:

1. Examine the surroundings. You must both name and describe.
2. Assess the hive goods and services acquired in your situation to find areas for improvement. We advise doing market research or beekeeper and customer surveys to accomplish this.

These bees produce honey, pollen, and propolis, and they may be found in most tropical or subtropical areas of the planet. Stingless bee products are prized for their special medicinal characteristics despite having substantially lower output than Apismellifera. Additionally, their pollination function, potential for money generation, and cultural significance are promoting their sustainable usage and growth, particularly in indigenous mid-low income nations. It is crucial to recognize that indigenous peoples typically keep stingless bees as a project planner or implementer. Therefore, any planned activity should be accompanied by respect for, consideration of, and integration of indigenous knowledge and customs, along with the development of fair trade conditions.

Threats, equipment, quality requirements, species employed, and sustainable bee raising techniques are all covered. The most significant advantage of bees is pollination, which is necessary for around 75% of the world's most important crops. Some species of the Bombus genus are raised and used for this purpose economically. They serve as a tangible illustration of the enormous economic importance of those insects, which is sometimes overlooked. The section discusses the methods and tools used for greenhouse pollination and sustainable breeding. The need for pollinators is growing, particularly in greenhouses, and this presents breeders with new options. Bumblebee breeding and utilization for sustainable agricultural ecosystem development.

By giving rural residents a reliable income, beekeeping is considered as a sustainable and low-investment way to reduce poverty. Beekeeping's accessibility and adaptability reduce the bar so that smallholder farmers may start their own apiaries everywhere. Beyond generating cash, the beekeeping industry is essential for rural development since bees help with pollination. Consumers should have access to information about the hive products' quality, whether they respect bees' natural behavior, and if they come from GBPs and pollution-free habitats. Modern traceability systems enable the location of items in the feed and food supply chain as well as the capacity to track their history. Cutting-edge technologies for enhancing traceability, like as blockchain technology and rapid response (QR) codes, strengthen customer confidence in the goods they purchase. By giving details about their manufacturing process and the country of origin, quality, and integrity of their goods, traceability helps smallholder beekeepers to sell their own honey. The chapter discusses the "education and extension" and "practices" aspects of sustainable production.

CONCLUSION

The quick overview of beekeeping and hive management underlines the significance of these techniques for agriculture, biodiversity preservation, and honey production. Beekeeping is essential for pollinating crops, guaranteeing food security, and preserving ecological equilibrium. It also produces important goods like honey, beeswax, and pollen.Understanding bee behavior, preserving hive health, and using sustainable beekeeping methods are all necessary for effective hive management. To preserve the health of bee colonies, constant study, observation, and devotion are necessary.As we dig further into the world of beekeeping, we learn about its complex science and art, which presents many chances for people and communities to improve the environment while taking pleasure in the delicious benefits of honey production. The path into hive management offers a closer connection to nature and the fascinating world of bees, whether you're a novice or an experienced beekeeper.

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CHAPTER 2
DEVELOPMENT OF BEEKEEPING: INCORPORATING KNOWLEDGE

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ABSTRACT:

Over time, beekeeping has developed greatly, embracing a multitude of new ideas and information. This abstract examines how beekeeping methods have changed, with special emphasis on how science, technology, and sustainable management approaches have been included.Due to increased awareness of the importance of bees in pollination, the preservation of biodiversity, and the production of honey, beekeeping has evolved from traditional practices to a complex enterprise. In order to maintain the wellbeing and production of their colonies, beekeepers have modified their procedures as understanding about bee behavior, hive management, and disease prevention has grown.The creation of more robust bee breeds, better hive designs, and enhanced disease control techniques have all been made possible by using information from disciplines like entomology, genetics, and environmental science. Aside from that, technical advancements like genetic analysis tools and hive monitoring systems have given beekeepers the capacity to make well-informed judgments and take a proactive approach to problems.Modern beekeeping has a strong focus on sustainability, with particular attention paid to organic methods, habitat restoration, and responsible hive management. The public is actively being educated about the significance of bees and their protection by beekeepers.

KEYWORDS:

Bee Products, Beekeeping Equipment, Hive Management, Pollination Services, Sustainable Beekeeping.

INTRODUCTION

A remarkable journey in the growth of beekeeping has been the integration of information from diverse disciplines. Apiculture, another name for beekeeping, has developed throughout the years thanks to discoveries in biology, environmental science, and agriculture. This advancement has not only made beekeeping a sustainable and profitable activity, but it has also highlighted its crucial position in our environment.The domestication of honeybees, a practice that has been practiced for thousands of years, was one of the early developments in beekeeping. Ancient civilizations like the Egyptians and Greeks understood the importance of bees for pollination and honey production. As their understanding of bee behavior and hive management increased, beekeepers started to create more efficient methods for honey extraction and colony upkeep. These early understandings served as the basis for contemporary beekeeping techniques[1], [2].

Insights from biology and entomology have been crucial in the development of beekeeping. Honeybee biology and behavior are better managed, illnesses are prevented, and bee health is improved because to beekeepers' understanding of honeybee biology. For instance, honey production was improved by directing beekeepers to the best foraging locations thanks to the discovery of the bee dance language, which communicates the location of nectar supplies.The importance of bees in pollinating crops and preserving biodiversity has been underlined by the integration of environmental science and ecology into beekeeping. Since wild bee numbers are declining as a result of habitat loss and pesticide usage, beekeepers now play a bigger part in providing pollination services for agriculture. This prompted the creation of beekeeping techniques that put an emphasis on protecting natural habitats and promoting healthy bee populations in addition to honey production[3], [4].

Additionally, beekeeping has recently undergone a revolution because to technological improvements. Beekeepers can carefully monitor hive conditions and take timely action thanks to tools like hive sensors and remote monitoring systems. These advancements have increased hive management effectiveness and helped the field of sustainable beekeeping as a whole.Beekeeping is a dynamic and changing profession as a result of incorporating information from numerous disciplines. Today, beekeeping incorporates a wider commitment to environmental management and the health of bee populations in addition to honey production. Beekeeping will probably continue to change as we gain more knowledge about these amazing creatures and their crucial role in our environment, ensuring that we may continue to profit from honey while protecting the priceless services that bees give to our ecosystem[5], [6].

DISCUSSION

Those who are thinking about a beekeeping development intervention should read this chapter. The bees and their hives are just one aspect of the narrative; every enterprise must assure its long-term viability in terms of the environment, the economy, and society. In order to use apiculture to help people escape persistent poverty, a proper scenario analysis and a solid grasp of markets and trade are essential. Utilize only native kinds or subspecies of bees, and become knowledgeable about their biology and behavior. Honeybees often reside in beekeepers' hives or in tree cavities. The species most often utilized is Apismellifera, which naturally exists in the regions of Europe, the Middle East, and Africa that are north of the Arctic Circle. Since being introduced to the globe, this bee has spread practically everywhere. There are several distinct subspecies with unique traits that allow them to survive in a broad range of climatic conditions, from -20 °C in the winter in Europe to 40 °C in the Middle East. Nevertheless, bees are present everywhere there are blooming plants, and several bee species generate the honey, beeswax, and propolis (covered in subsequent chapters) that support human lifestyles[7], [8].

Many developing countries are located in tropical areas of the globe, and tropical bees vary significantly from bees that have evolved to live in places with temperate weather in terms of biology and behavior. As a result, apicultural methods that are effective in temperate temperatures in industrialized countries may not be suitable for tropical climates and isolated rural locations. Bees can't be confined like other creatures and may forage and reproduce freely in the natural world. Never transfer bees from another location; this is how diseases and parasites that affect honeybees (like Varroa) have recently spread. Because bees marry normally in the wild, introducing bees is pointless because it requires ongoing, yearly beekeeping, which is not sustainable. Additionally, it disrupts native bee populations that have developed to flourish in the region. However, a lot of unneeded and harmful commerce and transportation of bees occurs because individuals may profit by selling bees and praising one kind above another. Contact a reputable organization like Apimondia for unbiased guidance if you are perplexed or uncertain about the information that is readily accessible locally[9], [10].

Beekeeping is a widespread hobby in underdeveloped rural areas of the globe because it is robust, sustainable, and low-risk. However, apiculture and people are not universal, and subsistence beekeeping does not always lead to financial success. Try to determine the actual obstacles that current neighborhood beekeepers are encountering, if any. Recognize that long-term growth takes time, and be ready to spend money on training to ensure that skills are retained over the long haul. A genuinely sustainable beekeeping initiative will capitalize on available local resources, skills, and knowledge while also offering training and follow-up assistance for at least two years.

Making choices on how to give training and provide follow-up assistance will be crucial. For instance, the lead beekeepers and followers approach works effectively for Bees for Development's operations in Ethiopia. The approach of master beekeepers passing on knowledge to novice beekeepers has not proven to be as successful elsewhere as it has in Ghana, where more formal training provided by local, trained beekeepers has. Finding the optimal model for each environment is crucial; this will rely on a number of regional elements, including as cultural norms, the social structure of village life, prevalent beekeeping skills, and transportation capabilities.

Size And Effectiveness

To evaluate the effects of direct costs, selling prices, indirect expenses, and volume, beekeepers require business skills. According to a business study, raising the total annual revenue from an apiary may be accomplished by concentrating on volume rather than the more typical method of focusing on price per kilogram. Beekeepers' business skills should be developed as part of projects.

Technology

A plan for the modernisation of apiculture is also an excellent concept. Many governments establish plans for the modernization of agriculture. In the notion that doing so would inevitably result in more honey, honey of higher quality, and enhanced productivity, there have been several initiatives that mainly aim to modify the sorts of hives that beekeepers are utilizing. Although it is anticipated that evolving technology would reduce poverty, there hasn't been any analysis of the impact these efforts have had. When the anticipated change has not happened, it is all too often attributed on inadequate training, the weather, or another factor, without consideration of whether trying to alter technology is indeed the best course of action. Equipment-focused projects are most lucrative for the companies who manufacture and distribute the equipment, as well as the consultants who instruct others on how to utilize it with bees in their particular global location.

Many African countries (including Ethiopia, Tanzania, and Zambia) export honey and/or beeswax that is of the highest quality and adheres to the tightest standards in the world to the EU and other markets. Every bit of our honey and beeswax is taken from hives built locally, which are the epitome of easy, affordable, sustainable beekeeping. In Africa, frame hives like the Langstroth hive, which the Rev. Langstroth invented in 1852, are sometimes called to as "modern" hives.

They should be known by this moniker, nevertheless, for their inexpensive, simple to create, generally accessible, and effective local-style hives. We now realize that the widespread practice of basic, natural beekeeping in straightforward, cylindrical beehives accounts for the continued presence of huge populations of healthy honeybees throughout Africa. Logs, reeds, grass, and clay are often utilized as building materials for beehives made in the region.

The typical shape is a cylinder, which provides honeybees with a charming nesting area. The bees attach their combs to the cylinder's walls since it has no moving parts. These sorts of hives have been tried and proven over a long period of time, and since they are constructed from naturally occurring materials that are readily available nearby, even the poorest people may afford them and utilize them. To boost their wages, poor farmers are often urged to commercialize, and many people believe that doing so necessitates a shift in technology. Simple neighborhood hives are urged to be abandoned in favor of so-called "modern" hives. This sort of intervention is often an unsuitable course of action and arises from inadequate situational analysis.

A beekeeper may occasionally recover the cost of a frame hive within a few years, according to cost-benefit calculations, although these projections are seldom based on real-world field data. According to Svensson, beekeeping ventures that were created using subpar research and inaccurate forecasts failed. Even if a beekeeper, for instance, can repay after four years, they are still trapped into debt since they lacked the capital to invest in the first place. It would be challenging to manage the African bees in these frame hives, according to Wainwright, who described the producer-owned enterprise North Western Bee Products in Zambia in a study. Most crucially, the beekeeper would incur debts that he would be unable to pay back due to the high initial cost of the hives. On the other hand, providing free hives is never viable.

With good cause, beekeeping programs have grown in popularity with funders and non-governmental organizations (NGOs). However, NGOs must create initiatives with observable and quantifiable outcomes due to the requirements and expectations of donor-funded projects. It is simple to create a budget for a certain number of hives, and after they are delivered, they can be tallied and photographed, aiding the NGO in demonstrating that the project was carried out according to plan. A new expertise or a new market relationship is far more difficult to identify and evaluate. In addition to raising project costs, investing in hives complicates neither the design nor the implementation of projects. Simple but pricey initiatives are appealing to implementing firms that rely on a portion of the project's overall expenses for overhead.

However, development initiatives often make the mistaken assumption that "modern" hives would enable individuals to profit more from beekeeping. Honeybees living in frame hives and those living in local-style hives are equivalent in terms of quality; they forage on the same flora, are located in the same location, and produce identical goods. The techniques used for harvesting and post-harvest processing are different. Some beekeepers harvest irresponsibly and sell low-quality goods to the market using hives made locally. Closer examination reveals that the market in which they operate accepts the caliber of their goods, and beekeepers lack knowledge of various market demands. Project assistance in this area is appropriate and helpful. The total yield from frame hives contains more honey and less beeswax than that from hives made locally because beeswax is recycled in frame hives. Beeswax, on the other hand, is a valuable commodity that is, in many respects, simpler to keep and sell than honey.

Additionally, it is now in great demand on the global market. When there is a substantial profit to be made from the sale of beeswax and foundation is either costly or unavailable, recycling comb has no financial advantage. According to a Ugandan beekeeper, "I was advised to provide foundation for my bees because then they can spend more energy making honey, and I can get more honey more quickly for selling." Wax comb is necessary for all bees, his neighbor retorted. I'd prefer the bees constructed the foundation for themselves for free than having to pay for it if I had to offer it.

Furthermore, tropical bees are often fast to flee when handled, while frame hives allow combs to be examined and put back in the hive. A centrifugal extractor may be used to replace the combs in frame hives after the honey has been extracted, but since these machines are costly and are often only used seldom, they must be shared and kept in one central area. As a result, it will be necessary to take boxes full of frames to the processing facility on foot or by bicycle, which will be a costly, time-consuming, and dirty operation.

Trade And Markets

Build a supportive atmosphere, listen to beekeepers, evaluate and document progress once your initiative is underway. Before starting any intervention, do all you can to understand the regional market structure. Achieving size and efficiency in beekeeping involves making it commercial. To achieve profitability, true manufacturing costs must be assessed. There is little evidence to support claims that frame-hive beekeepers in sub-Saharan Africa produce more honey overall than beekeepers utilizing a lot of local-style hives, despite the fact that they are cheaper to build. Local-style hives are more lucrative than frame hives because of this. Beekeepers will increase their investment in beekeeping if markets are open, lucrative, trustworthy, and fair. Poor market knowledge and connectivity, a lack of operating capital, a shortage of containers, low investment, and poor communication all contribute to supply chain issues, which are common in developing countries. Therefore, these issues should be the main emphasis of projects.

Quality Harvesting and Handling

Any beekeeper who adheres to basic, ethical principles may produce high-quality honey that is packaged and labeled in accordance with supermarket specifications. Investing in teaching beekeepers and collection center workers in proper harvesting techniques from any kind of hive, record-keeping to enable product traceability, and proper post-harvest handling and storage should be a priority for all projects.

CONCLUSION

In conclusion, the development of beekeeping with an emphasis on knowledge integration is crucial for the industry's sustainable growth. From a historic activity to a contemporary, scientifically educated enterprise, beekeeping has come a long way. Knowledge, research, and technology have been used to enhance hive management, boost honey output, and protect bee populations.It's critical that we maintain funding beekeeping research and teaching as we go ahead. Understanding bee behavior, genetics, disease control, and environmental elements affecting bee colonies are all part of this. Beekeepers may make wise choices to advance the health and production of their hives by using information from these fields.Furthermore, tackling the difficulties beekeeping encounters, like as colony collapse disorder and pesticide exposure, requires information exchange and cooperation among beekeepers, researchers, and governmental organizations. This group effort may result in ground-breaking ideas and environmentally friendly methods that assist beekeepers and the larger ecosystem.

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CHAPTER 3
GEOGRAPHICAL DISTRIBUTION OF BEES: A HISTORY AND AN UPDATE

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ABSTRACT:

Bees have a crucial role as pollinators in worldwide ecosystems, greatly enhancing agricultural output and preserving biodiversity. This abstract gives a succinct summary of the historical background and current knowledge of the global distribution of bees. The history of bee dispersion research is investigated, revealing key junctures in the growth of our understanding of these vital insects.An update on the status of bee dispersion research is also provided in this abstract, with a focus on recent technological and methodological developments that have made it possible to conduct more thorough and accurate evaluations of bee populations across the world. In order to solve urgent ecological issues including habitat loss, climate change, and the reduction of pollinators, it addresses the need of geographical distribution data.The article ends by highlighting the urgent need for further study and conservation efforts to keep track of and safeguard bee populations all around the globe. Bees' critical function in ecosystems and the survival of agriculture and the natural world as a whole depend on our capacity to understand the bees' geographic range.

KEYWORDS:

Bees Distribution, Geography, Honey-Making Bees, Modern Beekeeping.

INTRODUCTION

The distribution of bees across the globe varies noticeably. One species of honeybee, A. mellifera, dominates the geographic range and is found in the Western Old World, the Americas, and Australia (where a second species, Apiscerana, is now also invasive). Three to five local honeybee species may often be seen coexisting throughout Asia. The most diversified species are stingless bees, which have more species in Asia than in Africa, which has more species than tropical America. The variety of the bee fauna is fairly equivalent to the botanical richness of different regions; therefore, these discrepancies cannot be attributed to disparities in land area or continental size. With the exception of the Andes, where Bombus just made its way there around 8 million years ago, the mountains of Asia, the north temperate zone, and the Americas are home to the most species of bumblebees. Natural vegetation and plant biodiversity are often diminished in places that are either agriculturally or intensively inhabited.

There are thus fewer bee species. By protecting natural habitats, restricting the use of pesticides, and reducing pollution, bee numbers may be kept under check in these places[1], [2].

Regional biodiversity varies tremendously. It is important to note that some species, such as A. mellifera, more strongly utilize a marked dry season than continuous, prolonged blooming periods in less seasonal conditions. The equatorial Amazonian nation of Ecuador is home to the hotspot for neotropical bee diversity, where 100 species have been identified within an 8 km^2 region of tropical rainforest. There are around 3000 tree, 600 liana, and 500 plant species. The Old-World African honeybee has just lately reached there, and it is still uncommon. Contrarily, rainfall patterns and the diversity of plants and bees differ in Panama's lowlands (9°N latitude). Along the protected Panama Canal watershed, they support roughly 2000 species of woody plants (trees, shrubs, and lianas) and 200 species of herbs. In lowland Pacific forests and the more humid Caribbean lowlands, the variety of honey-producing bees is around half that in those areas. There are 32 species in the Isthmus of Panama, 22 in the Pacific, 46 in the Caribbean, and a total of around 56 species of honey-making bees along that transect, which is just 76 km long. Higher latitudes and altitudes have fewer social bee species, but areas with significant topographic and elevational variation, like Costa Rica, have more species per unit area at a particular latitudinal range[3], [4].

DISCUSSION

Figure 1: Honey-making bees from the three tribes [fao].

The planet is home to wild bees, but very few human communities have been able to raise and care for bees to meet their requirements. Beekeeping for honey using local bees has been practiced by mankind since the dawn of time. Modern beekeeping, which mostly uses the

Afro-European honeybee Apismellifera (A. mellifera), has spread around the globe. More than 20,000 species of bees are thought to exist in the globe, yet many regions are losing their natural bee habitats. Bees are now recognized for their pollination work as much as their honey. Only particular social bees with colonies and a queen, which will be discussed in this chapter, combine these two crucial tasks. Honeybees, bumblebees, and stingless honey-making bees are the three types of honey-making bees that reside in colonies (see Figure 1). Approximately 100,000,000 years ago, they initially appeared. The majority of bees met today are of the roughly 1000 species of honey-producing bees that are still existing and flourishing on Earth. Naturally, they did not all develop at the same time or in the same locations, and this large and significant group's biology differs. Flowers must have nectar for bees to produce honey, and pollen must have protein for the brood. These plants also have unique distribution patterns, occurrence rates, and blooming times. We make an effort to give information about bees and allied plants as succinctly as we can in this area. The distribution of bees is well recognized, as are many bee conservation and management challenges, and our knowledge of bee populations and "functional groups" is growing[5], [6].

Bees from Every Country

The ruins of the former supercontinent Gondwana, which formerly included South America, Africa, Antarctica, India, Australia, New Zealand, and Arabia, are where the first social bees originally emerged. Bee colonies have traveled incredible distances in their honey-filled nests through continental drift, floating island mats, in solitary trees, along rivers, and across seas. They were alive throughout the period of the dinosaurs and experienced mass extinctions. About 65 million years ago, towards the very end of the dinosaur era, a large asteroid collided with Earth near the Yucatán Peninsula in what is now the Gulf of Mexico. Another was close to India. Even while we still don't fully understand all of the changes it brought about, we do know that 70% of all species undoubtedly including bees were wiped off. The following are some of the most significant generalizations we can draw regarding honeybees in the modern era:

1. They are mostly tropical (all honeybee species, with the exception of one, are primarily tropical).

2. All honeybee species create flying reproductive swarms, and they often migrate.

3. Swarms of stingless bees that immediately enter a new nest proliferate.

4. Stingless bees have the greatest number of species, the widest geographic spread, and the oldest origin.

5. Despite being important pollinators, bumblebee colonies typically only retain a little amount of honey and have a one-year lifespan.

