ENVIRONMENTAL SCIENCE ARCHIVES
ISSN: 2583-5092
Volume III Issue 2, 2024
www.envsciarch.com

REVIEW OPEN ACCESS

Role of Apiculture in Sustainable Livelihoods, Socio-economic Development and Improving Ecosystem Services

Cliff Dlamini[1] and Stanley Dlamini[2]

[1]Centre for Coordination of Agricultural Research and Development for Southern Africa (CARDESA), Plot 4701 Mmaraka Road, Private Bag 00357, Gaborone, Botswana
[2]Agriculture and Environmental Consultant, Herefords Matfuntini Near New School, P.O. Box 7514-Manzini-M200, Eswatini
Correspondence for materials should be addressed to CD (email: cdlamini@ccardesa.org)

Received: 2024/05/14
Accepted: 2024/05/29
Published: 2024/07/01

Abstract

Bees play a pivotal role in agriculture development, maintaining biodiversity and promoting sustainable livelihoods including food security. Nevertheless, the potential of beekeeping is not fully exploited in forestry activities and development programs because information on the benefits of beekeeping has not been explicitly disseminated to stakeholders. Farmers and other stakeholders in the forestry sector should be well informed and convinced to accept beekeeping as a viable commercial and protective measure to be prioritized and integrated into sustainable forest management (SFM) and other development strategies. Beekeeping belongs to an enterprise where managers are the beekeepers and workers are the bees. This makes it one of the simple, time-saving and low-cost enterprise that could be afforded by people with different financial situations. There is evidence of the decline in the population of pollinating insects, including bees, on the planet due to unsustainable forest management practices that disturb these insects' lifecycles. It is important for SFM stakeholders to understand the environmental, socioeconomic and sociocultural utilities (goods and services) generated by beekeeping in order to identify possible interrelationships between them. Through this understanding, SFM stakeholders could come up with watertight interconnected programs and strategies that could enhance their value.

Keywords: Beekeeping; Sustainable forest management; Sustainable livelihood; Biodiversity; Environmental utilities; Economic utilities; Sociocultural utilities

Introduction

Bee-keeping is an inclusive and diverse activity that provides multisystem benefits to society, contributes to the sustainable development of rural areas and helps the development of global sustainability (Attia et al., 2022; Etxegarai-Legarreta et al., 2022). This is carried out by generating goods and services that improve the per capita income for communities. Further, the bee-keeping industry contributes to the creation of jobs. Recent studies have shown great interest in the pollination service provided by bees as they generate intangible goods and services. This increased interest in bees is because multifactorial causes are leading to a global reduction in the number of pollinating insects, including bees of various species (Nath et al., 2023; Bernauer et al., 2022). This could lead to the possible loss of crop productivity, thus impacting food security globally. According to Spash and Guisan (2021), pollination is crucial for the ecology, economy, and society and is of utmost importance for crop productivity. Understanding human needs and the uses that humans derive from things and living beings (in this case, bees) is the first step in becoming aware of the present situation. This is necessary for the evaluation and assessment of initiatives aimed at spearheading development. The primary utilities generated by honey bees and beekeeping can be grouped into three main blocks: environmental, socioeconomic, and sociocultural (Pacheco and Ocaña, 2023; Hadjur et al., 2022). These blocks have fundamentally been studied individually; however, it has become necessary to study them in a connected way, since some of these utilities

can be considered from a triple perspective, thus increasing the synergies that they produce individually.

Background of Eswatini Beekeeping

The apiculture sector in Eswatini was formalized in 1986. The Ministry of Agriculture (MoA) liaised with the United States of America Peace Corps to establish demonstration sites. These sites were used to train beekeeping farmers in all the four regions of the country. The main training centre was at the Lutheran Farmer Training Centre (LFTC). Other trainings were held at the four MoA regional farmers' training centres. The program involved the training of extension officers to be apiculture training trainers (ToTs). Before this initiative, beekeeping in Eswatini was underdeveloped and it was done at the individual level. The main focus was on the wild honey hunting and it was done without paying attention to sustainable forest management. Uncontrolled wild honey hunting increased in cases of uncontrolled fires which disturbed the lifecycles of some plant species thus affecting biodiversity, reducing the population of bees and also destroying some homesteads. The livelihood of communities, particularly those close to natural forests was impacted.

As a means of improving the apiculture industry, the MoA commissioned a study which was focused on finding out the status of the beekeeping sector and identifying areas of improvement. The MoA's vision was to establish an apiculture sector that could generate over US$100,000 in annual revenue (Bislimi, 2022; Singh et al., 2023). Capacity building was highlighted as the main driver of apiculture development in the country. Beekeeping requires specific technology which was not common at that time. Target groups for capacity building included extension officers, economics and prospective apiculture farmers (Brown & Campbell, 2020; Oravecz, 2020). The target beneficiaries for this initiative were the marginalized community members including the youth and women. For sustainability, the MoA established an apiculture school at the Lutheran Farmer Development Centre.

