



SUSTAINABLE CONTRIBUTION OF BEEKEEPING TO CLIMATE CHANGE MITIGATION FOR NATURE CONSERVATION AND BIODIVERSITY SECURITY: A REVIEW

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Abstract

The important role of honey bee in world food production, climate change mitigation, forest and biodiversity conservation and their economic values cannot be overemphasized. Forests, most especially ones with no direct agricultural activity, provide a source of organic nectar that are necessary for the honey bees (Apis mellifera) because they are nature's very important agent of pollination. The original concept of ecosystem is majorly understood in the aspect of the services and benefits that it provides to the living, both human and animals. This can be categorized into different functions such as provisioning, regulating, cultural and supporting services. Beekeeping activity has over the years helps in preserving nature, agriculture, sustains livelihoods as well as provides food security. Bee products provide healthy, high-nutrient food, safe medicines (apitherapy) and raw material for industries as well as enhance pollination. This paper, therefore, explores the important role and contribution of bees as a NTFPs in climate change mitigation and adaptation which go further to strengthen the intimate and reciprocal relationship between humans and the natural world thus eliminating the inaccuracy of considering the ecosystems as mere providers of services to humans.

Keywords: Forest, Climate change, Beekeeping, Biodiversity, Conservation.

Introduction

Climate change is a significant variation in the statistical distribution of weather patterns over periods ranging from decades to millions of years (Adejuwon, 2006). Climate change over any particular place around the world is caused by a host of interacting factors that are both natural and man-made (Okali, 2007). These factors include greenhouse gases of carbon dioxide, nitrous oxide, methane, and halocarbons (Aluko, 2008). Since the dawn of life, the ozone layer has protected the globe from dangerous UV radiation (Agnew and Fennessy, 2001). Additionally, the ozone layer sends out to the earth 70% of the less harmful fraction of ultraviolet light. The loss of it could endanger both plants and animals, causing them to grow more slowly (Odeyemi *et al.*, 2001). Fruits and nuts, vegetables, medicinal plants, resins derived from plants or animals, essences, dyes, fish and game, and a variety of barks and fibres are all examples of non-timber forest products (NTFPs) (Jimoh, 2005). Wild honey and Brazil nuts are examples of NTFPs that are well-known worldwide (FAO, 2009).

Beekeeping activities are usually integrated with the conventional crop, livestock, and agro-forestry farming systems. Through beekeeping, households may have access to food, fruits, medicines, poles, and organic manure (Joni, 2004). The potential of beekeeping is directly proportional to the presence of virgin forests and low human population density, which provide an environment conducive to beekeeping (Agera, 2011). Beekeeping can increase respect for bees while also encouraging humans to try to protect their habitat and foraging areas as much as possible.

The Contribution of Beekeeping to Food Production

Beekeeping provides numerous economic and agricultural benefits to both farmers and ecosystems worldwide. Except for cereals, many food crops rely on insects for pollination. Pollinators such as bees, birds, and bats influence 35% of global agricultural production (FAO, 2009). In the last 50 years, the area covered by pollinator-dependent plants has increased by more than 300 percent (Aizen and Harder, 2009). It is critical to emphasize the importance of bees in pollination. Bees pollinate approximately one-third of all the plants and plant products consumed by humans, thereby contributing to biodiversity conservation (FAO, 2009). Bees are the main and excellent insect pollinators that play an important role in maintaining natural plant communities and ensuring seed production in most flowering plants because they spend the majority of their time collecting pollen (Oyerinde *et al.*, 2014). Whereas the performance of bee colonies, as well as the production of honey, wax, and other hive products, is dependent on forage plants (Teklu, 2016).

Beekeeping is a viable way to help people work their way out of poverty while preserving natural diversity (Agera, 2011). Honey bees are valued for producing honey and beeswax, which generates income and medicines. Beekeeping allows some of the world's poorest people to harvest commodities of international quality and value (Havsteen, 2002). Poverty, climate change, deforestation, biodiversity loss, water scarcity, pollution, and urban sprawl are all current issues facing our world, and they frequently have the greatest negative impact on the most vulnerable people (Eaton and Eaton, 2000). It has also been revealed that beekeeping leads to a reduction in global warming (Oyerinde *et al.*, 2014). Beekeeping has been described as competitive for on-farm integration because of its low start-up cost, less labour, and large-scale dependency on traditional beekeeping technology. The dependency on

traditional beekeeping techniques implies the impact of weather conditions on the beehives with the attendant consequences of climate change (Okoso-Amaa *et al.*, 2004).

As a result, the nation's ability to address food and nutritional insecurity, and poverty, and to stimulate and sustain national economic growth and development is highly dependent on agricultural performance. Beekeeping, as one of the important livestock subsectors, makes a significant contribution to the improvement of the nation's population's livelihoods.

The Contributions of Bees to Environmental Health

The key role of pollinators in food production has been under increased scrutiny (Lebuhn *et al.*, 2013). However, it has been estimated that around 35% of global crop production is dependent upon animal pollinators (Klein *et al.*, 2007), which also maintain the biodiversity of wild plants (Aguilar *et al.*, 2006). Land-use change (Hendrickx *et al.*, 2007; Rader *et al.*, 2014), pesticides (Brittain *et al.*, 2014), pollution (Rortais *et al.*, 2005), and reduced resource diversity have all contributed to pollinator decline (Biesmeijer *et al.*, 2006). The decline is critical due to the need to feed a growing population with dwindling resources (FAO, 2017; Campbell *et al.*, 2017). Pollination increases crop yields without additional land use and resource inputs.