All beekeepers rely on blooming plants, and these species are often more abundant in open, disturbed settings. In areas with greater sunlight, such as regenerating forests, natural grasslands, or steppes, there will be more flowers and nectar to be found. In certain instances, fire is essential to establishing an open, fruitful environment for blooming plants. As a result, changed but undamaged habitats are often preferred for preserving social bee colonies. There, a variety of honey-producing bee species or genera, including those introduced from other continents, may flourish. Non-native bees, especially honeybees and bumblebees introduced to enhance agricultural production of seed or fruit crops, have raised concerns about their undetected expansion. Concerns concerning the alleged "spillover" of pathogens or disease-carrying agents like parasites among imported and native animals are legitimate. The opposite has been reported, neither the transmission of native bee illness or the introduction of parasites to non-native bees. Only bees that produce stingless honey seem to be virtually disease-free and are unable to transmit illness in temperate regions[7], [8].

In conclusion, honey production in wilderness close to certain disturbed but managed regions may be higher than expected for large, untamed wildlands. The fauna, including bees and the blooming plants they rely on, has not yet reached an equilibrium or stable condition, which is one of the causes. It's possible that native species don't need or use all of the floral resources. Bees adapt to satisfy any restrictions on bee numbers or the number of species that may coexist amid blooming plants. There are several varieties of flowers that are particularly alluring to bees in tropical and temperate croplands and human areas. A simple multiplication of floral resources (pollen, nectar, oils, and resins) by open flowers cannot even approximate how many bees or other pollinators can be sustained or renewed, so we lack the information to determine how many plants and pollinators would be required, either in the short term or long term. Whether or whether they are native, bees may multiply due to their diverse nature. When they have sufficient nesting grounds, little to no pesticide intervention, little to no pressure from their natural enemies (parasites, illnesses, predators), or when they are properly managed and cared for by humans, this occurs.

Where to Find and Take Care of Sustainable Bees

Currently, disposable pollination units include Apis, Bombus, Megachile, Osmia, and a few others, largely in the temperate zone, on much smaller sizes. Since these colonies or nests of solitary (non-social) bees have little food when their applied pollination activity is through, beekeepers are sometimes obliged to employ and then destroy them. A. mellifera, or honeybees, are an exception; they are moved about to pollinate and then recuperate in other places. In contrast, long-lived apis or meliponine colonies may flourish in the tropics provided they are sheltered, close to enough greenery, and devoid of pesticides and the other stressors described. Although most bee colonies have never been maintained (only about 10% are regularly retained), a variety of bee colonies may be considered for local usage or exploitation. There are between ten and fifty different kinds of honey-making bees in many natural regions, between fifty and one hundred in a few.

Because they are movable pollination units, these bees are also among those that are most in demand for pollination services. Insects that visit flowers reflect the variety of their floral resources, as has previously been established, and honey-making bee diversity varies geographically. The best explanation for distribution and abundance patterns seems to be an ecological hierarchy in which one Apis replaces many stingless bees, which in turn replace several other bee species. This does not apply to isolated places, such as those on oceanic islands or in regions bounded by other obstacles. Each group of these bees also has a genus name that is a component of a tribe and belongs to a subfamily. The majority of these bees also have a local and scientific name[9], [10].

The subfamily Apinae of the bee family Apidae contains all honey-producing bees. Honeybees belong to the genus Apis (tribe Apini), bumblebees to the genus Bombus (tribe Bombini), and meliponines to the tribe Meliponini, which has several species. In temperate regions, only a small number of bees produce substantial quantities of honey. This shows that there are more individuals per species when fewer species are present. Apismellifera, the Western honeybee, is mostly an African species. Its subspecies have recently migrated from Africa into the temperate zone, making it the bee that is maintained the most extensively on Earth. The species was spread by humans, and it flourished in the Americas and certain regions of Australia. The environment will once again change because to habitat modification, chemical products in the air, water, and land; climate change; and, most recently, pandemic limits and circumstances.

A stingless bee in Australia (Austroplebeiaaustralis), a honeybee in Laos, northern India, and Nepal (A. laboriosa), and the majority of bumblebees are the only true non-tropical honey-producing bees apart from Apismellifera. In the American tropics, a few Bombus inhabit lowlands. According to the number of bee species that coexist in each region, there are ten in Africa and between 20 and 100 in the lowlands of tropical America. There are thought to be 5 to 30 species elsewhere, including on islands that are the size of continents (such as Australia, New Guinea, Madagascar, and Borneo) or smaller regions that are cut off by tall mountains (such as India) or by the sea (such as the Philippines).

Non-Stinging Bees

In the Neotropical area, stingless bees may be found between 34.90°S (Montevideo, Uruguay) to 27.03°N (Lamos, Sonora, Mexico). They may be found in the Indo-Malaysian/Australasian area from 36.41°S in Australia up to 24.23 °N in Taiwan, whereas in Africa they can be found from 28.54°S (Eshowe) in South Africa to 18.00°N (Njala) in Sierra Leone. However, Dehra Dun, Uttar Pradesh, in India, has the northernmost records for stingless bees (30.32°N), and there are numerous additional Indian records over 28°N. The majority of the Indian subcontinent is home to stingless bees, at least up to 1000 m above sea level in India and Nepal. They are uncommon over 2500 meters above sea level in South America and Asia, however incredibly, they have been seen as high as 4000 meters in the Andes of Peru and Bolivia. Only a limited amount of information exists about the exact distribution of stingless bees in India. The fact that a gregarious insect with a poor tolerance for cold weather spends significant amounts of time in such northern latitudes, where it is often below freezing, should spur further behavioral and physiological research in northern India[11].

Bumblebees

Some species of bumblebees are common in areas of the globe with dense populations, and they are generally well recognized. They are huge and often have vibrant colors. The majority of bumble bee species belong to the subgenus Bombus of the family Apidae, however others are parasitic. Globally, there are around 250 species, with northern temperate zones having the most variety. Most of Europe, North America, and Asia are home to bumblebees. Although they are uncommon in hotter regions like the Mediterranean, some do live in the lowland tropics of Southeast Asia, Central America, and South America. These mostly northern creatures have been able to cross the equator because to the mountain ranges that nearly continually extend from North to South America. The Andes, which stretch from Venezuela to Chile, contain a moderate amount of biological variety. They are often exclusively found at elevations between about 1000 m to 5600 m in the Himalayas and the tropics.

Mountains east of Tibet and those in Central Asia have the highest levels of species diversity. In flower-rich meadows in the higher woodland and subalpine zones of Europe, species diversity tends to be at its highest. Because of how much more basic their social structure is compared to honeybees, bumblebees are thought to be primitively eusocial. Without assistance from a worker caste, their queen establishes a colony and forages on her own. In a similar vein, the majority of bumblebee species have an annual cycle, unlike stingless bees and honeybees. However, certain tropical bumblebee species start new colonies by swarming, much as honeybees do. Although certain tropical species may have two or more queens active at once, colonies typically only have one queen. Similar to stingless bees, they practice cooperative brood raising, with sterile workers caring for the brood, maintaining the nest, defending it, and foraging. Despite not producing enough honey for people to commercially gather, bumblebees are crucial for pollinating crops. To be employed in plastic tunnels and greenhouses all over the globe, at least five species are now grown commercially under artificial circumstances. In Mexico and South America, two other species are raised on a semi-commercial basis.

Honeybees

Although honeybees are native to Eurasia and Africa, humans have spread them to all four continents. They are renowned for building wax colony nests that last a lifetime, for the size of their colonies, and for producing and storing extra honey. At the Eocene–Oligocene border (34 million years ago), the first Apis bees are first documented in the fossil record. There are presently twelve recognized species and several subspecies of honeybee. The Western honeybee (A. mellifera), which is raised for honey production and agricultural pollination, is the most popular kind of honeybee. A. laboriosa honey harvesting is a regular activity in the Nepalese Himalayas, but the Eastern honeybee (A. cerana), which is located throughout Asia, is the only other honeybee that is handled. Contrary to widespread belief that the species is in danger of extinction, the number of honeybee hives is decreasing in certain regions of the globe while rising overall.

CONCLUSION

The research of bees' global range, as described in this history and update, offers insight on the intricate and always changing interaction between bees and their surroundings. To better understand biodiversity, ecosystems, and the critical function these insects serve in pollination, academics and amateurs have devoted countless hours to mapping the distribution of bee species worldwide.This voyage through the historical growth of bee dispersion research demonstrates how far our understanding has progressed, from the findings of early naturalists to contemporary scientific paradigms. The significance of continual study to keep up with environmental modifications and new dangers to bee populations, such as habitat loss, climate change, and pesticide usage, is brought home by this.We become increasingly aware of the connectivity of all living things on our earth as we continue to learn more about the geographic dispersion of bees. This information supports conservation efforts and emphasizes how crucial it is to save bee species and their habitats for the health of ecosystems, agriculture, and the world's food supply. Our ability to protect these amazing animals and the priceless services they provide to our planet depends on the continued research of bee dispersion.

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CHAPTER 4
HONEYBEE GENETIC RESOURCES: LOCAL BEES AND GENETIC DIVERSITY

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ABSTRACT:

Through pollination and honey production, honeybees (Apismellifera) play a crucial role in agriculture and ecosystems. Their populations do, however, suffer a number of difficulties, including as illness, climate change, and habitat loss. The resilience and sustainable management of honeybees depend on our ability to understand and preserve their genetic diversity, the value of researching the genetic diversity of local bee populations while examining the genetic resources present in such populations. Local bees are significant for breeding programs and ecosystem services because they often display distinctive features suited to their particular surroundings. For honeybee health, production, and adaptability to environmental changes, genetic diversity is essential.This study explores population genetics and molecular approaches as tools for evaluating genetic diversity. It also explores the possible advantages of protecting and exploiting regional bee genetic resources, such as boosting honeybee health, expanding honeybee resilience, and promoting environmentally friendly beekeeping methods.Overall, the significance of genetic variety in honeybee populations is emphasized in this abstract, as is the need of protecting regional bee genetic resources for the benefit of honeybees and the ecosystems they support.

KEYWORDS:

Bees, Genetic Diversity, Genetic Resources, Honeybee, Local Bees.

INTRODUCTION

The genetic diversity of honeybees is essential for sustainable agriculture and beekeeping. Local bee populations that have adapted to their particular settings are essential for preserving the genetic variety of honeybee species. Given the difficulties bee populations are now facing, this variety is essential for their adaptability and long-term survival.Local bee populations, sometimes known as "ecotypes," have developed distinctive traits through time to flourish in their particular geographic areas. These traits include the capacity to survive a range of environmental conditions, feeding habits, and resilience to local illnesses and pests. These characteristics are the outcome of natural selection because bees with beneficial characteristics have a higher likelihood of surviving and procreating in their natural habitats.In order for honeybee populations to adjust to changing environmental factors, genetic diversity is crucial. A broad variety of genetic features among bee populations are essential in light of climate change and the increasing pressure from pests and illnesses. It enables the growth of colonies that are better able to withstand these difficulties and maintain hive populations that are in good condition[1], [2].

Even though the honeybee has roughly 30 subspecies and a wide range, only a small portion of this variety is used in contemporary beekeeping. The distribution of the species and often also the genetic make-up of honeybee populations within its native range have undergone considerable modifications as a result of the need for high economic performance from bee colonies coupled with desirable behavioral traits. Breeding efforts have centered on features with high economic value, often employing inter-subspecies crosses and mass reproduction from small stocks, which has resulted in hybridization or even replacement of the native honeybee population in many locations. Additionally, A. mellifera was introduced into the native allopatric range of other species of honeybees in Asia, leading to resource rivalry and disease exchange. The ectoparasitic mite Varroa destructor's host transition from the Asian A. cerana to A. mellifera is the most notable example of pathogen exchange, and it has had severe effects on beekeeping across the globe[3], [4].

Local adaptation is now widely acknowledged as a key component impacting the survival and production of honeybee colonies, nevertheless, given honeybee health and colony losses in recent decades. Native honeybee populations are probably highly adapted to the local environmental factors, such as the climate, vegetation, pests, and diseases, in locations where they are still mostly unaltered.

The honeybee is not native to much of its present range, however. Moreover, the original indigenous population has been hybridized or supplanted in numerous areas, particularly in large portions of Central and Northern Europe. In certain areas, honeybee strains that have been raised and bred in one place for a number of generations might be regarded as regionally adapted[5], [6].

DISCUSSION

Native Bees

Protecting the honeybee species' capacity for adaptation entails safeguarding its genetic resources. It is important to preserve a range of populations across the globe that are suited to diverse conditions to deal with future difficulties that may occur from causes like climate change and new infections, as well as changes in market requirements. These populations may act as a gene pool, including genes that could be useful in the future. High genetic variety makes honeybees hardier, and preserving honeybee genetic resources is crucial to sustained growth.

Additionally, when undesirable alleles are progressively eliminated from the population via selection in honeybee breeding programs, the genetic diversity of the breeding population may gradually decline. In certain instances, rigorous selection might result in the depressive consequences of inbreeding. Due to complementary sex determination, honeybees are more susceptible to inbreeding than other animals. In certain circumstances, it is advantageous to add more genetic variety to the current breeding population in order to mitigate these impacts. Maintaining source populations with significant genetic variety in this manner is essential. Tropical to temperate climates are among the many habitats where honeybees may be found. for further details. Keep in mind that further studies on honeybee genetic diversity are required in certain areas, and that new sources may be found in the future[7], [8].

Discovery

Honeybee species and subspecies were first described scientifically in the 1800s. Early accounts, however, often lacked objectivity and scientific rigor. For instance, until the middle of the 20th century, A. cerana's species status was up for discussion, and it wasn't until 1983 that experimental evidence of the two species' reproductive isolation from one another was published. Similar to this, the Russian Ural Mountains were thought to be the eastern limit of A. mellifera for many years. Only recently were indigenous A. mellifera subspecies found in Central Asia, expanding the species' range by thousands of km. Our understanding of the distribution and subspecies diversity of A. mellifera still has several limitations. Recent discoveries and descriptions of numerous new A. mellifera subspecies include A. m. ruttneri, A. m. pomonella, A. m. simensis, and A. m. sinisxinyuan. However, the danger that many species and subspecies may become extinct before they are identified is alarmingly real given the constant increase in honeybee trade and movement caused by economic need[9], [10].

Characterization

The earliest articles on variation based on morphometric measurements of a few body sections were published in the 1920s, marking the beginning of the characterization and description of honeybee variety. Later, morphometrics was developed utilizing an expanded range of morphological traits and improved statistical analytic tools, and starting in the 1960s, it became the accepted technique for analyzing geographic variation and diversity in honeybee populations. In 1988, a thorough monograph describing the overall pattern of honeybee biodiversity was released. The development of molecular tools and their application to the study of honeybee biodiversity have advanced significantly during the 1990s. In the near future, diagnostic technologies based on single nucleotide polymorphism analysis will make it possible to accurately divide unidentified honeybee material into subspecies from a single study. Notably, behavioral categorization of honeybee populations and subspecies is gaining prominence and relevance. Examples include seasonal brood cycles and swarming behavior, nest defense, and mating behavior.

Utilization

Honey production, inclination to swarm, and docility are just a few of the commercially significant features that commercial honeybees are expected to excel at. These qualities have long been improved continuously by selective breeding in various parts of the globe. In recent years, breeding programs throughout the globe have begun to place more emphasis on and include features relevant to colony health, such as enhanced resistance to parasites or illnesses.

Conservation

Modern beekeeping methods include migratory beekeeping, using genetic stock generated commercially, trading queens across borders, and using migratory bees all contribute to the introgression and hybridization of local honeybee populations. If this occurs often, especially when the native population is tiny, it might result in the loss of certain adaptations to the environment or possibly put the whole population in risk. Many places have established conservation zones to safeguard indigenous populations against the introduction of alien genetic material. indigenous beekeepers often took the initiative to establish these areas. These areas typically consist of a protected zone where only colonies with the genetic origins under protection may be kept and where commercial or migratory beekeeping activities using commercial or imported stock are prohibited.

One example of a successful conservation project that was started by beekeepers and subsequently formally taken up by government officials is the preservation of the almost extinct indigenous honeybee of Sicily, A. m. siciliana. In a few instances, whole nations made the decision to enact laws governing the importation and exchange of honeybee genetic material in order to save their indigenous bee populations. For instance, in Slovenia and Croatia, where this is the native subspecies, it is prohibited to import anything other than A. m. carnica material. The Danish island of Laes, where a tiny remnant population of the pure native A. mellifera persists and is guarded against hybridization by nearby imported A. m. ligustica and Buckfast stock, is another well-known example of a well-established conservation area[11], [12].

Conservation Techniques

Localized Conservation

The preservation of honeybee populations in the areas of their native range is referred to as in situ conservation. Creating protected areas is a typical method of preserving honeybees in their natural habitat. In addition to safeguarding the pollen and nectar-producing plants that are essential to colony survival, designated protected zones also prohibit interbreeding via reproductive isolation between non-local populations and local populations. If physical separation is not feasible, then geographic distance may be the cause of the isolation. It is advised to keep non-local people out of a 6-7 km radius around the population that is being protected.

Beekeepers may contribute to the genetic improvement of local populations, or conservation by exploitation, to the protection of local honeybees in addition to protected regions. When breeding programs based on local populations are implemented, their performance may be improved, giving them a better option for local beekeepers who would otherwise import queens from other sources, particularly from highly chosen stock. Due to competition and possible genetic stock hybridization, local populations may get affected. Therefore, sustained conservation is made possible by beekeepers' ongoing usage of local honeybees. The genetic diversity and integrity of local populations should be carefully observed while they are being maintained. Monitoring using morphometrical and/or genetic techniques may provide crucial information about the population's present condition and serve as the foundation for choosing what has to be done if the population is in danger.

In-vivo and ex situ preservation

Ex situ in vivo conservation is the preservation of living honeybees outside of their natural habitats, which often vary from their native habitats. Ex situ in vivo conservation may support in situ conservation even though it is often the favored option. In situ conservation is particularly helpful for endangered honeybee populations since they have tiny populations and a high risk of losing genetic diversity owing to infectious illnesses, natural catastrophes, or genetic drift. Ex situ in vivo conservation populations may replenish the original population in such cases. Ex situ in vivo conservation may be expensive for population maintenance, hence its effective implementation need long-term financial assistance.

Cryoconservation

Another method of ex situ conservation is cryoconservation, which includes storing genetic material in cryobanks after being frozen. Although cryoconservation involves specialized equipment and methods, when they are in place, preservation materials need little upkeep. Cyroconservation may protect genetic diversity from infectious illnesses and environmental calamities, similar to ex situ in vivo conservation. Genetic resources may be gathered and stored for many generations, allowing for the reuse of resources from earlier generations that are no longer alive. The retention of these alleles may increase genetic diversity in the future. Older generations may possess alleles that, as a result of genetic drift, are not present in the current population. Research may follow changes in a population's genetic makeup by cryopreservation of materials from previous generations, providing insight into the population's trend and guiding future action.

Since semen is utilized in honeybee cryoconservation, live queens, which may originate from populations under other modes of conservation, are needed for population reconstitution following cryoconservation. As a result, it is wise to combine cryoconservation with in situ or ex situ in vivo conservation given present technology. Only a few cryobanks are now operational in the developing area of honeybee cryoconservation. Recently, techniques for successfully cryopreserving honeybee semen have been developed and verified, and initiatives to create medium- to long-term storage of honeybee semen for the preservation of priceless or endangered genetic material are now underway. Cryopreservation of honeybee embryos is another topic of research, however there isn't currently a proven technique accessible. In addition to sperm banks, there are several scientific collections made up of honeybee samples and data, the majority of which are managed by research institutes. While China has the biggest gene bank exclusively for the preservation of honeybees and pollinators, neither Europe nor the US have national collections.

CONCLUSION

The topic of honeybee genetic resources, with a particular emphasis on local bees and genetic variety, highlights the crucial need of protecting and using the genetic richness within honeybee populations. Local bee kinds are advantageous for sustainable beekeeping and agricultural pollination because they have developed special environmental adaptations.In order to protect world bee populations and agriculture from illnesses, pests, and environmental changes, honeybee populations must be genetically diverse. Local bee genetic resources need to be preserved in order to safeguard these important pollinators as well as to sustain the global resilience and productivity of ecosystems and agricultural systems.In order to comprehend the intricate relationships between bees, their habitat, and human activities, efforts must be made to preserve and research the genetic variety of honeybees. These initiatives provide the groundwork for the advancement of sustainable beekeeping techniques, increased agricultural yields, and increased food security while preserving the delicate balance of our natural environment.

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CHAPTER 5
DEFINITION AND HISTORY OF LOCAL-STYLE HIVES

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ABSTRACT:

Local-style hives are a rich history of traditional beekeeping techniques from throughout the globe, distinguished by their varied forms and materials. The concept and historical importance of local-style hives are examined in this abstract, offering light on its cultural, ecological, and useful implications. These centuries-old hives, which are often constructed of locally accessible materials like clay, straw, or wood, have played a crucial role in maintaining bee populations, conserving traditional knowledge, and boosting local economies. In order to appreciate the worldwide variety of beekeeping techniques and to educate contemporary apiculture initiatives that seek to integrate conventional knowledge with sustainable beekeeping techniques, it is crucial to comprehend the development and cultural background of local-style hives.