A tremendous improvement in the apiculture industry was realized between 1987 and 1995. The sector received financial sectors from a number of international sponsors including the Near East Foundation, the United States Agency for International Development (USAID), the European Economic Union (EEC), Barclay's Bank Fund for Development, W.K. Kellogg Foundation, Lutheran World Federation, Genesis Foundation, Public Welfare Foundation and the American Peace Corps (Gbolahan et al., 2023; Singh et al., 2023). Commitment from the MoA extension department as well as positive response from the apiculture stakeholders also contributed to the growth of the industry. Unfortunately, the financial support from the international organization dried out soon leaving the MoA with no option to re-strategize and devise sustainable means (Singh et al., 2023). The most viable strategy was to establish beekeeper associations. This gave birth to the Swaziland National Bee-Keepers Association (SNBA). The main objective of the SNBA was to allow farmers to market their products and approach potential sponsors as a unit. Further, the SNBA was tasked with conducting apiculture research and disseminating results to all stakeholders. In the early 1990s, the beekeeping training programs expanded to include sewing and carpentry for the production of beekeeping uniforms and equipment respectively (Singh et al., 2023). This was crucial as it provided opportunities for entrepreneurship and created more job opportunities. Further, the production of beekeeping equipment locally reduced costs thus making the industry more affordable and profitable. Over the years the industry has faced challenges such as theft, fires, climate change, and over usage of inorganic chemicals (pesticides and herbicides) which disrupt the lifecycle of bees and other pollination agents (Gratzer et al., 2021). To avoid theft and fires, farmers resort to keeping beehives closer to their homes and this has posed a threat to human ad livestock. Regardless of the challenges, apiculture remain a lucrative opportunity for sustainable livelihood development.

Concept of beekeeping

Andrieu et al. (2023) defined beekeeping as "*the art, science, and/or business of managing bees for the purpose of producing honey, wax, and other bee products for personal consumption and industrial use*". The bee is the main component of this industry as it does all the work without assistance from the beekeeper (Tutuba and Kapinga, 2022; Devkota, 2020). Therefore, beekeeping does not interfere with other agricultural interventions. As such, the beekeepers can engage in other enterprises and do beekeeping on part time basis. Apiculture does not require a lot of man-hours as farmers need a few hours a month to manage and ensure the bees' production cycle is not interrupted. Where necessary, the farmers provide support in terms of feed during periods where nectar is limited and provide water during dry periods. In some cases, farmers resort to migrating the beehives to areas where there is good vegetation and water. However, there are many challenges associated with this initiative. For instance, the risk of theft and fire is increased given

that there is limited human resources to look after the beehives. Further, the initiative has cost implications and there is a possibility of damaging the beehives during transportation.

Besides livelihood development, apiculture acts as an incentive for natural resource management (Sponsler & Bratman, 2021). Beekeeping contributes greatly towards enhancing sustainable and healthy ecosystems. Notably, this sector could be implemented with very low budget but contribute a lot towards sustainable livelihood development, healthy and clean ecosystems and improved crop yields. Therefore, this sector fits well with the concept of small scale agriculture production (Mokgomo et al., 2022; Debonne et al., 2021). Apiculture should be mainstreamed in all the other sectors such as food security, environmental conservation and economic development. Given the poor financial situation for rural farmers in Eswatini, apiculture offers great potential for development. Additionally, apiculture could be a solution for lack of arable land in the country particularly women and youth. Apiculture could be practiced in small land holdings and does not require costly land preparation (Jeil et al., 2022; Hlophe et al., 2021).

Unlike the other forms of livestock, which need a lot of support from the farmers, bees need limited support. In fact, under normal circumstances, they can produce without any form of support which is why they can produce in the wild. They can travel freely and scout resources without being obstructed. Further, bees do not require medical attention from the beekeepers and they produce faster than all the other livestock types (Zalilova et al., 2021; Topal et al., 2021). Beekeeping is complementary to forestry and agriculture and contributes significantly to long-term sustainability of these sectors (Djurabaev and Rashidov, 2021). Table 1 highlights some of the advantages of beekeeping over other agriculture enterprises.