Pollinators, in addition to increasing yield through pollination, can provide honey and protein sources, such as drone broods (DBs) (Lindström *et al.*, 2016). Moreover, life cycle assessments (LCAs) of beehives usually focus solely on honey production (such as; Kendall *et al.*, 2013; Mujica *et al.*, 2016). Whereas, the global warming potential (GWP) of DB production with honey production has also been analysed (Ulmer *et al.*, 2020). Pollination services and by-products might cause net-positive environmental impacts (Grönman *et al.*, 2019). This is because increasing crop yields and replacing land-based protein production could increase bee populations, among other things. Pollinators, in addition to increasing yield through pollination, can provide honey and protein sources, such as drone broods (DBs) (Lindström *et al.*, 2016). Honey can be used as a sweetener to replace sugarcane or sugar beet production, which requires agricultural land. It can also provide protein that can replace animal-based protein sources (Kahn *et al.*, 2007). Furthermore, the environmental impact of beekeeping, such as global warming potential (GWP), land use (LU), and freshwater use with the inclusion of pollination services and by-products such as DB and pollen protein, requires much attention in recent times.

Enhancement of Honeybee Farming to Climate Change Adaptation Strategies

Climate change is caused as a result of natural factors like alterations in the earth's path around the sun, volcanic activity, and fluctuations within the climate system (Adejuwon, 2006). Furthermore, by burning fossil fuels and destroying rainforests, humans are exerting an increasing influence on the climate. Deforestation emits a massive amount of carbon dioxide into the atmosphere (Markson, 2004). Bees are critical for maintaining and protecting ecological balance and biodiversity in nature, both for plants and animals. Bees are generally used to assess the state of the environment (FAO, 2009). They are important pollinators, and many ecosystems rely on them for pollination. A decline in bee colonies could endanger plant species survival. They also play an important role in crop pollination (FAO, 2007). Beekeeping is extremely beneficial and necessary for forest resource management. This is because where beekeepers have placed their hives, bushfires are protected and avoided, and people are discouraged from cutting timber, poles, and other forest resources. Eventually, vegetation grows and these areas turn green. There is also fresh air in these areas due to forest vegetation cover, which helps to improve the environment. Human activities are hampered in those areas due to the fear of being stung by bees; additionally, grass and other plants have more space (Lalika, 2008). Examples of tree species that are conserved through beekeeping include *Brachystegia spiciformis*, *Dalbergia melanoxylon*, *Dalbergia nitidula*, *Julbernardia globiflora*, and *Pterocarpus angolensis* (Lalika, 2008).

Beekeepers must engage in activities that improve climatic conditions, allowing the right environment conducive to bee growth and fecundity. Bee activity contributes to climate change mitigation. A colony of honey bees comprises a cluster of several to 60,000 workers (sexually immature females) and a queen. Bees form a tight cluster to conserve heat as temperatures drop below 57° F. Young bees survive the winter, while the old ones gradually die (Mannering, 2014). During early spring, the lengthening days and new sources of pollen and nectar stimulate brood rearing. The bees also gather water to regulate temperature and liquefy thick or granulated honey (Mannering, 2014). The colony's temperature must be kept at around 93 degrees Fahrenheit (30 degrees Celsius) during hot summer days, which means the bees must keep their bodies cool (Mannering, 2014). After reproduction, all colony activity is geared toward winter survival. In addition to their role in forest resource management, bees are important pollinators of both wild and agricultural plants. Bees also bring about cross-pollination, in which pollen from one plant is transferred by bees to another plant, which is one sure way to obtain mixed genes in plants. In this manner, the offspring have a better chance of survival. The bees can also set in motion many symbiotic relationships that could keep the forest healthy for centuries. Therefore, the uncertainty of climate change's short- and long-term effects on agricultural production has become a societal issue (Markson, 2004). Beekeeping improves the nation's economy. From time immemorial, Beekeeping and honey have been considered by many cultures as a valuable commodity that is used in traditional rituals, in healing, or as food. Beekeeping can be practiced as an additional source of income for farmers in rural areas and has been successfully implemented in poverty-alleviating projects (Popoola *et al.*, 2013). Beekeeping requires few resources to commence production, it is not a labor-intensive activity and honey harvesting generally takes place during lean periods in agriculture (when most farmers have reduced pressure from farm work). The collected bee products can be sold to generate additional income to pay for school fees or health expenses, especially during periods of reduced income from agriculture. Beekeeping can eventually also lead to the development of other activities within the

community such as the making of protective gear, smokers, and beehives; or the production of value-added products such as honey beer, beeswax candles, or wood polish (Popo-ola *et al.*, 2013).

Conclusion

Climate change is defined as a significant shift in the statistical distribution of weather patterns over periods ranging from decades to millions of years. Climate change over any given location on the planet is caused by a variety of interacting natural and man-made factors. Beekeeping can increase respect for bees while also encouraging humans to try to protect their habitat and foraging areas as much as possible. The potential of beekeeping is directly proportional to the presence of virgin forests and low human population density, which provide an environment conducive to beekeeping. Beekeeping provides numerous economic and agricultural benefits to both farmers and ecosystems. Beekeeping is a viable way to help people work their way out of poverty while preserving natural diversity. Bees are critical for maintaining and protecting ecological balance and biodiversity in nature. A decline in bee colonies could endanger plant species survival. Beekeeping can be an additional source of income for farmers in rural areas and has been successfully implemented in poverty-alleviating projects. Beekeeping can thus be considered a viable commercial and protective measure that can be integrated into national forestry and other strategic planning programs.

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