KEYWORDS:

Hive Design, Indigenous Hives, Local-Style Hives, Natural Beekeeping, Traditional Beekeeping.

INTRODUCTION

Local beekeeping buildings, also known as traditional hives, have been created and utilized by communities around the world for ages. These hives differ from contemporary, conventional beehive designs, like as Langstroth hives, and are often customized to the specific climatic and cultural conditions of the region.Ancient civilizations where beekeeping was a practiced art may be used to date the origin of local-style hives. Indigenous peoples-built hives in places like Africa, Asia, and the Middle East utilizing resources that were easily accessible in the area. These pioneering beekeepers designed hives that offered shelter, protection, and accessibility for honey harvesting based on their understanding of bee behavior and the requirements of the colony. The precise layouts and materials used differed from location to location, illustrative of the variety of beekeeping techniques worldwide[1], [2].

Local beekeeping traditions and culture are often important to local communities. These hives have been handed down through the centuries, and the beekeeping practices connected to them have been engrained in regional traditions and customs. In addition to being useful instruments for making honey, they serve as markers of history and identity.The flexibility of local-style hives to adapt to their surroundings is one of their distinguishing traits. These hives are built to endure the local climatic conditions, plant life, and animal life. For instance, hives may be built with high insulating walls in places with hard winters to protect the bees from the cold, while hives may be designed with shade and ventilation in places with hot, desert climates.In recent years, there has been an increase in interest in protecting and encouraging the use of local-style hives because of their ability to support sustainable and biodiversity-friendly beekeeping practices as well as its historical and cultural relevance. In addition to advancing our knowledge of honeybee ecology and behavior, the study and documenting of these traditional beekeeping practices have brought to light the value of maintaining regional traditions in the face of beekeeping modernity[3], [4].

DISCUSSION

A simple, locally constructed hive in which the bees connect their combs to the ceiling is known as a local-style hive or a native hive. Because they have been used for a long time, they are also sometimes referred to as "traditional" hives. Since the bees kept in these hives are healthy and live normally, they have the potential to serve as the foundation for big, thriving, and genetically robust bee populations. A beekeeper that uses this kind of hive could have several hundred of them since they are inexpensive. These hives are a good option for many settings, particularly in rural locations, since they are very sustainable and economically and environmentally feasible. Beekeeping is believed to have started in the earliest ancient civilizations that existed in regions with a plentiful supply of nectariferous plants and honeybees. These vegetative-rich areas supported human populations, and agriculture as we know it today was founded there[5], [6].

One of these was the Fertile Crescent, which is an area in the Middle East that bends in a crescent form from the Persian Gulf to contemporary southern Iraq, Syria, Lebanon, Jordan, Israel, and northern Egypt. It is also referred to as the "cradle of civilization" and is located in the region now occupied by Israel. The ancient civilizations of Mesopotamia, Egypt, and the Levant, which comprised the Sumerians, Babylonians, Assyrians, Egyptians, and Phoenicians, are widely acknowledged for having made significant contributions to global culture. The lush valleys of the four major rivers in the area, where the earliest agricultural civilizations emerged, are included in the lush Crescent, which has played an important role in human history from the Neolithic Age through the Bronze and Iron Ages. Buildings for storing food were necessary when certain human populations gave up their nomadic hunter-gatherer lifestyles and moved permanently to become farmers. This allowed them to have access to seasonal foods all year round[7], [8].

Because social bees like to build their nests in cavities, beekeeping may have started by accident. Humans have created several tools throughout history, with containers being one of the most significant. But because we were nomads and lacked pack animals and carriages, these containers had to be compact, light, and most likely transient. As a result of settling, it was possible to create containers with a higher capacity composed of more durable, sturdy materials. Some of these containers were just the right size for Western honeybees to establish new colonies and construct their nests in. Many academics think that bees intentionally entered some of these vessels. The significant environmental influence that agriculture may have had on the area might also help to explain why they chose to nest here.

A crucial coincidence for the beginning of beekeeping was undoubtedly the production of containers with capacities of 30 to 50 liters, a size that is equivalent to what bees love. Humans may then create specially designed containers for the swarms after seeing bees using these containers as nests. The types of hives used to house bees altered as beekeeping extended to new regions, depending on their location and the availability of local resources see Figure 1. Swarm traps and the method of swarm collecting were first used in beekeeping. Swarm trapping is the practice of luring bees to strategically placed traps when they are in the colony-level reproductive period and looking for a new nest site. Because it might be difficult to get rid of them, bees are caught before they locate a place to nest. There are several books that cover the history of beekeeping from its beginnings to the present, but The World History of Beekeeping and Honey Hunting by Eva Crane is particularly interesting to read.

Figure 1: Different Kinds of Local-Style Hives [fao].

When referring to certain hives that are prevalent in some areas or in neighborhoods that are often linked with emerging regions, the phrase "traditional hives" is frequently used. It has been mistakenly assumed that this makes it unusable in the current world. Thus, the phrase should be changed to "local-style hives" to indicate hives constructed from materials that are readily accessible locally. Local-style hives may be divided into two major categories:

1. "Vertical hives" with combs that are fixed. The bees freely construct combs and fasten them to the hive's roof. Normally, the bees are tended to from below.

2. "Horizontal hives" with fixed combs set in overlapping rows. The bees freely construct combs and fasten them to the hive's roof. Typically, both sides can control the bees.

Since then, the Mediterranean region has seen a widespread adoption of horizontal hives from the Fertile Crescent. The most typical style of hive used in traditional beekeeping today in Africa, the Middle East, and several nations in southern Europe is still horizontal hives, which come in a variety of designs and are constructed from a variety of materials. These divisions are obviously not rigidly defined. For instance, Sicilian beekeepers built their natural hives out of enormous fennel hives, which they still sometimes use today. They have the ability to split the mother log hive in half or destroy a log hive comb by comb. Hives managed locally differ from those with moveable frames in terms of management. a believe that they need more expertise in beekeeping methods, however with a basic skill training, they are simple to utilize. Only locally available natural materials are used for construction, which makes them more affordable and accessible in big quantities while making up for their lower honey production. The next subsections provide a more thorough explanation and examples of various local-style hives used across the globe[9], [10].

European beehives made locally

With the likely assistance of the Phoenicians, beekeeping extended from Asia Minor to the Aegean area, eventually across Greece, through Magna Graecia, and along the

Mediterranean, from Malta to Spain. Depending on the temperature and the availability of local resources, various regions of Europe employed log hives constructed of terracotta, stone, wood, cork, straw, and other materials, frequently treated with clay mud, lime, or dung to weatherproof them and boost their thermal insulation. Our understanding of beekeeping and honeybees is greatly owed to the ancient Roman civilization, which later expanded across the Mediterranean region. Most scientific and technological advancements occurred after the seventeenth century. Even though there are relatively few archaeological remains and very few photos of Roman hives, we may infer from accounts that the majority of them were horizontal. To make sure that the bees had enough food for survival, only the honey-filled combs from horizontal and vertical hives were removed.

With the spread of apicide after the collapse of the Roman Empire, beekeeping saw a decrease. This is a part of traditional beekeeping that is sometimes neglected. Bees are taken out of their hives at this time to harvest honey and wax. The several varieties of hives that gained popularity across Europe in the years after the collapse of the Western Roman Empire did not alter in design or material, but they were often utilized and labeled differently. In lowland places where it was difficult to get large enough trunks, basket hives covered in mud or dung became popular. Here, for practical purposes, horizontal wooden hives often became vertical. Only southern Italy and the Alps have a long history of using horizontal hives. Since then, movable-frame hives have mostly replaced local-style hives throughout Europe. These hives are simpler to industrialize, standardize, and get better results from.

Africa's regional beehives

Numerous rock drawings show that beekeeping has been practiced for ages in numerous nations, and Africa has been the home of bee species for thousands of years. Many African tribes consumed honey throughout the early stages of civilization, which they would get via honey hunting. Communities began building hives for the aim of maintaining bees as a result of the development of equipment and instruments for an easier existence. There are many distinct local-style hives because various kinds of hives have been utilized for many generations depending on the resources available to the different communities. Africa has experienced a sharp growth in honey exports to the European market and other regions that appreciate the distinctiveness of African honey as the demand for natural honey rises on the global market. African honey is gathered from traditional hives that have been in use for many generations for more than 90% of the honey that continent exports. These hives enable Africa to generate a significant amount of beeswax, which is then sold to several nations across the world[11], [12].

Latin American beehives in the local style

With the advent of European immigrants, who brought honeybees with hives manufactured in their own countries, the breeding of Apismellifera in Latin America started. There are no "local-style" hives for raising Apismellifera in Latin America since in certain areas, hives were fashioned from clay, ceramics, or stranded reeds because there was a dearth of other materials. However, these hives always followed the dimensions and patterns of European nations. Stingless bees of the genera Trigona and Melipona are the native bees of Latin America. We may notice several hive forms for these bees, not only by geography but also by species. They keep food in various methods and come in various forms, sizes, and materials.

Asia's regional beehives

The overlapping rows of tubular hives that were employed in Ancient Egypt 4500 years ago are still in use in the Middle East. Cerana, A. Local-style hives vary significantly based on the materials that are readily accessible in the area, and like A. mellifera, A. cerana occupies a wide range of habitats with a high degree of environmental variation, spanning from tropical to temperate climates. The log hive is one of the most popular varieties. To keep them off the ground, hives are often stacked on top of supporting items. They are positioned on roofs or attached to walls in certain areas.

In Oceania, regional beehives

Oceania's social, environmental, political, and agricultural landscape underwent major change as a result of the advent of European immigrants, including the introduction of honeybees and beekeeping. Oceania is home to a wide variety of native bee species, however no native honeybees exist east of the Wallace Line, which runs along the western border of Sulawesi and Lombok in Indonesia. As a consequence, there is no historical social tradition of honeybee beekeeping in this area. This is a crucial factor to take into account when planning and implementing beekeeping for development projects in the area because it affects the prevalent indigenous technical knowledge, social perceptions, roles, and acceptance of beekeeping, bee collection and management, hive construction, and customs and uses related to the use of bee products as food and medicine.

In skep hives, Apismellifera colonies have been introduced into Oceania during the last 200 years at various times, with differing degrees of success. A. mellifera was successfully introduced for the first time into Launceston, Tasmania in Australia in 1831. Numerous native bees inhabit this region, along with extensive indigenous technical know-how, culture, and traditional beekeeping and honey-gathering activities. Southeast Asian beehive constructed in the regional style Mangungu Mission Station at Hokianga, New Zealand, in 1839. Before Langstroth hives were adopted, another 50 years or so passed. England, the home of European or British black bees, is where honeybees were first imported into Australia and New Zealand. In 1862, the Ligurian Bee, another name for the Italian honeybee, was brought to Australia.

It has shown adaptable to most climes, from subtropical to chilly temperatures, and is perhaps the subspecies that is maintained the most often over the globe. Later on, more subspecies were introduced, including as Carniolan and Caucasian honeybees. Since European honeybees were imported to Australia, escaping colonies have often mated with wild bees, creating hybrids, making it difficult to discover many subspecies in their pure form. After 1840, and in many nations only after 1950, apismellifera was introduced to additional Pacific Island Countries and Territories. The sorts of hive technologies used in the introductions of Apismellifera across Oceania are poorly documented; nevertheless, dates earlier than 1880 are unlikely to have been in Langstroth hives. A. mellifera was introduced into the majority of PICTs via bilateral assistance initiatives from Australia and/or New Zealand. Hive technologies in Oceania's developing countries should concentrate on fostering local economies while using local resources and expertise to design and construct beehives that are appropriate for the area's particular social and environmental conditions.

CONCLUSION

The purpose of this section was to provide a broad picture of how regionally specific hives evolved around the globe. Considering the local-style hives should always be a consideration for policymakers and project managers, based on the environmental, economic, social, and cultural setting. They may serve as the foundation for large, wholesome, and genetically robust bee populations and are environmentally sustainable. In all situations, it is preferable to employ (rapidly) renewable natural construction materials for hives, locally adapted honeybee species, and environmentally friendly methods. For beekeeping programs in rural development regions, local hives and bees are essential, and decision-making should always be guided by the environment in which the project will take shape. This includes knowledge about local technical expertise, societal perspectives, beekeeping roles and acceptability, prices of hives and their potential production, and the usage of bee products as food and medicine, as well as their other potential markets.

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CHAPTER 6
HISTORY AND TYPES OF MOVABLE-FRAME HIVE

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ABSTRACT:

An interesting trip through the development of beekeeping techniques may be found in the history of mobile frame hives. The origins, advancement, and numerous varieties of movable-frame hives that have influenced contemporary beekeeping are briefly discussed in this abstract.Although the idea of movable-frame hives has roots in ancient cultures, substantial advancements only came about in the 19th century as a result of efforts to better understand bee behavior and increase honey output. By providing moveable frames with precise bee-spacing that enabled beekeepers to view and manage hives without disturbing the bees, Lorenzo L. Langstroth's seminal innovation of the Langstroth hive in the middle of the 1800s changed beekeeping.Since then, movable-frame hives have evolved into a variety of forms, each with its own distinct features and benefits. The Langstroth, Top-bar, Warre, and Flow hives are just a few of the well-known kinds that are examined in this abstract. The design, management methods, and applicability of these hives vary according to the different beekeeping objectives.Both beginning and seasoned beekeepers should be familiar with the development of movable-frame hives as it provides insights into the rich history of beekeeping techniques and the variety of bee management choices. This information lays the groundwork for sustainable and effective beekeeping, benefiting both beekeepers and honeybee colonies.

KEYWORDS:

Langstroth Hive, Movable-Frame Hive, Observation Hive, Skep Hive, Top-Bar Hive.

INTRODUCTION

The historical history of beekeeping from regional-style hives led to the development of mobile-frame hives. The ability to open movable-frame hives allows beekeepers to see what is going within. As a result, they can administer treatments more readily and avoid harming honeycombs without the need for an apicide. Additionally, it enables them to grow new colonies. All of this leads to an improvement in the quantity and quality of honey. They may also make it possible to use various beekeeping methods and provide pollination services. In addition to offering bee colonies a comfortable place to live, mobile-frame hives also make it easier to produce and collect bee products. A colony may be fixed in situ by the beekeeper, shielding it from adverse weather or predators, permitting closer health monitoring, and facilitating simple storage and product harvesting. However, movable-frame beekeeping requires initial funding and materials that aren't often accessible in remote regions. You should first confirm that beekeepers can independently access the materials required for more technologically sophisticated beekeeping and that rural people are receptive to new beekeeping techniques before choosing mobile-frame hives. The history of portable frame hives will be discussed in this part, along with information on how they are now being used on several continents[1], [2].

It is not a very productive type of beekeeping to have to kill or drive away all the bees in order to collect honey and wax. The honey and wax business in this area was at a total standstill throughout the Middle Ages since hives that used this method were the most prevalent in Europe. Many researchers in the fifteenth and sixteenth centuries who were reading Latin writings on bees and beekeeping came to the conclusion that ancient beekeeping was far more lucrative and that bees were never slaughtered to get their priceless goods. Even Leonardo Da Vinci condemned the practice of apicide in some of his limited notes on honeybees, writing: About the honeybee - And in many beehives, their food sources will be taken away and ruthlessly, by humans without thinking, they will be immersed and killed. Oh God's justice, why remain silent while your creatures are mistreated[3], [4].

DISCUSSION

Greek hives, according to George Wheler and Jacob Spon in the seventeenth century, allowed for significant honey gathering and intentional colony division to avoid swarming. A proposal for "a hive that I have devised to multiply swarms, following the method adopted today by the inhabitants of Crete" was published in a three-volume treatise by the Abbot Della Rocca in 1790. As a result, it was commonly known starting in the seventeenth century that hives with combs that could be removed from above, as discovered by Wheler and Spon 130 years earlier, were also common in the Cyclades and in Crete. The Enlightenment saw an increase in scholars competing to define new types of hives that would both enable the regrettable practice of apicide to be abolished and make beekeeping more lucrative as a result of growing awareness of the absurdity of apicide and knowledge of practical alternatives. It is necessary to provide only one of the several historical books that outline the characteristics that such a hive must possess:

1.In addition to being made smaller, something may also be enlarged to accommodate for a population that is more or less substantial.

2.That it can be opened by itself without upsetting the bees, whether to clean it, create artificial swarms, split up a single swarm into many, or add winter-appropriate food.

3.that the bees will suffer the least amount of harm when the hive's output is harvested.

4.interior cleanliness, smoothness, and the absence of fissures.

The Enlightenment considerably increased actual scientific study on honeybees in addition to studies for more effective beekeeping. It was possible to learn a lot about the biology of Apismellifera by using observation hives and microscopes. The discovery of the intercomb distance, which describes how honeybees construct their combs with just enough space between them to for two bees to travel through back-to-back, served as additional inspiration for the creation of movable-frame hives. The Ukrainian beekeeper Petro Prokopovych, who developed his own movable-frame hive and maintained as many as a few thousand colonies in his apiaries, is widely regarded as one of the pioneers of professional and commercial beekeeping. Pastor Lorenzo Lorraine Langstroth was a Protestant from Massachusetts. He spent his whole life researching bees and, building on numerous prior models, created a hive with replaceable combs. He discovered "bee space" in 1851, which is the exact opening that bees never fill with wax or propolis in a hive or nest. A gap of this size between frames prevents bees from creating honeycombs or bridges, and since the frame is movable, honeycomb extraction does not require the destruction of honeycombs. The contemporary beehive is largely credited to Langstroth as its creator. He refined and standardized the measures, putting them together into a hive model that serves as the foundation for the majority of hives in use today. However, without the development of the waxy sheet by Johannes Mehring and the centrifugal honey extractor by FrantiekHauschka, the success of movable-frame hives cannot be fully understood[5], [6].

Varieties Of Portable-Frame Hives

A "movable-frame hive" is any hive in which the frames are not fixed and may be taken out and replaced by the beekeeper, or even relocated to another colony. As was indicated before, this enables the beekeeper to examine the hive, identify and treat bee ailments, and adopt a variety of beekeeping practices. The size of the colony may be adjusted during the year in some of these hives, allowing the bees to have more or less space depending on their requirements. Some vertical forms of hives' honey chambers may be built using the same modular design. The productivity of the indigenous bees used in hives is adapted. Depending on the particular demands of the colony, the size of the frames and the quantity within each module may change. Since there is no need to destroy combs, movable-frame hives often provide better quantities of high-quality honey than local-style hives. One or two chambers may be found in movable-frame hives:

1.Beehives that only have one chamber: horizontal beehives

hive with top bars. Bee management is usually done from above. There are no frames in these hives; simply top bars on which the honeybees construct their organic honeycombs. This indicates that, unlike in natural hives, the combs are mobile rather than anchored to the interior walls of the hive. Because they are in between "local style hives" and other varieties of "movable frames hives," they are also known as "transitional hives." Kenyan top-bar hives and Tanzanian top-bar hives are the two major groups of top-bar hives. In contrast to traditional local-style hives, they are simple to examine. The Tanzania model features long, perpendicular walls, whereas the Kenya model has long, slanted walls. Corwin Bell's modern cathedral hive is one of the further advancements of the top bar hive. Numerous horizontal hive frame layouts have been adopted by local beekeepers in several nations since top-bar hives in recent years. The hive of Layens. The horizontal hive seen here was Georges de Layens' idea. 20 huge frames may fit on one level. Depending on the local bee flow, the number of frames may be less or more. It is opened for honey collection in the late summer or early fall after being loaded with frames in the spring[7], [8].

2.Two-chamber beehives:

Vertical hives Some of the most popular hives in the world are vertical modular hives, which are moveable frames separated into chambers. The brood chamber, which lies on the bottom, is where the bee colony and its offspring are gathered. One or more nest modules may be used to create it. The "super" is the upper chamber, where the bees store any extra honey and the beekeeper lays the modules for honey deposition and eventual collection. These modules for gathering honey might be smaller or the same height as the nest modules. Since it prevents the queen from laying in the super, a queen exclusion grid is often positioned between the brood chamber and the super to restrict brood space to the brood chamber.

In order to prevent the hive from becoming insulated and to allow the bees to create an air current between the roof and the top chamber, there is a space above the chambers that serves as an air chamber. A sheet metal roof, either straight or gabled in regions with a lot of snow, covers the top of the hive. Since the lowest half of the hive is prone to dampness, the foundation or floor is often built of hardwood or high-density fiberboard. Additionally, there are little pieces of brood chamber detritus on the ground. The Ware hive, the Lang troth hive, the Zander hive, the standard hive, and the Dadant hive are the most often used vertical modular hives worldwide. One of the most well-known movable-frame modular hives is the Warré hive. The hives of the eighteenth century are their source. The honey chamber is in the bottom, while the brood chamber is at the top. It enables the beekeeper to separate colonies artificially and gather honey without seriously upsetting the bees. Since the chambers of the Langstroth hive are the same size, they may be switched around. This is more challenging if additional modules aren't added to the honey chamber in a Dadant or Jumbo hive since the honey chamber is shorter than the brood chamber. The size of the hive varies depending on how productive the colony is and how much room is required to store honey. The most well-liked modular vertical hives worldwide are Langstroth hives. The beekeeper may add additional nest components since they are customizable [9], [10].

The brood chamber measures 24 cm in height, 51.5 cm in length, and 43 cm in width in the original Langstroth hive design. Ten frames measuring 23 cm tall each include four wires, a head or top strip measuring 47.8 cm, and a bottom strip measuring 44.7 cm. This results in a final capacity for breeding of 44 liters for the hive. When compared to a naturally spherical swarm, this form of hive's nest has a tendency to be oval, and the three-dimensional connection is not optimal. Beekeepers and technicians aim to have the most bees in hives maintained for production objectives at the height of nectar flow. The queen needs space to lay as many eggs as she can one month before to the peak flow. However, many think that the Langstroth hives' limited size and cell count is what makes the queen ascend to the second chamber in the first place. This leads to the usage of a queen excluder grid, however this is dangerous since the queen prefers to swarm when she is restricted to less area than she requires.

Beekeepers often relocate some capped brood stocks into the honey chamber, which is blocked by the exclusion grid, during the advanced spring season to avoid this from occurring, and then replace them with empty or waxed honeycombs to ensure the queen continues to lay eggs. This procedure is known as "frame rotation." One of its downsides is the possibility that pests like wax moths, acaricides for Varroa treatment, or sugar syrup that the bees did not eat may have come into touch with brood combs. These combs have a higher likelihood of carrying sugar syrup residues or some other sort of acaricide residue as they accumulate. Because of this, beekeepers should take care to use low-impact acaricides to treat varroa. Bees maintain less honey reserves throughout the winter because they have less room in the hive, but in temperate and cold temperate areas, these reserves are not enough to sustain them until the next active season. Beekeepers in these areas are thus compelled to feed the bees or store food in the honey chamber.

Avoiding nutritional stress, which makes bees more vulnerable to viral illnesses, is also advised. Although it has been said that Langstroth hive chambers of the same size, a shorter honey chamber, known as a half-rise or three-quarter-rise, is utilized in Langstroth hives because of the weight of the hive when it is filled with honey. Half-rises are the same size as a regular chamber in terms of length and breadth, but they have a 14.5 cm box and 14.5 cm of height. As an alternative, a queen excluder grid must be used with a normal chamber for honey and a half-rise as the brood chamber. It is possible to employ a variety of chambers or half-rises and stack them as required. A standard-rise honey chamber has the benefit of being considerably simpler for bees to fill, which makes it popular for the production of monofloral honeys. Beekeepers also employ honey chambers with the same measurements as the brood chamber, but since there is no industry standard for height, they may range from 16 to 17 cm.

Only for honey production, which favors bigger frames, are these measures employed. Additionally, a three-quarterrise that has a bigger bottom slat and broader sides and just eight frames per rise requires unique dimensions. The wires zigzag downward to upward. As a consequence, more wax and honey are produced. The Zander hive and the British National hive, which also allow for many brood chambers, are similar to Langstroth in idea and administration.

There are several varieties of the Dadant hive, which is also quite common. It is distinguished by nest frames that are bigger than those found in a Langstroth hive as well as by super frames that are only half as tall as the nest frames. The brood chamber is 30.8 cm high, 51.5 cm long, and 43 cm broad in the original Dadant hive design. The head or top slat is 47.8 cm in height, the bottom slat 44.7 cm, and the squares are 29.6 cm high. Its four distinct wires are spaced 5.5 cm apart. It has a capacity of around 54 litres. The Dadant hive originally had 12 frames, which meant that its breadth fluctuated. Its increased height provides it the perfect proportions to sustain a large brood nest that is naturally spherical in form, and it offers the queen adequate space to lay eggs without having to switch chambers.

The super, however, is only 16 cm, so the chambers cannot be switched about as in the Langstroth hive. The larger capacity, meantime, allows for the storage of more honey stores for the winter and typically eliminates the need for artificial feeding. The size and weight of the Dadant hive are its only drawbacks, making it very difficult for nomadic beekeeping, which is crucial for crop pollination as well as honey production. Half-rise supers are located on top of the brood chamber in the pastoral Layens hive.

The modules and frames of the divisible Layes hive, on the other hand, are all half the height of the frames. The Layens hive has a square portion in both variations. The Jumbo or Yumbo hive is another.

Because the brood chamber of the Langstroth hive is too tiny for excellent egg-laying queens and swarming is frequent once it surpasses 60,000 bees, some American beekeepers dislike it. As a result, A.N. Draper simply increased the height of the Langstroth brood chamber from 24.0 cm to 29.5 cm while maintaining the same supers, and the issue was resolved. The hive is 43 cm broad and 51.5 cm long. It is 27.7 cm tall and contains 10 frames with four wires each. Its head, or higher slat, is 48.1 cm, while its lower slat is 45 cm. It has the ideal proportions at this size to accommodate the brood nest and winter honey supplies. It is comparable to the Dadant but more portable since it is lighter and smaller.

Modern beehives

In recent decades, a number of novel hives have been developed. Some of these hives, like the aforementioned cathedral hive, which is based on the top-bar hive, are motivated by a desire for more naturalness, while others are built on cutting-edge technology. The intricate solar hive, created by German artist GuntherMancke, is one example of a natural beehive. Bees construct honeycombs within semi-elliptical frames inside this circular beehive. It is intended to be positioned at a height of around 2.5 meters above the ground and has a funnel-shaped entrance at the bottom, making it incredibly challenging to find. Due to the intricacy of its construction and the difficulty of inspecting it, it cannot be classified as a movable-frame hive or a local-style hive. The revolving hive and the flow hive are examples of technological hives. The circular frames of the rotating hive are turned slowly and constantly by an electric motor that is either driven by electricity or a tiny solar panel. In addition to preventing swarming, the rotating honeycombs also lessen the negative effects of the parasite mite Varroa destructor. But because there is no scientific proof of their efficacy and they are not grounded in honeybee biology, this complicated, pricey hive is mainly regarded as one of the numerous gimmicks that beekeepers love to create and experiment with. The flow hive is the most well-known example of a technologically advanced form of hive that facilitates or automates honey extraction for family honeybee management. These self-harvesting hives, however, give the false impression that beekeeping is as simple as placing bees in a box and expecting to get enough honey for a whole family. In actuality, beekeeping entails actively participating in the care of the bees, particularly at the present, when Varroa is widespread over most of the globe. Both of these concepts are often regarded as novelty hive models rather than actual productive solutions.

European beehives on movable frames

With several regional names, bee residences or bee hotels are notably common in Slovenia, Austria, Germany, and Switzerland. In Italy, they are no longer in use. Most European nations favor the Lang troth and Dadant hives. Nevertheless, the British National hive and the Zander hive, both of which enable the brood chamber to be enlarged, are both widely used in the UK and Austria, respectively, while the Dadant hive is the norm in Italy. In the Iberian Peninsula, Central, and Northern Europe, both variants of the Layens hive are very common.

African beehives with movable frames

With the aid of development partners who are helping them with beekeeping initiatives as a method of combating severe poverty and hunger, what is now known as "modern" technology is gaining traction in many African beekeeping communities. As a result, commercial beekeeping projects have been established, using correct "modern" beekeeping techniques to:

1. enlarge the colonies by colony splitting and queen raising;

2. enhance honey production for retail sales;

3. supply mobile colony supplies to aid in pollination.

The Langstroth hive and the top-bar hive are the two movable-frame hives that are most often employed in Africa. The latter is more often used since it is less expensive to build and maintain hives and colonies. Due to the high cost of Langstroth technology, many community beekeepers choose to use top-bar hives and local-style hives instead.

CONCLUSION

Always take into account the geographical setting, customs, and history of the local populace before choosing movable-frame hives for your beekeeping endeavor. As we've seen, there are benefits and drawbacks to this kind of hive.The key benefit is that they are more productive than hives made locally. Additionally, using movable frames makes it simpler to perform numerous tasks like colony inspection, finding and inspecting the queen bee, health monitoring, reserve monitoring, and applying treatments to control bee diseases, as well as a number of other beekeeping techniques like artificial swarming and queen caging. On the other hand, drawbacks include the need for standardized beekeeping tools, operator training, and resources (such as beehives, frames, and a smoker) to guarantee output. This kind of beekeeping thrives in more developed nations where beekeepers have the financial means to purchase the necessary tools and where apiaries and honey homes are conveniently located along driving lanes.

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CHAPTER 7
HOW BEES CONTRIBUTE TO THE ENVIRONMENT: ENVIRONMENTAL THREATS

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ABSTRACT:

Bees are exceptional pollinators and vital to the stability and health of the ecosystem. The key role that bees play in ecosystem services and the current environmental risks they face are summarized in this abstract.A considerable number of the world's blooming plants, including many crops that make up a significant component of our world's food supply, are pollinated by bees, both wild and domesticated. The effect of this pollination service on food production, biodiversity, and ecosystem resilience is direct. Bees also aid in the growth of several plants that serve as homes and food sources for a wide variety of other species.But bees are presently in danger from a variety of environmental factors that endanger their numbers and therefore the services they provide. Bee feeding and breeding areas are disrupted by habitat loss and fragmentation brought on by urbanization and agricultural growth. Neonicotinoid pesticide usage, in particular, presents a serious threat to the welfare and behavior of bees. Climate change affects blooming plant availability and timing, which has an impact on bee nutrition and survival.For conservation efforts to be successful, it is essential to comprehend the role that bees play in environmental processes as well as the difficulties they face. This information highlights how urgent it is to embrace sustainable agriculture and land-use methods, minimize chemical exposure, and lessen the effects of climate change in order to safeguard these vital pollinators. In addition to being an issue of ecological concern, protecting bee populations and their environmental benefits is a protection for both ecosystem stability and global food security.

KEYWORDS:

Beekeepers, Environmental Inputs, Environmental Threats, Pollination.

INTRODUCTION

Bees rely extensively on their surroundings. It directly affects both the health and output of bees as well. The bee colony obtains nourishment from its surroundings and, in exchange, makes an important pollination contribution to the environment's function and health. Pollutants in the environment may also have a significant impact on bees and hive products. Because of these factors, beekeepers should always give great thought to where they put their hives. It is in the beekeeper's best interests to choose the ideal habitat for the hive, with the exception of situations when bees are utilized to monitor the environment. In addition to bee management expertise, effective hive environment management often entails collaboration with other stakeholders in larger landscape management[1], [2].

Environmental Inputs

Bees interact with their surroundings on a variety of scales, from the regional to the local, and the inputs become more obvious the closer they are to the hive. Some inputs are dependent on the bees' ability to fly, and as a result, are limited by their maximum flying distance, which is around three kilometers from the apiary. Some inputs are dependent on the bees' ability to fly, and as a result, are limited by their maximum flying distance, which is around three kilometers from the apiary. The area climate, the hive's physical characteristics, and its microclimate are all factors in how the climate affects hives. The topography of the terrain, its direction, and the composition of the surrounding vegetation are examples of physical characteristics.

These control how much of the hive is exposed to the light, shade, wind, humidity, and frost, and they also provide a local microclimate that affects the hive's performance and even survival. These local factors will have a greater or less significant role in reducing the negative impacts of the climate, depending on the area climate. Honeybees and other pollinators are the beneficiaries of all the direct and indirect impacts of the many kinds of pesticides used in agriculture, even though they are not the intended insects. Insecticides, acaricides, fungicides, herbicides, and antibiotics are examples of these chemicals/pesticides. Their effects on bees range from acute poisoning and instant death of adult bees and developing forms to chronic and fatal effects that are varied, occasionally very unfavorable, and difficult to quantify. Using more pesticides is often required in intensive agricultural practices[3], [4].

Although there has been a trend in recent years to use less pesticides overall, honeybee losses are still rising as a result of the usage of new, more lethal insecticide families. The effects of pesticides on pollinators are extensive, obvious, and becoming more and more well-documented. Pesticides are a major hazard to the environment, ecosystems, and public health because of the reduction of honeybees and other pollinators. Because bees need to be able to access their essential nutritional supplies, the flora in the area must be abundant. For the colony to survive and reproduce, there must be a enough variety, quality, and quantity of these nutrients accessible throughout the bee season[5], [6].

DISCUSSION

In certain blooms, bees will find lots of nectar to meet their sugar demands, while in others, they will find plenty of pollen to meet their protein needs. The requirements of bees may vary, necessitating the use of various, sometimes specialized plant species, depending on the time of year and the particular tasks to be completed in the colony. The demands of the bees cannot be satisfied over the whole prospecting time, however, since each flower has a specific blossoming season. Therefore, during their time of need, bees must be able to locate plants with staggered blooming that are accessible from their colony at a distance. The beekeeper will also be interested in this staggered blossoming since he or she will be able to get honey with unique flavor and qualities because of the particular flowers involved. Due to all of these considerations, the habitat in wild and semi-natural places must be adequately biodiverse, and agricultural landscapes must have a variety of crops, preferably blended with nearby natural areas for foraging[7], [8].

What Bees Do for the Environment

The primary function of bees in the environment is flower pollination. Bees pollinate a large number of blooming plants, including many food crops and wild species. According to estimates, the majority of insect- and animal-pollinated flowering plant species account for around 80% of all flowering plant species. Bees take nectar and pollen from flowers, and while they do so, they move pollen from the male to the female parts of the flower, causing fructification, which allows the bloom to develop fruit. Fruit production is crucial for the regeneration and viability of terrestrial natural ecosystems, as well as for their capacity to reproduce. Fruits guarantee the ecosystem's functioning by spawning new plants or by being eaten. Bees enable cross-pollination of flowers by flying from blossom to bloom, which promotes genetic dissemination and plant variety.

Additionally, the functioning and resilience of ecosystems are derived from this genetic diversity. Some flowers even need specific plants to cross-fertilize them, which makes bees even more necessary. It has been shown that honeybees have a substantial impact on agricultural pollination. They enhance the quality of fruits and seeds through the way they pollinate flowers or inflorescences, which increases agricultural production by raising the percentage of pollinated flowers and, therefore, fruits and seeds. As pollination decreases, beekeepers are being paid more and more to place their hives close to agricultural areas. It should be mentioned that on a worldwide basis, pollination is considered to have a significantly bigger economic value than bee products. However, bee products often serve as the incentive for beekeepers and support neighborhood services such as food security, income, and health. Bees and their products may contribute to the environment's food chain. Bees themselves may be eaten by birds, hornets, or parasites, for example, and bee reserves may be subject to predatory attacks[9], [10].

Threats from the Environment

Bees and the plants they rely on are both impacted by the climate. Bee physiology, bee activity, and vegetation are all impacted. Flowering patterns may alter over time as a result of climate change, which may shorten the time that bees have access to nectar and pollen. Particularly if the number and diversity of species decreases with shorter blooming times, greater gaps between flowering times, and inadequate output in terms of both quality and quantity, the situation may become catastrophic. Reducing crop variety, increasing plot sizes, and destroying natural areas rich in blooming plants surrounding or within agricultural landscapes all have an adverse effect on biodiversity and, as a result, the availability of sufficient supplies for bees, leading to a fall in pollinators and bee populations.

Pesticide misuse or overuse reduces variety and, in certain situations, is directly linked to bee death. Chemical treatments also limit diversity. The same is true for bee illnesses like varroosis, Aethinosis, and nosemosis, which are both effects of globalization and affect invading species that disrupt biodiversity. The ecosystem might be negatively impacted by honeybees as well. The honeybee benefits from being a generalist since it may consume nectar and pollen from a variety of blooms belonging to various plant species. On the other hand, certain local bees or wild pollinators are more specific or less adaptive[11], [12].

The host plant may become extinct as a result of a decrease in the variety of plant resources, or pollinator competition for the host plant may grow. It has been discovered that wild pollinators often outperform honeybees in pollinating some plants or situations. Honeybees are not the best pollinators for certain flowers because they may harm the reproductive organs and reduce fructification. There are instances when the influx of honeybees results in aggressive behavior and competition with wild bees. Beekeepers must think carefully and rationally when deciding where to put their hives for all of the aforementioned reasons.

How to Create an Environment that is Favorable to Bees and Other Pollinators

As was said, materials in the ecosystem must be accessible for bees. The same is true for wild pollinators, which utilize the environment both as a source of food and as a place to lay their eggs. The abundance of habitats in the immediate area and their connectedness to one another are both important factors in the availability of natural resources. Pollinators are negatively impacted by the fragmentation of the environment, which separates habitats and limits their ability to travel. Hedgerows and other larger natural or semi-natural regions, as well as pollination-friendly landscape management techniques like intercropping and nectar-rich crop provision, are beneficial to pollinators, especially when diverse natural habitats are otherwise constrained and isolated in plant production systems.

Analyzing the variety and quantity of pollinators in the environment, learning about their biology, using and incorporating any relevant indigenous local knowledge, and tracking their numbers through time are all highly helpful tasks. Fortunately, there are tools available to assist in identifying populations, creating monitoring procedures, and managing landscapes sustainably with the goal of improving pollinator health and supply. These assessment and monitoring techniques and tools are much more crucial and should be required to stop environmental degradation in situations when foreign bees are brought into an ecosystem, the number of colonies is raised, or there is a mass arrival of bees. Both controlled pollinators and wild pollinators may be monitored using user-friendly technologies. Beekeepers are significant environmental stakeholders and have a significant impact on managing the landscape.

They can enhance the environment and persuade others to do the same via their frequent observations of nature, expertise, contacts with other stakeholders, legitimacy with shared benefits from their bees and partnerships, and awareness-raising. Beekeepers, farmers, pastoralists, loggers, custodians of local and indigenous knowledge, managers of watersheds, and scientists are just a few of the many diverse players that might contribute to the management of the landscape. At the landscape level, it is advised to preserve, support, and secure links between some of the essential elements on which pollinators rely, particularly to avoid the construction of great distances without favorable habitats. This may be done by establishing natural regions with local flora that has a variety of densely packed blooming plants that act as nectaries. Natural spaces may grow along streams, surrounding or inside fields or populated areas with hedges, trees, uncultivated regions, or woodlands in agricultural and urban environments.

When agricultural systems are maintained using an ecological strategy, pollinators may also profit from the interactions between agroecosystems and weed control. For nesting and foraging, many pollinators rely significantly on forests, and the amount of forests in a landscape affects the pollination services provided to many wild plants and crops. It is also advised to use diversified management that considers ground-nesting bees and blooming seasons in order to maintain and promote landscape heterogeneity and patchiness with tiny plots of different plants. This broadens the variety and interconnectedness of habitats and supplies for floral pollinator nesting. Ecosystems must be managed so that pollination services are appropriately maintained throughout the year, particularly in areas where honeybees are transported periodically. In farming, in addition to these landscape strategies, integrating spatial and temporal variety may help to increase variability and connection in particular within fields. In order to produce diversity in flora, flowers, and soil, several agricultural strategies may be used to cultivate a variety of crops on small, spaced-out plots.

By cultivating crops that blossom at various times, staggered mowing or harvesting, and intermediate flowering crops, temporal variety may be produced. Forest management in forestry may promote spatial and temporal variation in tree groups and habitats, repair damaged forests, and have a big impact on pollinator diversity and abundance. Selective logging, thinning, or coppicing; controlled mowing or grazing; or planned burning, maintaining a mosaic of burnt and unburned regions, may all be used to increase heterogeneity. In particular, cavity-nesting and ground-nesting bees may benefit by maintaining standing and laying dead wood in forests and making sure there is enough bare ground. Bees are remarkable animals not just for their organization and collective intellect, but also because they pollinate plants, which is a crucial function for both people and environment.

For many beekeepers, keeping bees gives them both joy and food and money. But if beekeeping is to be sustainable, bees and the environment must work together for the sake of both. Beekeepers must be conscious of the local effects their managed bees may have on the environment. They have a duty to protect the environment from their honeybee colonies' damage and to modify their methods in order to maintain sustainability and the ecosystem's natural balance. They have the power to enhance the environment and intervene in landscape management, fostering biodiversity that helps bees, other pollinators, and nature in general. On the other hand, producers must also be conscious of the negative impact that pesticides and all other environmental toxins have on bees. The ministries of every nation must make sure that any pesticides that enter the market have no negative impact on the environment, the health of people or animals, or any other unwanted repercussions. Beekeepers, farmers, and other interested parties should take responsible action with policymakers to safeguard bee populations, environmental quality, and biodiversity. That is likely the only way to guarantee future generations' access to food.

CONCLUSION

In conclusion, it is impossible to emphasize the importance of bees as environmental guardians. Their extraordinary contribution to our agriculture, biodiversity, and ecosystems highlights how vital it is to preserve a stable and healthy environment. Bees enable the reproduction of innumerable plant species, including many of the crops that support human existence, via their pollination services.Bees, however, are under danger from a number of serious environmental problems that endanger both their health and the ecosystems they sustain. Urbanization and intensive agriculture are the main causes of habitat loss, which disturbs the natural landscapes that bees rely on. The usage of pesticides, especially neonicotinoids, puts bee health at risk directly, while climate change modifies resource availability and exacerbates stresses. Additionally, Varroa mites and other illnesses and parasites decimate bee colonies all over the globe.Not only should bees be protected from these environmental hazards, but also the delicate web of life that depends on their pollination services. Prioritizing conservation initiatives, such as developing bee-friendly habitats, implementing sustainable farming methods, controlling the use of pesticides, and funding studies into the resilience and health of bees, is crucial.

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CHAPTER 8
AN OVERVIEW OF BEE SPECIES: GENUS APIS

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ABSTRACT:

Some of the most well-known and commercially significant bee species worldwide belong to the genus Apis. The important bee species found in the genus Apis are briefly summarized in this abstract, emphasizing their distinguishing traits, range, and importance.Possibly the most well-known species in this genus is Apismellifera, sometimes referred to as the Western honeybee. It is praised for its function as a pollinator, producer of honey, and supporter of international agriculture. Apismellifera, which has its roots in Europe, has been domesticated and grown as several subspecies all over the globe.Apiscerana, the Asian-native Eastern honeybee species, is another important species. This bee species is valued for its durability in many climates and has economic and cultural importance in many Asian nations.The Giant honeybee, Apisdorsata, is notable for the size of its colonies and its unique nesting habits. It is indigenous to South and Southeast Asia and is very important for pollination and honey production.

KEYWORDS:

Honeybee, Hymenoptera, Nectar, Pollen, Pollinator.

INTRODUCTION

Only eight out of the 20,000 species of bees, with a total of 43 subspecies, are honeybees: Apiscerana, Apisdorsata, Apisflorea, Apisandreniformis, Apiskoschevnikovi, Apislaboriosa, Apismellifera, and Apisnigrocincta. The behavioral ecology, eating, and reproduction of honeybees are briefly discussed at the beginning of this chapter. The emphasis shifts to include Apismellifera, Apiscerana, Micrapis, and Megapis after that. The goal of this chapter is to provide a short overview of the behavioral ecology, nutrition, and breeding habits of Western and Eastern honeybees. It primarily focuses on behavioral features at the individual and group levels that may be threatened by contemporary concerns such pesticide exposure, nutrient-poor settings, and unpredictable weather. Additionally, it offers recommendations for enhancing bee welfare by highlighting best practices for sustainable beekeeping and healthy bee behavior.

A superorganism called the colony

A superorganism is made up of many members of the same species working together synergistically. Eusocial insects, like the honeybee, are the ideal illustration of such complex systems since they depend on labor division among specialized units. Each unit relies on the health and efficiency of the others in order to survive, and they all work together to create the organized colony dynamic. A healthy hive of honeybees normally has three adult castes: the queen, workers, and male bees, sometimes known as drones. The average number of honeybees in a healthy hive is between 5,000 and 65,000. The queen bee, who may produce up to 250 000 eggs a year, is the only actively reproductive female in the beehive[1], [2].

The biggest caste, which is solely composed of infertile females and forms the foundation of the colony, is the labor caste. Worker bees are assigned responsibilities inside the hive based on their age. Bees advance from inside-the-hive chores to those outside the hive, albeit this follows a rather flexible pattern. Younger bees often begin by cleaning and capping cells before moving on to brood and queen caring. They proceed to nest-building and food-handling duties after that, followed by hive guarding. Older bees are in charge of outside tasks including foraging. While drones immediately perish after mating, they are in charge of fertilizing virgin queens during their nuptial trip. This technique allows for the selection of advantageous features across many generations and guarantees that the beehive has sufficient genetic variety. When food becomes limited, drones who are unsuccessful during mating season are expelled from the colony[3], [4].

DISCUSSION

Communication among honeybees

To communicate, honeybees release pheromones unique to each caste. Queen signals are a complex blend of chemicals produced by the queen bee that help workers and drones. She controls behavioral and physiological systems to keep the beehive stable, maintain social peace, and enforce reproductive hierarchy via this chemical communication. This entails controlling worker behaviors, preventing worker reproduction, and preventing the development of young queens. The degenerative dynamics that occur after the queen's unintentional death provide as proof of the pheromones' exclusive function. If the colony is unable to produce a new queen, the extended absence of queen signals causes the castes to be unable to carry out their individual duties and ultimately results in the colony's demise. Although worker pheromones are not as important as the queen's signals, they are just as important for sustaining colony dynamics, helping to control worker behavior, and connecting with food marking and foraging[5], [6].

They also exhibit protective behavior as a result of the release of alarm pheromones. Drone pheromones are mostly associated with mating, highlighting the comparatively little role played by male bees in the dynamics of the colony. Honeybees also employ dancing, a highly specialized form of communication. It is believed that ritualized dances, which are essential to nest-site construction, developed in this environment. Foragers employ the "waggle" dance to communicate details about the whereabouts, nature, and aroma of a food source. The returning worker inserts herself in a certain location of the hive and starts waggling her abdomen while walking straight. This is done when a new food source is discovered. She then makes her way back to where she started by roughly following the shape of an eight. The direction and distance from the nest to the foraging area are communicated via the waggle dance. Depending on the quality and accessibility of the food supply, it might be repeated. When supplies are harder to obtain, geographically grouped, or of varying quality, this nest-based communication is useful for foraging.

Honeybee intelligence

A honeybee brain has a volume of around 1 millimeter. Bees possess exceptional cognitive skills that were originally thought to be unique to creatures with bigger and more sophisticated brains, despite their little size. In controlled laboratory conditions, honeybee cognition has been the subject of several investigations to better understand its mechanisms and processes. The first person to explain bees' capacity to recognize various flower designs was Karl von Frisch. Additional research indicated that honeybees can also recognize the direction of such patterns and pick up other skills like symmetry, with a preference for more flower-like symmetries like radial and circular. Additionally, honeybees may be taught to navigate labyrinths and mazes by imitating colors and symbols, and more recent research has shown that they are capable of counting up to four items while flying[7], [8].

Bee cognition has been extensively studied in the literature, and it is unquestionably regarded as a distinguishing trait of the species. Foraging success depends on the ability to learn and remember. Bees learn to correlate fragrance, color, texture, and patterns with favorable rewards, such as nectar and pollen, by observing the visual and olfactory cues used by flowering plants to entice pollinators. But how can a bee choose among so many distinct flowers, each with a unique look and reward characteristics? The most valued flowers in terms of nectar and pollen are finally chosen by bees. They are drawn to flowers at first by their intrinsic inclinations and then come back to them because of their experiences. In order to locate and identify significant forage supplies and increase the effectiveness of each foraging excursion, bees depend on the integration of these multisensory signals.

The complexity of cues affecting bees' decision-making is further shown by studies that have revealed blossom temperature as another characteristic influencing this reward-driven process. Bees' cognitive skills let them function well in a challenging, sometimes disorganized environment of sensory stimuli. We shall discuss how human and environmental stresses are now threatening these brain processes later on in this chapter. Personality is defined as a collection of behavioral traits that are persistent throughout time and context in a person's life. This is known as individual and collective personality in the study of behavioral ecology. Worker bees have previously shown how they switch between tasks based on their age, displaying a unique behavioral repertoire that is task-specific. Even among individual workers doing the same activity, persistent personality variations in bees have been seen in a variety of circumstances[9], [10].

People may have aggressive tendencies, accomplish activities with varying degrees of activity, and engage with others more or less. The idea of personality may be used at the colony level in highly integrated eusocial insect systems. varied colonies are known to behave differently and engage in varied amounts of activity, varying in their foraging efforts, defensive reactions, comb repairs, and undertakings. Different colony personalities may result in disparities in reproductive success and survival because natural selection plays a significant impact at the colony level. Colonies that are collectively more active when foraging have access to more of the resources needed to maintain the hive's structure and provide food for its inhabitants, which leads to a hive that is more productive. Even though the relationship between higher defensive reaction rates and increased survival chances is less clear, they are related. Honeybee personality research is crucial from a scientific standpoint, but it also helps us protect bees and, hopefully, stop their further decline by providing a more sophisticated understanding of how environmental and human-caused changes may affect colony temperament and performance.

Threats to the behavior of honeybees

Much attention has been given to potential dangers to the health of pollinators after alarming trends in their numbers of honeybees and other pollinators were noticed. Many have been noted, such as the depletion of floral resources in the environment, climatic stressors, and chemical exposure. All of these elements work together to reduce bees' general fitness and raise their vulnerability to illness and colony collapse.

Pesticides

Pesticides may be especially hazardous because they obstruct the cognitive functions that allow superorganism survival at the behavioral level. The primary active ingredients of many commonly used pesticides are neurotoxins, which have deadly or non-lethal effects on the neurological systems of bees. A sublethal amount of exposure may not cause the bee to die right away, but it can harm its cognitive functions, often resulting in behavioral impairment. Regardless of the chemical administered, adverse effects all have an influence on general cognitive function, with learning and memory processes continually being negatively impacted. The memory mechanisms required for navigation from the hive to flowers may be interfered with, preventing the bee from correctly navigating sensory signals leading to significant foraging resources.

Additionally, navigation may be hampered, especially in terms of energy consumption and the transport of food back to the hive. As the colony's overall health declines, so does the desire to forage. The outcome is irreversible decrease, which finally results in colony extinction. Recent research has also shown how the queen's exposure to pesticides throughout her development alters her pheromone production and mating behavior, potentially leading to colony collapse. Therefore, there is a need for careful pesticide management in agriculture to safeguard pollinators from toxic substances that might reduce their overall fitness and prevent the physiological development of structures that are essential to their behavioral ecology. A concern to the quality and security of bee products is pesticide exposure. Pesticides should be tested on bee products before they are sold to consumers. Furthermore, beekeepers often use miticides, which infect young bees and bee products, to fight pests like the mite Varroa destructor. The prudent use of medications to bees is essential for this reason as well.

Climate change impacts on landscape composition

The behavior and productivity of the colony are greatly influenced by the surroundings. Because of their many adaptations, honeybees can live in a variety of habitats. Nevertheless, honeybees are becoming more and more harmed by environments with limited resources. Ecological deserts are often produced by intensive agriculture and poorly managed semi-natural regions, which fail to feed honeybees and other wild animals with enough nutrients, causing habitat loss and resource fragmentation. When these factors are added to the present climate uncertainties, they all become much more worrying. Researchers are unsure if gradual changes in climatic factors including temperature, humidity, water availability, CO2 levels, and UV radiation would have an impact on plants' capacity to produce high-quality nectar and pollen. To better understand the connection between climate change and honey production, beekeepers may work with scientists to collect data and monitor environmental factors. The possible harm that a changing climate may have to the well-being of honeybees is difficult to estimate. We must be careful when deciding which factors may further affect bees' capacity to adapt to resource scarcity given how degraded contemporary environments already are. Environments that are now lucrative might gradually stop producing, which would lead to less effective production and even colony collapse.

Encourage bee wellbeing

A strong sustainable beekeeping model should constantly prioritize actions that support biologically sound and secure settings, enable the expression of inherent behavior, and lessen pain and suffering. Although hives provide the bees a good habitat, the environmental and human-induced constraints on the surrounding landscapes nevertheless have a significant influence on their wellbeing. The key to physiologic health and nutritional balance is creating an environment that is suited with a variety of foraging options accessible throughout the foraging season.

This is why we advise beekeepers to think about involving agricultural producers and organizations in their framework for responsible beekeeping. The public might provide a lot of assistance as honeybees become a more prominent species. It is now hard to decrease market demand for goods that need heavy honeybee labor, but changing demand to sustainably produced bee products could be a viable option. Campaigns to educate the public about bees, biodiversity, and organic foods will also help them understand the issue. Similarly, raising consumer demand for sustainably produced beekeeping goods might benefit the interests of bees, beekeepers, and the environment by raising awareness of the need of healthy bees and sustainability.

Protecting floral variety can help bees' diet and health.

Depending on the plant type, pollen has a wide range of nutritional value. Adult worker bees depend on flowers' nectar and pollen supplies. These foods provide the protein, carbs, fats, and other nutrients needed to sustain normal biological functions. The mass blooming crops that are mostly grown in monoculture farming could not provide enough nutrition for a balanced diet of honeybees. It has been shown that nutritional deficiencies make bees more vulnerable to infections and susceptible to illness. Beekeepers need to be mindful of the effects that a nutrient-poor environment might have on the health and productivity of their hives.

Crop rotation and organic farming are examples of agricultural pollinator-friendly activities that should be supported and valued in a sustainable beekeeping paradigm. Beekeepers need to be encouraged to locate their hives next to agricultural polycultures that support a variety of plants and animals. Including wildflower patches among agricultural cultures may also assist to guarantee a diverse bee diet. Adding spaces appropriate for hatching and foraging, enhancing the supply and accessibility of natural shelters, and creating corridors to reconnect fragmented habitats are all actions that may be taken in urban and semi-natural environments.

Managing stressors and avoiding pesticide exposure

Beekeepers should take into account the effects of stress on honeybee wellbeing in order to increase output and protect the welfare of a colony. The detrimental consequences of oxidative stress on a variety of physiological functions in bees are well-known. As was already noted, large-scale agriculture relies on pollination, and it has been shown that migratory beekeeping methods are linked to higher exposure to stressors and shorter lifespans. Oxidative stress, which has both modest and significant detrimental impacts on bee health, is a consequence of poor nutrition due to nutrient-limited availability, recurrent evaluation and readjustment to new environmental settings, and increasing exposure to agricultural chemicals. Chronic stresses are considered to be linked to colony failure because they may impair the immune system, metabolic functions, and cognitive function. Therefore, it bears emphasizing how important it is to avoid pesticide exposure. A network of communication between beekeepers and nearby farmers would provide efficient communication and permit the temporary transfer of bee colonies in situations when the use of pesticides may be absolutely essential. Cooperation between beekeepers and farmers would grow if more information on the importance of bees for pollinating certain crops was made available to farmers. Finally, beekeepers may work together to develop regional databases that monitor threats as well as positive or negative trends in bee production and overall health conditions.

CONCLUSION

The improvement of honeybee health and welfare is a job that calls for a lot of group work. We must emphasize that even though we have listed a number of potential remedies, there may be interactions between many man-made and natural problems that we are unable to control. Given these constraints, the focus of sustainable beekeeping should be honeybee behavioral ecology. In summary, we should encourage the management of organically in the vicinity of apiaries, preserve agricultural variety, and think about introducing bee-friendly plants while protecting wild plant species. Beekeepers should get training on how to maintain robust, healthy hives, and incentives should be put in place for them to manage their livestock and/or crops in a low-impact manner. It is necessary to invest in technology that will enable the development of a trustworthy network of data on population trends, together with the development of a monitoring system to identify anomalous death rates associated with pesticide overuse. In order to properly aid beekeepers and ensure that veterinary products are used appropriately, veterinarians should have the proper training. The use of native bees should be promoted since they are better equipped to cope with the limitations of their natural habitat. More broadly, efforts should educate the public on the significance of the ecosystem services provided by bees and the need of healthy pollinators and biodiversity in contemporary society. Finally, we must promote industrial goods made from materials with an agricultural or animal origin that are responsibly maintained. The present situation can only benefit from a more ecology-centered approach, which will increase awareness and provide the knowledge required for advancement and further active involvement.

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CHAPTER 9
VETERINARIAN DRUGS AND DISEASE CONTROL

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ABSTRACT:

Drugs used by veterinarians and disease management are essential for protecting animal health, assuring the safety of food, and reducing the threat of zoonotic infections. This abstract offers a succinct review of the critical relationship between veterinary medications and disease prevention, highlighting the importance of these treatments for both veterinary and public health.Pharmaceuticals used in the diagnosis, treatment, and management of disorders in animals are referred to as veterinarian medications. These medications are essential for preserving the health of wildlife, domestic pets, and farm animals. In order to battle infectious organisms, parasites, and other health concerns, disease control techniques significantly depend on the responsible and effective use of these medications.Effective disease management in animals is crucial for safeguarding human health as well as animal welfare. Zoonoses are illnesses that may spread from animals to people, making disease prevention and control in animals an essential first line of defense in protecting the public's health. When used wisely, veterinarian medications may aid in ending the cycle of disease transmission from animals to people.

KEYWORDS:

Antiparasitic, Disease Prevention, Disease Surveillance, Drug Resistance, Epidemiology.

INTRODUCTION

There are several foundations of beekeeping that remain constant despite the fact that methods might vary greatly based on the location and level of output. The GBPs for the Western honeybee are examined in this chapter. This word is "integrative activities that beekeepers apply for on-apiary production to attain optimal health for humans, honeybees, and the environment."

The use of GBPs favors excellent production standards while also having a good impact on colony health and society. Additionally, GBPs assist beekeepers in deciding on the most robust and sustainable tactics at the apiary level. The following basic advice, when appropriately followed, may help in avoiding or at least decreasing harm to honeybee colonies, even if each unique honeybee illness or parasite has its own specialized management strategies. GBPs fall under the following categories, according to the World Organisation for Animal Health-FAO categorization of good agricultural practices: general apiary management, veterinary medications, disease control, cleanliness, bee feeding and watering, record-keeping, and training. There is a list of appropriate actions for each subject[1], [2].

DISCUSSION

General administration of apiaries

1. Choose apiary locations carefully, staying away from windy, excessively humid, or flood-prone regions. Aim to locate the apiary as far away from pollution sources as you can, preferably in a location with plenty of melliferous and polliniferous plants and next to a road.
2. Position the hive in a stable location that is easy to reach and enables for winter checks.
3. When necessary, do beehive maintenance.
4. Avoid putting beehives down on the ground. When the threat of predators necessitates taking these measures, bees should be maintained on stands and hives should be safely enclosed.
5. When visiting honeybee hives, use safety shoes and personal protection gear. • Prefer working in areas with guaranteed cell coverage and avoid working alone in the apiary.

Keep a safe distance from the apiary and take note of any nearby residences, buildings, or schools. The apiary should generally be at least 5 to 10 meters away from nearby properties or roadways, but you should always check your local or national laws to make sure that legal distances are also observed. Assess the area's capacity for melliferous and pollen as well as its access to water. Install the number of hives necessary to sustain the bees throughout the season while not exceeding the capacity of the environment. Do not leave beekeeping supplies in the apiary; maintain it clean, and make sure the hive entrances are not blocked by shrubs or thick grass. Regularly cutting the grass in front of the hives may assist identify unusual bee mortality. Maintain a healthy balance between the number of hives and the quantity of pollen-producing plants in the region. This may be inferred from your hives' output[3], [4].

Manage hives based on the area, the season, and the colony's health. To maintain healthy colonies, replace queens at least every two to three years. Prevent swarming through colony splitting, installing supers, adding fresh wax foundations, removing entrance reducers, and choosing queens with a low propensity to swarm.

To reduce comb in the honey chamber and improve honey quality, use a queen excluder. During the warmer months, enlarge the hive entrance. Maintain active colonies with enough of healthy workers, excellent laying queens, and enough honey and pollen reserves. Only a steady, ample supply of pollen and nectar can allow for this. Identify the queen bee based on her birth year.

Place hive openings so that the light may shine on them all day long, beginning in the morning. This makes it feasible for the bees to begin working as soon as possible, even on colder days. To simply keep track of combs and make sure they are changed on a regular basis, mark the age of the combs on the top bar of the frame. Check to see whether the hive has enough supplies. To preserve the operators' health, have corticosteroids or other medications on hand during apiary inspections. Installing hives in a way that offers the best working circumstances is important. This includes avoiding slopes and soil that is uneven or slippery, adjusting the height of hive stands to promote proper back posture while working, limiting the weight that may be lifted, and using back protection devices as necessary. Keep your workspace tidy. To lessen risks from ticks, snakes, and fires, mow the grass occasionally[5], [6].

Veterinarian drugs

GBPs are often the greatest method for preventing illness and may lower the need for medication. Don't treat bees with substances that are prohibited or unlicensed. Use only veterinary drugs and foods that have been lawfully imported into your country or that have been registered particularly for honeybees. Don't use unapproved therapies, and make sure you follow the directions while doing any surgeries or treatments. Always heed the advice of your provider, and utilize safety equipment as necessary. When selecting and administering medications for disease prevention, use extreme caution since the majority of these compounds readily contaminate honey and hive equipment, breed diseases with heightened resistance, and weaken bees. Only provide treatments when necessary. The decision should be made with low-impact medications in mind.

Mechanical/ biological control may be the best first and second option; it is undoubtedly the safest in terms of hive product contamination with drugs and danger to human health. Organic beekeeping practices focus on pest management techniques that are good for bees, bee products, and human health. Before selling bee products, appropriate testing has to be done to confirm that there are no residues. Keep track of therapies in a special diary. Make sure that any equipment you use for application are suitable and properly calibrated for use. Use biosecure disposal techniques when discarding old tools and equipment. Always verify the expiry date and observe the necessary storage requirements for veterinary medications and food.

Disease Control

Purchase new bee colonies only after thoroughly checking them for diseases, ideally with a health certificate; keep them apart from the current stock for a sufficient amount of time to monitor them for illnesses and avoid transmission. Ideally, employ young worker bees or combs containing hatching bees to strengthen weak colonies. Only healthy, robust colonies should be kept in the apiary. Colony strength should be balanced across colonies, but the ratio of nursing bees to brood should not be out of balance. Monitor the health of the hives by doing thorough inspections on a regular basis. An integrated pest control strategy eliminates the need for pointless treatments and the development of medication resistance. Be sure to thoroughly examine hives for clinical indicators of bee illnesses and the existence of the queen before supersizing. In the case of notifiable diseases, according to the directions of the veterinary rules and relevant authorities[7], [8].

In the spring and at the conclusion of the beekeeping season, thoroughly check hives for the existence of the queen and any clinical indications of bee illnesses. If sick hives are discovered, isolate them and take precautions to stop the spread of the illness. Before establishing new colonies, remove all beekeeping equipment and carefully clean the area in the case of contagious illnesses. Verify any illness symptoms as soon as possible by consulting a specialist, veterinarian, or more seasoned beekeeper. If necessary, gather samples for laboratory examinations after discovering unwell or deceased bees. As soon as possible, remove deceased colonies and isolate sick beehives. If flames are not permitted, carefully bury the dead colonies distant from any apiaries. Burn the dead colonies before burying them. All combs from dead or damaged colonies should be removed and processed for wax. Burn the combs if there is an outbreak of American foulbrood. Keep track of the colonies' health. every year, replace 30% of the hive combs. Choose the honeybee stocks with the greatest performance. Choose and breed colonies that are more tolerant of or resistant to illness. Choose queens that are more disease-resistant and climate-adapted in your area. Maintain weak or newly acquired colonies in a quarantine apiary.

Take considerable caution while moving combs and hives. To prevent the transmission of illnesses, only healthy hives should be used for migratory beekeeping. In the same way, avoid moving sick combs across apiaries or from one hive to another. If the health of the hives is unknown, avoid moving frames, hives, or any other biological material between them. Ask your wax source for the lab analysis findings regarding residues and composition if wax foundations are offered. Use only bees and brood combs from healthy colonies for starting fresh nuclei. Make sure they are thoroughly inspected to rule out any signs of illness or parasites. When necessary, seek out professional assistance. It is far simpler to avoid an error than to fix the harm it has done. Make an effort to organize the hives so that every bee in the apiary may easily return to its own hive[9].

By doing this, disease and drift transfer between colonies will be reduced. Avoid cramming apiaries or having too many colonies in a single row. Maintain a spacing of at least one meter between hives. Paint numbers or identifying signs on the entrances of the hives. By raising hive entrance sizes in the warm season and decreasing them in the winter, thermal strains may be reduced. To prevent heatstroke, move or transport bees during the cooler parts of the day and make sure the hives have enough apertures for air flow. To avoid robbery and the potential for persistent infections to move among colonies or to other apiaries, do not dispose of honeycomb, wax, propolis, or other hive products close to the apiary. Equipment for the beehive should be clean, including gloves. To avoid spreading the infection to the healthy hives, only check on diseased hives at the conclusion of apiary inspection. Additionally, after looking over an infected colony, clean the instruments you used and, if feasible, use disposable gear like rubber gloves.

Hygiene

Keep the hive tidy. Beekeeping tools and hive components should always be maintained clean and in excellent functioning condition. Equipment should be regularly cleaned, sterilized using an autoclave or gamma rays, and disinfected wherever feasible using a torch, NaOH, or hypochlorite. Clean used apiary equipment and old hive components that were purchased or obtained from dubious sources. Control unidentified swarms or hives for honeybee illnesses while keeping them in a quarantine apiary to make sure the bees are healthy before bringing them to the apiary. In situations of contagious infections, use hot, high-pressure water to disinfect hives and hive gear. Observe the norms of hygiene. Deal with deceased colonies with care and proper cleanliness. After checking hives harboring contagious illnesses, sterilize all levers and other possibly contaminated machinery. Maintain all documents pertaining to cleaning and disinfecting equipment or beehives, as well as any records demonstrating that these processes have been successfully carried out. Note the manufacture and usage of all cleaning agents and consumables. To prevent interaction of honey with C. botulinum spores, do not set honey supers directly on the ground and keep supers away from dust while moving supers from the apiary to the honey house. Make sure you are knowledgeable with the production of hygienic honey, including hygienic honey extraction and handling.

Techniques for enhancing/supporting the apiculture of Apismellifera

It is necessary to put in place support measures that are targeted exclusively at beekeeping and the beekeeping sector. These need to center on two things: (1) include beekeepers in the larger agriculture discussion; and (2) enhancing beekeepers' knowledge and abilities so they can implement GBPs and strengthen their resilience. There is mounting evidence that the use of GBPs, and specifically the degree of beekeeping education and disease management, are directly related to the performance of a sustainable company.

1. Honey production is just one aspect of beekeeping. The following suggestions are made in order to enhance or help the industry:
2. Encourage the growth of small and medium-sized businesses, innovation, and equipment modernisation.
3. Encourage ongoing education in sustainable beekeeping.
4. Encourage the use of local honeybee subspecies.
5. Put in place marketing/control strategies that support high standards for hive goods.
6. Encourage the growth of beekeepers' organizations.
7. Support a multisectoral strategy that allows producers to interact with institutions, experts, and stakeholders at many levels.
8. Supply consolidated data to help beekeepers make decisions.

Illnesses, Parasites, And Pests of the Apex Species

Beekeepers must maintain a healthy population of honeybees in order for them to perform their necessary and useful functions. The main barrier to improving the quality of honey production is illness and pests, which are present in many nations. Research to discover methods of avoiding or managing them is ongoing in many areas of the globe, but since the Asian and African bee industries are still developing, there hasn't been much done to study bee illnesses there, especially in Africa. Africa is home to the majority of the viruses, parasites, pests, and predators that have an impact on the health of honeybee colonies worldwide. Southeast Asia is home to most honeybee species, and some parasitic mite species have Asian honeybees as their natural hosts.

In Asia, the cohabitation of many honeybee species and the parasitic mites that accompany them may encourage the transfer of parasites between them as well as concurrent infestations by various mite species at the colony or individual levels. The capacity of the beekeeper to implement appropriate pest and disease management strategies determines whether beekeeping with the Apismellifera is successful or unsuccessful in various regions of Asia. Since A. mellifera is the only honeybee species that has been brought to a continent that already has many native species of Apis, colonies of this species are vulnerable to invasion and attack from all of the native bees' natural enemies in addition to their own. Bee mites, hornets, and microbiological illnesses are among the most significant, however wax moths, birds, and animals all provide a hazard. Evaluation of bee health in South America is challenging due to the continent's size and extreme diversity, which includes a broad variety of temperatures, elevations, and beekeeper types[10].

CONCLUSION

In conclusion, the efficient use of veterinary medications is a crucial instrument in the battle against illness in the animal world. Through the appropriate and prudent administration of these pharmaceuticals, the profession of veterinary medicine plays a crucial role in preserving animal health, maintaining the safety of food, and protecting human health.Veterinarian medications are crucial for treating and preventing infections in companion animals, wildlife, and cattle in addition to livestock. However, their usage need to be constrained by rigorous moral standards, regulatory control, and a will to stop the spread of antibiotic resistance.Additionally, illness management in the veterinary arena goes beyond drug therapy. It requires a comprehensive strategy that includes immunization, biosecurity precautions, cleanliness rules, and instruction. Veterinarians make a substantial contribution to upholding animal welfare, protecting biodiversity, and improving public health by using these tactics.

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CHAPTER 10
BEEKEEPING TECHNOLOGY ADAPTATIONS FOR AFRICANIZEDBEES

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ABSTRACT:

Beekeeping, a vital agricultural activity across the globe, has encountered particular difficulties in areas where Africanized honeybees, sometimes known as "killer bees," have become entrenched. This summary gives a general overview of the cutting-edge technical innovations and management techniques used to control populations of Africanized bees while maintaining honey production and pollination services.Africanized bees, which are descended from African honeybees brought to the Americas, are infamous for their aggressive characteristics and propensity for protective swarming. These characteristics created serious concerns to beekeepers, which prompted the investigation of innovative beekeeping techniques in regions where Africanized bees are common.

KEYWORDS:

Africanized Bees, Apiculture, Bee Management, Beekeeping, Colony Behavior.

INTRODUCTION

Africanized bee technological adjustments are now required in areas where these aggressive and extremely defensive hybrid bee populations have been established. In the middle of the 20th century, Africanized beesoften called "killer bees" owing to their aggressive behaviorwere first brought to the Americas. Since then, they have multiplied and interbred with populations of European honeybees, posing a special set of difficulties for beekeepers.The creation of customized protective equipment is a critical adaptation. The increased inclination of Africanized bees to swarm and attack ostensible dangers is well recognized. To reduce the danger of stings, beekeepers operating with these bees need upgraded protection gear and clothing. This includes multiple-layer bee costumes, veils that cover the whole body, and gloves composed of materials that provide further protection[1], [2].

Designing and managing hives is a big adaption as well. Africanized bees are more likely to defend their colonies, and the swarming behavior they exhibit may enhance hive hostility. In order to adapt, beekeepers have created hives with greater protection for both the bees and the beekeeper. In order to stop swarming, they may also use strategies including routine hive inspections and the elimination of queen cells.Programs for selective breeding have also become popular as a way to control populations of Africanized bees. Beekeepers may lessen the impact of Africanized genes in their hives by selecting European honeybee queens who exhibit desirable characteristics like gentleness and less aggressiveness. A more regulated and managed beekeeping experience is made possible by this method[3], [4].

DISCUSSION

The Africanized Honeybee is covered in detail in the next chapter. It is a hybrid bee subspecies that was unintentionally introduced in Brazil in the 1950s and consists of European and African bee subspecies. In addition to much of South and Central America, it has expanded as far south as northern Argentina and as far north as the United States. Even though the experiences described here were mostly obtained in Brazil, the advice given for the particular care of that bee may be regarded as being generally relevant.

Services and goods

In Brazil, Africanized bees primarily produce honey, propolis, beeswax, pollen, royal jelly, and bee venom, in that order of economic significance. Although bees are also used to pollinate other crops including coffee, strawberries, and some others, pollination may be a significant source of revenue in specific parts of the country, particularly for melons in the north-east and apples in the south.

Africanized bees and good beekeeping practices

Understanding how Africanized bees vary from European bees, for whom the majority of beekeeping techniques were created, is crucial to managing them effectively. Africanized bees are a hybrid of several European and African bee subspecies. Because Africanized bees prevail in tropical and subtropical environments, they are known as "Africanized" bees. They are genetically 85–90% African in these climes of South America. In their native temperatures, Africanized honeybees outperform temperate-climate bees in terms of defense and productivity, but they are noticeably gentler in colder climes. Africanized bees tend to be more protective around the equator and at lower elevations, and less so when placed at high altitudes and less tropical areas. Although Africanized honeybees were initially thought to be a problem in Brazil, it soon became clear that they had many benefits, one of which was that they produced more honey than the European bees that they replaced. Beekeepers also started to adapt and develop the necessary technology to handle them. When Africanized bees initially started to expand over Brazil in the early 1960s, some beekeepers maintained them in simple box hives and other locally created hive designs. The common Langstroth hive, which was already predominate, was the only alternative available to the nation since it quickly became clear that it was impossible to manage these new bees in anything other than movable-frame hives [5], [6].

Using Africanized bees for beekeeping

The majority of bee colonies are free, and it is simple to capture fresh swarms and expand colony sizes. Africanized bees can reproduce rapidly, and in the wild, colonies and swarms are frequent occurrences. Because of this, many beekeepers use bait hives to attract the colonies they need to maintain or grow their hive numbers rather than purchasing or splitting colonies. Beginners may just purchase or construct an empty hive and draw a swarm rather than having to purchase bees. 5-frame or complete 10-frame hives may be used as bait hives. Due to the bees' attraction to the scent of wax and propolis, older hives perform better than new ones. A piece of old beeswax may be added to a new box to enhance appeal, or the entrance can be sprayed with an extract consisting of propolis and old beeswax. Beekeepers insert a little strip of beeswax foundation into each frame to encourage a fresh swarm to construct its combs there. These bait hives may be positioned on the ground in the shade or suspended from trees. The first blooms opening during a robust honey flow, particularly after a period of scarcity, is the greatest time to put bait hives. Beekeepers get familiar with the swarming paths and seasons in their area. The ideal locations for bait hives are a clearing in a forest, the border of a woodland, or under a tree in a field. Additionally, they may be positioned in suburban and urban areas to draw swarms that might otherwise assault structures. It takes a considerably less effort to catch a swarm in a bait hive than it does to remove a colony from a roof or another area of a structure[7], [8].

Africanized bees are much more primitive and disease-resistant.

Because of their more advanced hygiene practices, they promptly eliminate aberrant brood, breaking the contagious cycle of disease organisms. Africanized bees are Varroa-resistant. These bees have lower infection rates than European bees do. Antibiotics and acaricides are not used to treat colonies. As a result, there are no leftovers from these ingredients in the honey that is produced.

Bees from Africa make more propolis.

The Africanized bee utilizes propolis lavishly, sometimes even covering most of the entrance, unlike many varieties of European bees that have historically been bred for decreased propolis production. This is probably a reaction to the unfavorable climatic circumstances in their native home, where the bees can somewhat control the weather and pests like ants by plugging holes and gaps with propolis. Propolis is now one of the most significant hive products in Brazil, and significant amounts are utilized to create a variety of extracts for use in medicine and pharmaceuticals. Brazil has recently started exporting both raw and processed propolis to nations like China, South Korea, Japan, and others. Much of it is used to make skin cream, shampoo, toothpaste, and other products that are marketed domestically as alcohol extracts or aqueous mouthwashes, sometimes combined with medicinal plants[9], [10].

Africanized bees survive and produce honey in places where European bees cannot. Many of Brazil's biological zones, including the country's tropical rainforests and, in particular, the arid, savannah-like Cerrado and Caatinga regions in the northeast, were unsuitable for beekeeping since the environment was too severe for European bees to survive. On the other hand, Africanized bees thrive in these kinds of climates, and colonies managed in these places produce a lot of honey.

Africanized bee colonies multiply quickly.

When robust colonies are required for the production of honey, this makes the job of the beekeeper simpler. Compared to European bees, relatively tiny swarms grow into robust, productive colonies faster. Africanized bees have more nimble foraging abilities, more prolific queens, and worker brood development that takes 19–20 days as opposed to 21 days in European bees.

Dimensions of the apiary

Apiaries were once situated close to homes and domestic animals, until Africanized bees arrived in Brazil. On shared hive stands, the hives were maintained near to one another. Beekeepers had to shift their apiaries farther away from humans and confined cattle as a result of the new bees' ferocious self-defense. The bees from the colony being handled would agitate the other colonies, therefore they discovered that it was preferable to maintain the colonies further apart. Similar issues existed with colonies housed on numerous hive stands. All the colonies on the stand would be alerted by the vibrations produced while handling one colony, hence many colonies had to be managed simultaneously. In order to prevent the bees from seeing and attacking neighboring animals and humans when the hives are handled or otherwise disturbed, it is helpful to surround the apiary with shrubs that are at least 2 meters high[11], [12].

Wearing Protective Gear

Defensive bees attack dark, textured clothes aggressively and preferentially. A light-colored straw hat or helmet and a robust, durable veil constructed of metal screening that is painted black just on the inside of the front panel to assist visibility are both examples of good contemporary protective gear. Outside-dark veils, such as those that are often worn, attract enraged stinging bees. These bees may be alarming as they cling to the veil and buzz aggressively, even though they cannot harm the beekeeper. This does not occur when there is a light-colored screen on the exterior. Light, smooth-textured clothing is preferred. In general, beekeepers should wear a large, white or light-colored overall with elasticized wrists and ankles that is zipper-closed. When using gloves, they should be made of smooth leather, light-colored plastic, or rubber. These materials don't typically harm the bees, and unlike rough leather gloves, they don't readily hold onto alarm pheromones. Additionally, light-colored, silky shoes and boots are recommended. Suede, which is a rough kind of leather, quickly develops stinging. Brazil has accepted the white butcher's boots made of rubber because they are affordable and reliable. If visible, socks should be tidy and light in color. Smokers The smoker used for European bees is insufficient for managing bee colonies that have been influenced by Africa. Beekeepers soon discovered that the only smoker that would allow them to control the bees was much bigger and more effective. Smoking the bees before they get out of control is a key guideline since it's typically too late after they do.

Strategies for managing the Africanized honeybee more effectively and efficiently

Honeybees from Africa are very reactive and sensitive. Every action a beekeeper takes with European bee colonies must be taken with more caution while treating Africanized bee colonies. The smoker and its usage are highly crucial. Beekeepers should constantly maintain it lighted, huge, and equipped with an effective bellows since Africanized bees require more smoke, particularly when they are initially acclimating to them. Keep additional charcoal nearby for the smoker. Africanized bees need smoke to be applied before touching the hive, unlike European bees, which may be opened and smoke provided as required based on the bees' behavior. Bees will immediately start to fly out and sting if the beekeeper delays to add smoke, making it impossible for the beekeeper to control them. Work in the apiary is substantially facilitated by using smoke appropriately before the hive is opened and during the first minute after. Africanized bees are good instructors since they respond fast to any mistakes made by the beekeeper, which beekeepers may use to their advantage to learn how to operate with these bees.

When working with aggressive bees, beekeepers often wear sturdy, thick bee jackets, veils that are very well-sealed, and hefty gloves. Near-perfect defense, although the greatest method to prevent being stung, may be detrimental since the beekeeper loses awareness of the bees' responses. When at all feasible, working without gloves is preferred. Gloves for beekeepers should be kept in their pockets and only be used when absolutely necessary. When disturbed, the bees will sting the beekeeper's hands, warning them and allowing them to apply smoke and handle the bees with more care. Beekeepers may "feel" the bees by exposing their palms. They will gradually adjust their handling methods subconsciously until they can interact with the colonies without causing too much disruption. The typical well-sealed bee suit, on the other hand, makes the beekeeper seem more like a bear ripping apart the colony, which irritates the bees. Aside from the beekeeper experiencing an unpleasant swarm of enraged bees trying to pierce their clothing and an apiary of colonies that remain uneasy for hours or days after, enraged bees will fly far outside the boundaries of the apiary and sting neighbors and other people who are not wearing bee suits and veils.

The way we treat bees has a significant impact on their protective behavior. Bees protect themselves if humans treat them rudely. Their goal is to get the intruder to depart. The bees will continue and step up their defense of their colony provided beekeepers are persistent and well-protected with gloves and a bee suit. With clouds of bees surrounding each invader and often gathering on the veil, many other colonies may soon become aware and join in, making work in the apiary unpleasant and hazardous. A hundred or even hundreds of meters away, people or animals may be assaulted. If the bees pose a threat to the neighbors, the beekeeper can then be required to relocate the apiary. Therefore, beekeepers need to understand how to manage their colonies without upsetting them. Smoke should be the first thing to contact the hive.

Make cautious not to disrupt any beehives nearby. If they are nearby, smoke them as well. To prevent the bees from being disturbed by vibrations, hive supports should be robust and unique. Smoke into the aperture of the hive cover after doing so, then into the entrance. The bees will be forced to descend and be encouraged to feed on honey if the cover is removed after that. When beginning to remove a super, each fresh opening has to be smoked. The smoke should be directed such that it penetrates the top of the hive box below as well as the bottom of the super being removed. To avoid leaving the hive open for an extended period of time, go steadily and rapidly. An skilled beekeeper can accomplish this on their own, but it is simpler to handle if one person smokes while the other removes supers and frames. This bee control procedure calls for a sizable, effective smoker.

The first stages are crucial for smoking. It is too late to calm the bees down once they start attacking in the air, therefore it is preferable to seal the hive. These measures may take a little more time at first, but with repetition, bee handling becomes normal and effective. Giving the bees the appropriate amount of room at the appropriate time is a crucial component of regular management. There should always be enough supers to prevent overcrowding in the colonies.

In order to ensure that the bees never run out of room once a honey flow begins, beekeepers must build more supers and collect the honey regularly enough. Africanized bees may swarm extremely quickly, which significantly lowers honey output. Additionally, following the honey flow, make sure the bees have enough food. Africanized bees will elope, leaving the apiary in search of greener bee pastures, as opposed to European bees, which simply deteriorate into a small colony.

What to do with colonies that are very protective

In an apiary, one or a few colonies are often more protective than the rest. If these colonies are disturbed, they may attack the beekeeper and cause the remainder of the apiary to defend themselves. It is advisable to manage these hives last because of this. Requeening or evicting these hives from the apiary might significantly alter the behavior of the bees. This strategy, which may be thought of as a kind of negative selection, is simpler and more fruitful than attempting to breed the least defensive colonies. The general behavior of the bees in the apiary may be improved quickly if the few most defensive colonies are consistently eliminated. But how does one requeen a large, very protective colony? This is easy to do using a number of ways. The defensive hive might be relocated to a different area of the apiary throughout the day as one alternative. The powerful colony will be weakened when the foraging bees return to the previous location. Brood combs that have been sealed up may also be taken out and introduced to other colonies. The colony will grow fairly weak and less protective if the hive is repeatedly moved about the apiary or if brood is removed, which will make it simpler to locate the queen. The bees may also be tossed into a vacant hive with combs, covered with a queen excluder and an empty box, and then smoked down to trap the queen on the excluder and make her removal easier. A extremely protective apiary may be dramatically and rapidly calmed down with the right handling, maintenance, and requeening of the most defensive colonies.

CONCLUSION

Beekeepers must be quick and effective in order to fully benefit from Africanized bees' speed and efficiency. If not, the hive will rapidly get overrun with bees, which will cause the colony to become much less productive and swarm. The foundation of the global beekeeping business is a lengthy history of technological advancements made for European bee breeds. As a consequence, bees have been chosen for their kindness and productivity, and efficient equipment has been developed for the production of honey, royal jelly, and other hive products. However, the Africanized honeybee is sufficiently distinct from the native honeybee that these methods are ineffective when used on it.

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CHAPTER 11
STINGLESS BEES AND GENUS BOMBUS

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ABSTRACT:

The stingless bees and the genus Bombus are two different but equally intriguing kinds of bees that are briefly discussed in this abstract. The genus Bombus, which includes bumblebees, stands out for its attractive look and essential function in pollination, whereas stingless bees from diverse genera throughout the globe have drawn attention for their distinctive characteristics and ecological relevance.Stingless bees, which are common in tropical areas, are notable for their eusocial behavior and lack of a painful sting. Their elaborate caste systems and sophisticated colonies greatly aid in the pollination of domesticated plants and agricultural crops. Meliponiculture, often known as the raising of stingless bees, has gained popularity as a sustainable method for preserving biodiversity and producing honey.The roughly 250 species of bumblebees that make up the genus Bombus are essential for pollination a variety of blooming plants, including those that grow in temperate temperatures. The captivating and effective pollinators of crops like tomatoes and blueberries are characterized by their distinctively huge bodies, fuzzy appearance, and buzz pollination activity. However, bumblebees are threatened by pesticides, climate change, and habitat loss, leading to attempts to preserve and safeguard these important pollinators.

KEYWORDS:

Biodiversity, Conservation, Meliponini, Native Bees, Stingless Beekeeping.

INTRODUCTION

When compared to honeybees, stingless bees are far more diversified. Unlike stingless bees, which are part of the Meliponini family and have more than 60 genera and almost 500 species, most of which are found in the New World tropics, honeybees only belong to one genus and have a very small number of recognized species. They also differ greatly in terms of colony size, body size, and color. In contrast to honeybees, stingless bees have either no sting or a sting that is so weak it cannot be used for defense, yet they may still deliver a devastating bite if their nest is disturbed. Most tropical or subtropical areas of the planet, including Africa, Australia, Southeast Asia, and the Americas, are home to stingless bees. Africa has a wide range of species, including Madagascar, where they are also housed. Heard identified the following distinctions in the nesting habits of honeybees and stingless bees:

1. In contrast to stingless bees, which raise their young in specialized brood cells and store their food in enormous pots, honeybees rear their young and store it in their hexagonal comb.

2. While stingless bees combine wax with plant resins to create propolis, which serves as their primary construction material, honeybees use wax primarily to construct their nests.
3. The guard bees of stingless bees bite and smear resin on intruders in addition to building a sturdy nest wall and entry tube for their own protection.
4. The temperature in the nest is tightly regulated by honeybees; stingless bees are less effective but still exercise a passably effective control.
5. Stingless bees produce brood cells with substantial food provisions, but honeybees consistently feed their young.
6. Stingless bees destroy and rebuild cells, while honeybees reuse their brood cells.
7. Stingless bees first construct a new nest before gradually moving in with a new queen, while honeybees established a new colony by the abrupt swarming of numerous workers and the previous queen.

Stingless bees are tropical, thus they are active all year long, albeit they are less busy in the fall and winter. A few species secrete formic acid, which results in painful blisters, in the mandibular secretions. Stingless bees may establish extremely big colonies that are robust due to the quantity of defenders, despite the fact that they lack stingers. However, they have also been found in wall cavities, old trash bins, water meters, and storage barrels. Stingless bees often build their nests in hollow tree trunks, branches, subterranean cavities, termite nests, or rock crevices. Queens only conjugate with one man[1], [2].

As it is simpler to manage the hive, many beekeepers continue to retain the bees in their original log hive or move them to a wooden box. Some beekeepers place the hives in bamboo, flowerpots, coconut shells, and various recycling bins like water jugs, broken guitars, and other secure bins. Stingless bees generate an abundance of honey and pollen, which enables the colony to endure times of scarcity.

Beyond their immediate demands, workers gather floral resources, which leads to targeted trips to favored flowers. They are able to tell other foragers of distance and direction. By enlisting nestmates, one may increase pollination efficiency and maximize nectar and pollen collection. According to Kajobe and Roubik, there is still much to learn about the biology of stingless bees, including caste and sex determination, nest building and the structures that arise, defense, feeding, reproduction, and nest construction and subsequent structures[3], [4].

DISCUSSION

Maintaining Stingless Bees for Beekeeping

Except for the Neotropics, where stingless honeybee domestication is widespread, the other tropics, especially Africa, have not been able to successfully harness the products from these bees due to a lack of fundamental understanding of their biology and behavior. Because the colonies are perpetual, stingless bee multiplication methods are environmentally friendly. They are readily mass-produced utilizing simple techniques. Because there are constantly fresh queens accessible in the colonies, they are self-sufficient.

Services and goods

Only a small number of stingless bees generate enough honey for humans to keep. Large, egg-shaped containers consisting of beeswax and different kinds of plant resin are frequently used by bees to store pollen and honey; this mixture is also referred to as "cerumen." The horizontal brood combs in the center of the arrangement, which houses the larvae, are often surrounded by the pots. Depending on the species, hives may house 300–80.000 workers at once. A combination of secreted wax, propolis, and other materials, like as animal feces, often lines the rest of the nest chamber, including the entry tubes. Meliponine honey is treasured as a remedy in many African cultures and in South America, despite the limited amounts produced. It boosts fertility and is used to treat fever, intestinal disorders, throat infections, and coughs. Numerous research have shown that it could have positive benefits. In comparison to Apismellifera honey, stingless bee honey has a higher moisture content, greater acidity, lower sugar composition, and reduced enzyme activity. 2018 saw Nordinet. Al suggested a uniform, international standard for stingless bee honey quality[5], [6].

Although stingless bees are highly coveted, they have long been eclipsed by commercial honeybees and treated with some disdain in pot-honey standards. These bees and their honey are now seeing a rebirth in popularity. All bees provide excellent pollination services. Since there is always a match between pollinators and their flowers, each bee has a specific specialization in the pollination world. Stingless bees are significant pollinators in tropical habitats and visit a variety of blooming plants to gather nectar and/or pollen before moving from blossom to flower to gather supplies for their nests. Stingless bees are important pollinators of a wide range of plants, including mango, avocado, lansones, rambutan, strawberry, lychee, and macadamia.

Tetragonulabiroi stingless bees have a low flying range of between 250 and 500 meters, whereas T. Carbonaria were found to be 333 and 712 meters in height, respectively. The reason they take use of more floral resources nearby may be due to their limited flying range. However, they show floral constancy when viewed at the level of the individual bee. For pollination work, stingless bee colonies may be housed in hives and moved with ease. The colonies may be evenly placed across the farm because to their short flying range, which makes sure that all of the blooms are seen. Stingless bees may also successfully pollinate plants produced in greenhouses. Tetragonulabiroi was shown to boost pepper, Capsicum annum, fruit set by 74% in a recent research. Melipona species. very useful for buzz pollinating tomatoes. The applications of stingless bee cerumen and honey, as well as their significance as pollinators, need more study.

Asian stingless bees

The stingless bee is a significant species that is well suited to tropical regions. It is locally known as "lebahkelulut" in Malaysia, "channarong" in Thailand, and "lukot" or "kiwot" in the Philippines. It has shown to be a successful pollinator of both domesticated and untamed plants and a producer of priceless goods like honey, pollen, and propolis. Most Asian nations have beekeepers of the rare A. mellifera's limited gene pool forces them to import queens. But across most of Asia, A. Because of the pressures from parasites and predators, mellifera cannot thrive in the wild. In addition to these issues, Apismellifera propagation has also been plagued by the pollination of invasive weeds, co-invasion with pathogens and parasites, genetic introgression affecting native plant species, and changes in the structure of native pollination networks. As a result, stingless bees are now being used in Malaysia, Thailand, Japan, Indonesia, and the Philippines for pollination. In 2017, Malaysia established the first national standard for honey made by stingless bees. The first standard for "kelulut" was based on the work of Nordin et al.

Africa stingless bees

The diversity of stingless bee species and genera is highest in the equatorial areas, with the Afrotropical region having the fewest species and genera. African stingless bees are smaller than Apismellifera, the continent's native honeybee. Stingless bees in the Afrotropical area were the subject of comparatively few studies up until recently. With the aid of regional experts and native peoples, stingless bee species may be recognized. The Batwa pygmies of Uganda, who seek for honey in the area of Bwindi Impenetrable National Park, assisted in classifying stingless bees by examining characteristics including size, color, and markings. Indicator pumilio, a little bird native to the Albertine Rift Mountains, a miniature honey guide, has sometimes assisted researchers in identifying stingless bee nest locations[7], [8].

Because species names have evolved through time and various authors have divergent ideas on phylogeny and classification, the taxonomy of stingless bees may sometimes be unclear. The majority of genera in the majority of locations have not been sufficiently examined to identify their forms. The most thorough taxonomy of the African stingless bee to date was published by Eardley in 2004. Although it is now thought that the author understated the real richness of tropical Africa, he claimed there were six genera and 19 species there. Due to a lack of research in this area, the precise number of stingless bee species in Africa is unknown. Before Eardley's publication in 2004, in 1964, Kerr and Maule identified 42 different species of stingless bees in Africa. Axestotrigona, Dactylurina, Hypotrigona, Liotrigona, Meliplebeia, Meliponula, Plebeiella, and Plebeina are among Michener's subgenera that he claimed were valid at the genus level. Michener listed five genera in 2007, but Kajobe and Roubik suggested there are actually eight, including the 24 species that are currently recognized, in 2017.

Further investigation is necessary in order to properly classify the genus Apotrigona. DNA barcodes, a technique that employs a brief genetic sequence to identify an organism, are the greatest tool for differentiating visually identical stingless bee species. Throughout Africa, there are several genera and species of stingless bees. For instance, in 2013 Pauly and Hora identified six species of stingless honeybees in Ethiopia and six species of stingless honeybees in Tanzania. Six stingless bee species from four genera were discovered in the BamendaAfromontane Forests of Cameroon, and six more were discovered in the Kakamega Forest of Kenya. Meanwhile, Aidoo and colleagues discussed five genera that included 11 species from Ghana, demonstrating the country's exceptional diversity. In comparison, just five species from two genera were discovered in Uganda's Bwindi Impenetrable National Park. Last but not least, the MakandéForét des Abeilles in central Gabon may be regarded as a meloponine hotspot due to the description of 14 species there by Roubik in 1999. The most well-known meliponine in Africa, Meliponulabocandei, is crucial for understanding the phylogeny of stingless bees on the continent. M. The majority of tropical Africa is home to bocandei, which is renowned for its honey. One nest is said to produce 5 to 18 liters of excellent honey, and the bees are manageable[9], [10].

Nesting

The nests of stingless bees may be used to identify them. Nests are significant in taxonomy, particularly in the little-studied equatorial tropical Africa. Excellent insulation is one of the characteristics of the majority of stingless bee nesting areas. Particularly well-insulated nests are those that are in big trunks or the ground. Many species, especially those from the wet tropics, cannot survive the cold. Brood cells and food storage containers are arranged and shaped differently within the nest. Ripe honey or nectar is kept on the edges of nest cavities, and some even surrounds the brood area. Meliponiculture is not often practiced frequently in Africa. Because many stingless bee species construct their nests underground or in tree trunks, honey harvesting is damaging. For stingless beekeeping, a deeper comprehension of the species' nest design is required since the majority of nests are not retained in box hives. One characteristic that is particular to a species is nest architecture, which may help to enhance species classification.

It offers details on the size or volume of the nest cavity, the size of the entry tube, colony insulation, drainage and waste facilities, the size and layout of the brood comb and food storage pots, temperature tolerance, defense mechanisms, and reactions to certain nest placements. It may also be used to assist decide how a species should be raised for pollination and honey production. The interior nest design and protective behaviors, like as assault or quick retreat, are only visible when nests are opened. Rarely examined are protective reactions to specific tiny predators, such as insects that capture bees in their nests. In a thorough investigation conducted in Africa in 2009, MoghoNjoya discovered that the arrangement of brood cells, arrangement of storage pots, nest entrance forms, and nest building of six species of stingless bees all exhibited distinctive design traits. Clusters, horizontal combs, or vertical combs may be used to organize brood cells.

The size and form of the cells vary, and involucrum may sometimes be used to cover the brood region. Meliplebeiabeccarii is an African species of obligate ground-nesting bee that builds nests in the soil that have architectural characteristics shared with Plebeiella and Plebeina. Having stated that, Meliplebeiabeccarii nests have three main areas: the brood region, the involucrum layer area, and the storage pot area. While cells are being created simultaneously, the combs are horizontal and constructed concentrically. In terms of the ecology of stingless bee nesting in Africa, nests are perennial structures that have the ability to last a long time, much like trees in the woodlands where meliponines dwell. A balance between nesting material, nest location, and a combative versus cryptic colony profile may be seen in the locations and construction of stingless bee colonial nests.

Honey hunters, including primates and maybe other animals, utilize nest openings to find hives by hearing or seeing bees flying above or by venting the nest. Different kinds of stingless bees have different nest entrances, which may range from little holes to trumpet- or dome-shaped openings. Small bee colony entrances are simple to protect because of their size. Traffic congestion and crashes during times of heavy foraging activity are one trade-off for this. Regardless of colony or bee size, African stingless bee colonies feature modest or discrete nest entrances. Chimpanzees prey on many of these colonies, using sticks to remove pollen pots, brood, and honey from different bee nests. In contrast to the stingless bees found in Asia or the Americas, this may have resulted in more covert nest entrances and activity. Aardvarks, mustelids, civets, apes, and humans are just a few of the enormous species that pose a danger to Africa. This added threat may have contributed to the variety of nesting sites used by African meliponines, especially those that resemble large termite or ant mounds. These animals often avoid biting bigger vertebrates.

Nuisance-free beekeeping

East Africa is more well-known for meliponiculture than West or Southern Africa is in the Afro tropics. In Tanzanian experimental hives, Marcelian et al. evaluated the honey production per colony. The average yields varied depending on the species: for Meliponulaogouensis, 2.7 litres; for Meliponulalendliana; for Dactylurinaschmidti; and for Plebeinahildebrandti, 0.6 litres. These results suggest that Tanzania, which has the highest species variety of stingless bees, has strong potential for beekeeping. Stingless beekeeping has just recently started in Ghana as an addition to Apis beekeeping. Stingless bees' honey may be obtained without harming the colony if the bees are properly maintained and sensible hives are utilized. Nowadays, log hives and boxes are employed in many regions of Africa. These hives feature a central flight entrance and closures constructed of woven or wood discs that have been precisely cut at either end. Urbanization and significant vegetation removal in certain areas have limited the amount of food and possible nesting locations that may serve as a source of stock for beekeeping operations. Numerous bee colonies have also been decimated by the indiscriminate use of agrochemicals and general pollution. Competition for fodder is the largest issue for beekeepers, however.

Bee stingless honey

Pot-honey, also known as stingless bee honey, is somewhat more acidic and has a larger water content than honeybee honey, but it is still highly sweet and palatable. Numerous stingless bee species forage beyond the nectar, pollen, and honeydew that serve as the foundation for honeybee products. Stingless bees, however, generate a lot less than honeybees do. Pot-honey is greatly sought after since it is said to have medicinal qualities and is used extensively in tropical Africa's traditional medicine. In conjunction with jungle herbs, stingless bee honey is used to cure fevers, throat infections, and coughs as well as to improve fertility. The honey has also been used to cure digestive issues including diarrhea and intestinal worms. Due to its cultural significance, stingless bee honey commands a greater price in Africa than honeybee honey. However, it has long been overtaken by commercial honeybees and partly disregarded in honey standards. These bees and their honey are now seeing a rebirth in popularity. To make the honey produced in East Africa a commercial commodity, efforts are being done to create controls and standards. This would significantly increase many regions' economies, but more importantly, it would highlight the need of stingless bee conservation and demonstrate the worth of these bees. Burundi, Uganda, Kenya, Tanzania, Rwanda, and South Sudan make up the East African Community, which has created a uniform stingless bee honey standard. The standard states that when tested using the approved test procedures, honey must meet certain parameters.

CONCLUSION

Threats to the survival of stingless bees in Africa include pests, predators, and habitat degradation from logging, bushfires, and the harvesting of wild honey. Since most stingless bees are arboreal, colonies are destroyed when trees are torn down. During the dry season, bushfires raging across tropical forests often destroy trees or meliponary rustic hives housing stingless bee colonies. Stingless bee nests are known to exist in a large number of rural locations. When collecting honey, people often fire the bees, destroying the colonies in the process. Predators and pests, particularly the SHB Aethinatumida Murray, whose larvae decimate whole colonies, are the main challenges faced by domesticated colonies of stingless bees. Adult hive beetles coexist closely with honeybees and stingless bees. If hive beetles get a chance to lay their eggs in a colony, the eggs hatch, the larvae swiftly decimate the colony, or the bees flee the nest. Colonies of stingless bees are also under danger from other predators including lizards, ants, and spiders. Pollination is known to suffer from human disturbances, despite the fact that the impacts on bee colonies have not been well explored. Habitat fragmentation is a consequence of several human activities in Africa, including agricultural production, livestock management, wood cutting, urbanization, and basically all human disturbances that promote loss of vegetation. In this case, vegetation that is different from the original vegetation divides ecosystems into spatially separated remnants. As a result, populations of plants and animals become geographically isolated and dwindle. Over time, fragmentation affects various habitat components in a variety of ways. There has not been enough research done on how bees react to changes in land use and how tropical fragmentation affects whole bee populations.

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CHAPTER 12
PRODUCTION LINES AND HONEY MANAGEMENT STEPS

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ABSTRACT:

From hive management through the final bottling and distribution of this delectable natural product, the manufacturing of honey is a multi-step procedure. The main procedures in producing honey are summarized in this article, along with how production lines help to guarantee quality and effectiveness.Beekeepers manage hives to keep honeybee colonies healthy and productive from the beginning of the process. This include providing a balanced diet, managing illnesses, and taking precautions against swarms. To increase honey production and protect the bees' welfare, effective hive management is crucial.

KEYWORDS:

Bottling, Extraction, Filtration, Honey Processing, Quality Control.

INTRODUCTION

This section outlines the management of honey in detail, from the bees' first raw material collection through food safety and the greatest possible preservation of its quality and nutritional worth. Only those methods that can really achieve this level of quality should be provided in a sustainable development framework. This chapter goes into further detail on the following processes: harvesting, separation/extraction, decantation, drying, crystallization, melting, storage, and packaging/market placement. Industrial processes like drying, melting, pasteurization, and ultrafiltration are primarily used to enhance the presentation of honeys or to reintegrate a product that does not adhere to international legal standards, such as unripe or degraded honeys, into the commercial circuit. Even if they are often used in certain nations, it should be mentioned that they are not appropriate beekeeping techniques[1], [2].

Honey management steps

The honeycombs carrying matured honey are taken out once the bees have been eliminated. The ripeness of the honey determines when it should be harvested. When producing unifloral honey, beekeepers should take into account the need to avoid using nectar from other flowers or those that can impart undesirable organoleptic qualities. Despite the fact that these requirements are related to economically important quality elements, getting unifloral honey at the necessary purity levels shouldn't affect honey maturity. Only honey that is fully mature, which corresponds to combs with more than 75% of the honey cells shut, should be picked. In any case, harvesting must be done on dry, non-rainy days with low relative humidity levels to prevent the honey's hygroscopicity from causing the water content to increase. When the average ambient humidity is less than 60% outside of the hive, a moisture level of under 18%

may be anticipated in the honey. Even sealed Apismellifera cells may contain honey with more than 18 percent moisture in hot, humid regions. In similar circumstances, the moisture content of capped honey cells from other Apis species may even be greater. The following are some excellent harvesting techniques:

1. Gather mostly capped, matured honeycombs to ensure that the moisture level is low enough to prevent fermentation and that it complies with regulatory standards.
2. Reduce biological agent, foreign body, and material contamination in solid, liquid, and gaseous forms. Use smoke sparingly, and only dry, non-resinous plants should be used to make it. Avoid using chemical repellents and avoid placing frames on the ground.
3. Limit the amount of time that honey is exposed to extreme climatic conditions, including humidity and heat.
4. Ensure that honeycombs are properly identified and traceable.
5. To reach high levels of sustainability, reduce the usage of water, items with a large ecological impact, and harmful non-renewable fuels.

DISCUSSION

Separation/extraction

The operator merely has to choose and trim the honeycombs to the required size for "chunk honey" production. However, before beginning the extraction by draining or centrifuging, the capping of the cells must be removed with a hot rod, scraper, or knife if the honey is to be separated from the honeycombs. In terms of conventional methods for separating honey from wax, pressing or even melting of combs is still utilized, but it should only be done as a last option. Three major goals should direct the separation/extraction step:

Biological agents, foreign bodies, and substances in solid, liquid, and gaseous form should be kept to a minimum; honey should also be exposed to high environmental temperatures and humidity as little as possible; separated honey should be properly identified and traceable; and water usage should be kept to a minimum in order to achieve high levels of sustainability.

Decantation

Honey is often refined using decantation or straining. The humidity of the honey and the temperature of the room affect how quickly this process proceeds. To separate wax particles and other objects, honey may be strained through a tube sieve or a kind of strainer in liquid form before being placed on a honey settling tank.

When honey is decanted, impurities and air bubbles are allowed to separate according to their relative weights in a large container kept at a temperature of about 25 °C. Wax flakes, insect parts, and other organic debris float to the top, while mineral and metallic flakes sink to the bottom. Particle size, container size, and honey viscosity all affect how quickly things settle; at temperatures between 25 and 30 °C, it often happens quickly and may be finished in a few days. The same three primary goals that guided the extraction process should guide the decantation step as well[3], [4].

Drying

Honey must be ripe and have a moisture content under 20% in order to meet the requirements of the Codex Alimentarius Standard for Honey. However, honey humidity has to be under 18% for effective preservation. Only by globally recognized techniques may the moisture content of honey remaining in the combs be lowered in extreme circumstances and to avoid fermentation. This is possible prior to honey being removed from the combs. The moisture content of honey may be decreased by a few percentage points by placing honey combs in an area with low ambient relative humidity. The same three primary goals that guided the extraction and purification processes should guide the drying step.

Crystallization

Over time, all honey crystallizes, although the process relies on several factors. The temperature, water, and glucose contents are the most crucial factors. While some producers regulate it to create creamed honey using various methods, others let crystallization happen spontaneously in the honey. Typically, they mix 5–15% of finely crystallized honey with freshly gathered liquid honey at a temperature of 25–27 °C. A large blender is used to blend the material at a 14 °C temperature reduction. Within 4.5 days, full crystallization should take place. Positive outcomes may also be obtained in the early phases of storage by homogenizing the product and letting it mature for two to three weeks after separation and before packing at around 15 °C to enhance and homogenize the organoleptic qualities.

Melting/pasteurization

Honey should only be subjected to temperatures exceeding 40 °C under very restricted circumstances since it is very sensitive to them. The growth in HMF, which is created from hexoses like fructose, and the breakdown of honey enzymes like diastase and invertase are both closely correlated with time and temperature. When beekeepers encounter crystals in their harvested honey, they might melt the honey to lessen the excessive or uneven crystallization. The honey is heated to the lowest temperature necessary for the shortest amount of time to accomplish this. Officially, only industry is permitted to pasteurize honey in order to stop unintended fermentation by osmophilic yeasts. A decent beekeeping practice guide should not include pasteurization as a commercial procedure. The extraction, decantation, and drying stages' three primary goals should also guide the melting/pasteurization phase[5], [6].

Storage

As a highly concentrated, somewhat acidic solution of fructose and glucose, honey is prone to physical and chemical changes during storage even when it is microbiologically stable. At any temperature higher than 5 °C, changes brought on by heating also take place. Honey should be kept in a refrigerator or freezer at or below 20 °C, and at or below 14 °C for unstable or creamed honeys. Honey must always be stored in tightly sealed containers in a dry environment. The following key goals should direct the storage phase: minimizing changes brought on by fermentation, granulation, discoloration, flavor damage, enzyme destruction, and production of HMF by keeping the honey at cool temperatures, avoiding rehydration by atmospheric moisture, and maintaining homogeneous achievement and maintenance of the desired organoleptic characteristics in the product.

Ultrafiltration

Ultrafiltration is a commercial process that significantly denatures honey and is not in accordance with ethical beekeeping principles. In contrast to what is often believed, "ultra-filtered honey" is not pure honey. These honeys must be specially labeled to educate customers in accordance with the EU Honey Directive.

Merchandising and packaging

The most common materials used to package honey include metal, glass, waxed paperboard, plastic, and earthenware. Containers constructed of glass, stainless steel, or covered with food-grade plastic, paint, or beeswax are acceptable for storing an acidic food ingredient like honey.

Hazardous materials, extraneous material, or agents that might change the organoleptic properties of the honey should not be introduced during packaging. When recycling containers, extreme care must be taken to ensure that they are fully odor-free and clean. Never keep bee products in containers that have previously held harmful chemicals, oils, or petroleum compounds, even after covering them with paint, plastic, or beeswax.

All items should be stored away from heat and light, and lids must be airtight to prevent moisture from entering. The Codex Alimentarius Commission states that honey produced in conformity with commercial and hygienic standards may be marketed. The following primary goals should direct the packaging/putting on the market step:

1. use of containers with surfaces inert to the content, so as not to transfer their constituents to food in quantities which could endanger human health, bring about an unacceptable change in the composition of the honey, or bring about a deterioration in the organoleptic characteristics thereof;
2. use of containers with surfaces compliant with the legal requirements, accompanied by a written declaration stating that they comply with the rules applicable to them, particularly that they are fit to come into contact with honey, in the environmental conditions of production, storage and market;
3. use of containers with intact and clean surfaces that cannot contaminate honey;
4. use of dry, water- and gas-impermeable containers with well-sealed lids, to prevent rehydration and absorption of extraneous vapours of honey;
5. application of maintenance able to maintain the conformity of the containers over time;
6. minimization of honey exposure to high environmental temperatures;
7. correct identification and traceability of honey and containers;
8. correct labelling, in compliance with the requirements in force in the marketing areas;
9. limitation of the use of polluting non-renewable energies, materials with a high ecological footprint and water to achieve good levels of sustainability.

International law establishes minimum standards for honey purity and sanitation

Type of bee, nectar supply, flower type, regional differences, and techniques of collection, extraction, and storage all affect the content and quality of honey. The various kinds of honey sold have different commercial values, frequently varying significantly, and safety and authenticity standards play a significant role in this, offering opportunities or placing restrictions on the entire reference chain, including the advancement of sustainable production. According to the Codex Alimentarius Commission and the European Union, honey is a naturally sweet substance made by Apismellifera bees from plant nectar, plant secretions, or insect excretions on living plant parts. Bees collect these substances, transform them by combining them with other substances, deposit them, dehydrate them, and then store them in honeycombs where they ripen and mature[7], [8].

Since the Chinese definition of honey is far wider than the CODEX definitionit is a "sufficiently brewed naturally sweet substance" created when "bees collect nectar, honeydew secretions, or plants, mixed with their own secretions"—the Chinese standard does not conform with the CODEX standard. Generally speaking, it is in the best interest of beekeepers to have specific regulations that safeguard their honey and their revenue, especially small enterprises that manufacture high-quality goods. In fact, it shouldn't be surprising that the product is the third most vulnerable food to fraud in the world considering how readily it can be changed and blended. A European Union monitoring program for honey discovered that a large percentage of the samples did not fulfill the standards for authenticity, underlining the need for regulations to be backed by effective means of identifying and preventing honey fraud.

Microbiological requirements

Contrary to the demands of the Codex Alimentarius Commission and the European Union, the Chinese honey standards include certain microbiological parameters, as seen in Table 18. When it comes to the danger that microbiological risks offer for human ingestion, honey that complies with Codex Alimentarius standards is not a good substrate for microbial development. The potential of microbiological risks is limited since no microbe is thought to grow at water activity levels lower than 0.60, or a water content close to 18 percent. The sole microbiological threat to honey, according to a thorough analysis of the literature and epidemiological data, is caused by Clostridium botulinum and other clostridia that produce the botulinum toxin. Although Bacillus spp. are often found in honey, and occasionally in large quantities, there is no evidence that they may cause sickness. The most appropriate course of action is to add product labels warning against consumption by infants or children under 12 months because there is no known way to completely eradicate Clostridium botulinum spores and because numerous tests would be necessary to confirm their absence in product batches[9], [10].

CONCLUSION

In conclusion, it is essential for both beekeepers and honey producers to comprehend production processes and management procedures. A number of precisely planned procedures are used to transport honey from the hive to the jar in order to guarantee its quality, security, and marketability.The honey business relies heavily on production lines because they make effective extraction, filtering, and packaging possible. By retaining the natural tastes and beneficial qualities of honey, these mechanisms aid in maintaining the substance's integrity.The honey management procedures, which include hive upkeep, bee health, and sustainable methods, are equally crucial. Beekeepers are essential in preserving healthy colonies, making sure bees have access to a variety of food sources, and reducing stresses that can negatively affect bee numbers and, subsequently, honey output.To produce high-quality honey while preserving honeybee numbers, production lines and honey management procedures must work in harmony. The art and science of beekeeping must coexist in a delicate balance, and best practices, innovation, and environmental stewardship all work together to provide customers a product that is not only delectable but also a tribute to the wonderful coexistence of humans and bees.

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CHAPTER 13
BUILD A HONEY TRACEABILITY SYSTEM FOR RURAL DEVELOPMENTUSING BLOCKCHAIN TECHNOLOGY

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ABSTRACT:

As a major source of income for countless beekeepers and a contributor to agricultural ecosystems via pollination services, the honey business has a substantial impact on rural economies. However, the difficulty in assuring product quality and proper pay for beekeepers has resulted from the absence of transparency and traceability in honey supply chains. This abstract investigates how blockchain technology may be used to resolve these problems by creating a reliable honey traceability system that supports rural development.The decentralized ledger and immutable record-keeping features of blockchain provide a creative way to trace honey from the hive to the customer. Every stage of production, from beekeeping methods to processing and distribution, can be publicly documented and validated by incorporating blockchain into the honey supply chain. Additionally, to ensuring fair remuneration for beekeepers and encouraging sustainable practices, this improves product quality.Furthermore, the application of blockchain technology opens new prospects for rural development. It helps beekeepers, who are sometimes located in isolated places, to reach international markets and get reasonable rates for their honey. By having access to comprehensive information on the honey's origin, manufacturing processes, and quality, customers may also make educated decisions.

KEYWORDS:

Data Security, Decentralization, Distributed Ledger, Hive Management.

INTRODUCTION

Among the various honey kinds that allow beekeepers to profit from price premiums because their honey is distinctive on the market are acacia, alfalfa, blueberry, macadamia, and sourwood. Beekeepers and their communities might suffer economically if honey's regional, varietal, or quality-specific features are not sufficiently differentiated and marketed. Beekeepers in the Global South often have their intentions to reach markets thwarted because they cannot demonstrate the quality and purity of their honey, which hinders the development of rural regions where beekeeping is successful. In this chapter, we demonstrate how distributed ledger technology, such a blockchain, may help smallholder honey producers all around the globe stand out from the competition at a reasonable price[1], [2].

We also demonstrate how a verified traceability system may help smallholder farmers get access to markets and improve product distinctiveness. Notably, producers may obtain data-driven assistance in conjunction with data-backed, record-keeping, and consulting services, and consumers can confirm the route and track goods to the origin. Finally, in addition to demonstrating the potential of using DLT in the beekeeping industry, we provide advice on how beekeepers may be ready now to take advantage of future applications of data-driven beekeeping and blockchain or other DLTs.

To reach markets and provide economic value, products must be unique, yet the high costs of product differentiation itself often act as a barrier to market entrance. Products must express their distinguishing characteristics in a defined and verifiable way in order to provide customers with a particular, safe, nutrient-rich, or sustainable option on the market. The growth potential of rural and smallholder producers who lack access to resources may be unlocked by doing so at a low cost. DLT has the potential to further improve traceability and accountability throughout the production and transport process by decreasing the cost of verifiable product differentiation, even as brands and NGOs have been working hard to develop certification processes that provide minimum standards for ethical production processes and quality requirements in the Global South[3], [4].

The introduction of a new standard for product and process integrity that allows manufacturers to distinguish their product independently and at a cheap cost is among the many things made possible by the simple but effective features of blockchain technology, a sort of DLT. Additionally, it may provide the infrastructure necessary for customers to communicate with farmers and learn about the origins of their products. This chapter begins by outlining the role that beekeeping plays in rural development. Then, we demonstrate how data-driven beekeeping may be enhanced by DLT to establish a transparent and responsible apiary data ecosystem. Then, based on the already available sensor and apiary management data, we evaluate the viability of utilizing DLT to establish a honey traceability system for rural development. Finally, we make suggestions for future implementation[5], [6].

DISCUSSION

Beekeeping for Development Driven by Data

Beekeeping has shown to be a perfect, approachable, and powerful prospect for rural business owners in underdeveloped economies. As a result, beekeeping has gained support from government officials, farmers, and development partners as a viable alternative source of income in rural regions. Beekeeping techniques are taught to farmers in rural regions in nations like Ecuador, Ethiopia, South Africa, and Uganda, among others, by government extension agents. Best practice sharing has been encouraged in Bangladesh through targeted investment programs in beekeeping that aim to strengthen rural economies. A few of the competitive benefits of beekeeping for on-farm integration include relatively cheap start-up costs and labor needs, as well as minimum land consumption. Additionally, it is often feasible to make necessary beekeeping tools and equipment locally, supporting rural and local businesses. Examples include smokers, hives, and protective apparel. Bees' pollination actions indirectly assist not just beekeepers but also farmers by improving yields, in addition to steady annual cash contributions that improve smallholder lives. By lowering food prices in rural regions, a more abundant food supply decreases hunger and aids in the reduction of poverty. Nevertheless, despite the growing number of programs aimed at encouraging beekeeping in rural regions, inadequate training and expertise have been identified as a major obstacle to effective honey production and increased family well-being. By providing access to data-driven solutions, rural beekeepers may gain more freedom and income via more effective beekeeping practices, directly influencing a number of the UN SDGs[7], [8].

However, in order to fully realize beekeeping's immense potential for protecting natural ecosystems and forests, it needs financial, technical, and extension assistance. This may be done by putting in place technical and data-driven solutions that make it easier to share GBPs, boost beekeeping productivity, and promote market access. Consumers all around the globe are placing more value on honey sourced from pesticide-free and natural environments, which presents beekeepers in rural regions with a large chance for economic growth. Any such product claims, nevertheless, must be supported by confirmation from a reliable source employing a traceability mechanism. Data can back up claims of originality and traceability for a unique product, enabling beekeepers to reach new markets and demand higher prices for their products. Both factors simultaneously fuel the expansion of the local and developing varietal honey markets. Both in the Global South and the Global North, smallholder producers who have the necessary tools to demonstrate the authenticity and integrity of their honey stand to gain considerably from them. Two key elements are required for traceability systems to work effectively: high-quality data and a way to store the data in a way that is dependable and verifiable[9].

Production of Honey and Beekeeping Powered by Data

Beekeepers have the chance to demonstrate the reliability of their beekeeping operation by gathering and securely storing data on honey production processes, management decisions, and secondary data sources like weather or crop data or satellite photos. This might be achieved by first gathering trustworthy data, after then extrapolating statistically from the primary and secondary data to confirm the quantity and kind of honey produced using recognized and knowable factors. Using image processing on samples of gathered honey and pre- and post-sale pollen matching, further verification may be carried out. A large variety of mostly manually gathered data elements are already captured by apiary management systems. An AMS may include accountability, traceability, and best practices into software to support beekeeping operations in addition to record-keeping. As data can be analyzed to determine which management activities or situations contribute to the greatest outcomes and maximum honey production, they also set the foundation for economic development, process improvement, and overall improvement over time. New types of diagnostic analytics may become accessible as beekeeping uses more data, and best practices generated from data may be developed based on the behavior of the bees within the hive. Models based on machine learning and artificial intelligence may be used to identify patterns and infections as well as forecast illnesses. Sharing information and status updates also allows extensive bee health monitoring. Early detection of threats and infections may help members and government authorities take preventative measures. It can also motivate members to adopt the best practices over time, adapting them to local customs, the environment, genetics of the crops, and blooming times.

Data Ownership, Privacy, and Transparency

A major obstacle in the area of research for development is data ownership. Frequently, sharing their data does not result in long-term gains for farmers or IT system users. Data privacy, where ownership and transparency allow individuals to control their data while selectively disclosing vital components in a standardized way so that it may be combined and aggregated with data from other users of the same or comparable systems, is thus another crucial component of an AMS. Data mining enables the use of analytics methods like statistics, machine learning, and artificial intelligence to provide insightful data that might be integrated into the system, benefiting all stakeholders. A honey management system, a different kind of data-entry infrastructure that may be utilized by honey houses, certifying organizations, points of sale, and honey labs, is what we recommend as an additional layer of data authentication. However, AMSs are mostly used by beekeepers. The two systems are linked enough for information provided by the beekeeper via the AMS to be anonymously checked by the HMS. As a result, the HMS is used to validate AMS-declared places of sale. GS1 EDI standards will be used in doing so and increasing engagement with stakeholders along the value chain. In the data authentication process, the apiary and honey management software together represent two distinct data input points. In step one, activities are recorded to create digital twins of analog processes. Either the AMS or the HMS are used to input the data. Based on four weighted categories—automated data input, third-party certification, algorithmic extrapolation, and secondary data—each of these data entries has a certain veracity rating.

The initial veracity degree of each data input in the honey authentication database is then used to classify them. It therefore becomes a task to make sure that the data that are entered into the database are saved in a way that is unchangeable and verifiable. Due to the fact that they enable data to be kept in an immutable way by default, blockchains and other DLTs are ideally suited to addressing this issue. DLTs like the blockchain, which combine encryption, decentralization, and game theory, are very valuable. Notably, before being stored to the ledger, each data input is timestamped and encrypted using a so-called "hash" technique. The blockchain divides the ledger into size-limited blocks that may each hold a certain amount of data entries. A chain of blocks is produced by using the final hash of each block as the initial hash of the subsequent block. So-called "consensus mechanisms" are clever combinations of decentralization and game theory that guarantee a constant stream of fresh blocks to store data. The proof of work method, one of the most well-known consensus processes, offers a steady stream of mathematical puzzles to answer. A sizable number of "miners" pool their computational resources to solve a mathematical conundrum. The privilege to provide the next block is awarded to the first miner who cracks the puzzle, and they also get paid in bitcoin. This game-theoretical strategy encourages miners to operate the blockchain's supporting computer systems. This technique requires a lot of energy to operate, but each miner also functions as a node with a copy of the whole blockchain. Last but not least, a distributed ledger like the blockchain may be either public or permissionless, meaning that anybody can interact with it, or private or permissioned, meaning that only a select set of people has access to it. Due to the transactions' openness and integrity being preserved inside each block of the blockchain, public ledgers are useful because of this. Since 2017, there has been a considerable growth in interest in DLTs and the emergence of several use cases in numerous sectors. One of the priciest types of honey in the world, m nuka honey, was utilized in a blockchain-based traceability pilot project in New Zealand in 2017. This has aided efforts to create end-to-end apiary management technology solutions like MyApiary.

Using both a permissioned and a permissionlessblockchain has a number of advantages. First off, deploying a permissioned consortium blockchain throughout the whole honey supply chain guarantees that only the AMS and the HMS have access to write to the blockchain. Second, a permissioned blockchain would make it possible to construct smart contracts tailored to the honey business that are connected to certain data inputs through the data-entry systems. Estimates of the pollination services a beehive has offered may be determined since the quantity of honey produced is almost entirely a direct consequence of the bees' foraging activity. Additionally, using oracles makes it possible to provide beekeepers customized insurance contracts that are connected to local climatic variability, as shown by the Chainlink network. Finally, the least quantity of data possible must be kept on-chain in order to save costs and improve energy efficiency. By exclusively storing hashes to the permissioned blockchain and hashes of hashes to the permissionlessblockchain, we hope to improve the off-chain/on-chain ratio. Most essential, three separate variables guarantee process and product authenticity:

1. Digital data collection enables for analysis and algorithmic exploration of beekeeping operations in a specific area.

2. The availability of reliable data is increased by increasing the volume and granularity of data gathered from independent sources, including autonomous data collection via Internet of Things sensors, third-party verification through labs, and point of sale data through the HMS.

3. Every stage of the honey production process is time-stamped and immutably saved, ensuring an unbroken chain of custody from the hive to the table.

This multi-layered strategy offers a framework that begins with the current situation of beekeepers and continues to their future state. The system becomes more reliable over time as more data points are entered and new techniques are created, increasing data input and validity. For local usage, however, it is necessary to account for the expenses involved with the integration and accessibility of the many data points. Only easily accessible data points may be gathered, especially in the development setting. To make both the software and the required telecommunications networks accessible in this situation, AMS suppliers must cooperate with governments and telecoms firms. The scaleability and dependability of honey traceability and authenticity grow over time as this beekeeping data ecosystem develops. Beyond customers, every party involved in the value chain may instantly confirm the origins and features of a honey product. Working with GS1 standards will also make it easier for stakeholders to handle and share data.

CONCLUSION

Beekeeping has been recognized as a low-investment, sustainable way to reduce poverty and provide rural inhabitants a steady income. Smallholder farmers may start beekeeping businesses everywhere in the globe because to beekeeping's accessibility and adaptability. The deteriorating trust in the integrity of honey products, as well as providing smallholder beekeepers with access to markets, are two pressing issues facing both emerging and established beekeeping industries that DLT may prove to be the right technology to address. Policymakers and project organizers should be aware that the collection of technologies discussed in this chapter may be used to create a precise traceability and authenticity system that offers the full history and analytics for any product linked to bees. Because it is adaptable, may boost local economies, and can open up new markets for goods that correctly represent their features, traits, and the values of the people engaged in making them, it is thus appropriate for application in any economic, sociological, cultural, and national settings. In light of this, if distributed ledger-backed honey gives customers confidence in the qualities and origins of the products. Consumers will be more likely to pay more for bee goods if the information needed from various players throughout the honey value chain is based on a publicly-stored and immutable record, as the blockchain does.The beekeeping industry is already essential to rural development because bee operations, particularly pollination services, provide advantages beyond chances for money production. When supported by DLT, data-driven beekeeping will not only improve routine operations but also provide traceability solutions that will help smallholder beekeepers sell their honey by demonstrating the integrity, provenance, and quality of their processes.

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