Table 1. Advantages of beekeeping over other agriculture enterprises (Richardson, 2023)

Pollination	Bees pollinate flowering plants and thereby maintain the ecosystem. Bees pollinate cultivated crops.
Honey	People everywhere know and like honey, a valuable food and income source.
Beeswax and other products	Beeswax, propolis, pollen and royal jelly. These products have many uses, and can be used to create income.
Few resources are needed	Beekeeping is feasible even for people with minimal resources. Bees are obtained from the wild. Equipment can be made locally. Bees do not need the beekeeper to feed them.
Land ownership is not essential	Hives can be placed anywhere convenient, and so beekeeping does not use up valuable land. Bees collect nectar and pollen wherever they can find it, so wild, cultivated and wasteland areas all have value for beekeeping.
Nectar and pollen are otherwise not harvested	Nectar and pollen are not used by other livestock: only bees harvest these resources, so there is no competition with other crops. Without bees, these valuable resources could not be harvested.
Different sectors and trades benefit from a strong beekeeping industry	Other local traders benefit by making hives and equipment, and from using and selling the products.
Beekeeping encourages ecological awareness	Beekeepers have a financial reason to conserve the environment: ensuring that flowers are available and bees are protected.
Everybody can be a beekeeper	Bees can be kept by people of all ages. Bees do not need daily care and beekeeping can be done when other work allows.
Beekeeping is benign	Beekeeping generates income without destroying habitat. Encouraging beekeeping encourages the maintenance of biodiversity.

Utilities generated by beekeeping

In general, the ecosystem services associated with beekeeping include pollination and habitat conservation. However, there is a new trend that includes economic, environmental and cultural ecosystem services (Gring-Pemble and Perilla, 2021). The following are the main categories of utilities generated by beekeeping (Table 2). The benefits of ecosystem to human development have attracted interest from policy makers and economists as they strive to maximize an initiative that has the aspect of sustainable livelihood development.

Potential of beekeeping in Eswatini

According to Singwane et al. (2023), about 71% of Eswatini is covered by forests (natural and man-made). The major part of the country's Highveld is covered by man-made forests which are used for timber. These plantations are both owned by local companies and large multinational corporations.

The Lowveld has a vast natural environment which in some of the areas is not yet disturbed. Production of honey has a complimentary effect on the vegetation and hence the promotion of bee farming in the country has significant potential. According to Dlamini and Loffler (2023), the domestication of bees plays a crucial role in minimizing the incidence of forest fires, which is a great threat to the local forestry industry despite the provision of valuable income for those involved in this business. Eswatini has over 400 beekeepers who collectively harvest over 60 tons of raw honey annually. Notably, a majority (about 70.2%) of the beekeepers are male youth with an average age of 32 years.

Table 2. Benefits of honey bees the human and natural environment

Environmental Benefits	Similar to other pollination agents, through pollination bees plays a major role towards biodiversity conservation and maintaining of ecological balance (Pocol et al., 2021; Schouten, 2020). According to Hatfield et al. (2020) the ability of bees to provide services could be hindered by the misuse of plant-protection products, environmental pollution and limited availability of nectar (Maderson, 2023).
Bioindicators of Planetary Health and Climate Change	Beehives are among the most accurate indicators of climate change and could be used as indicators for detecting disturbances within the ecosystem (Box et al., 2019; Hatfield et al., 2020). This is because they have high sensitivity to any form of environmental pollution and they fact that reach different areas within a short space of time (Garrett et al., 2021; Pearce-Higgins et al., 2022).
Socioeconomic Profitability	Bookkeeping is the best option for rural livelihood development given that it is a low-cost enterprise, does not require large land holdings, uses fewer resources and has the ability to create job opportunities (Abro et al., 2022; Feketéné Ferenczi, 2023).
Honey Bee Products	Beekeeping products include honey, pollen, royal jelly, wax, propolis and apitoxin. Each of these products has specific functions in the bee hives and could be used for food, and medicine business purposes (Puranik et al., 2023; Camacho-Bernal, 2021). According to Hasan et al. (2023) honey bee venom can be used to improve the immune system for livestock.
Honey Bees as a Product	Some beekeepers sell and or lease their bee colonies to crop farmers who wants to supplement pollination services in their farms. This is more common in horticultural crops and fruit trees. Honey bees visit about 90 % of the 107 most important types of crops globally (Veereshkumar et al., 2021; Bass et al., 2024; Durazzo et al., 2021).
Ancillary Services Created around Beekeeping	Beekeeping has the potential to create many entrepreneurship opportunities. For instances, some business people are making a living out of selling beekeeping uniforms and beehives as well as providing beehive maintenance services (Bilik et al., 2024; Sari, 2023).
Sociocultural Uses	Some people derive satisfaction and personal reward from beekeeping such that they take it as a hobby (Szczurek et al., 2023; Kowalczuk et al., 2023). Further, beekeeping has some spiritual and religious values such that beekeepers establish associations and it can also be used as tourism attraction (Panta, 2020; Zhao et al., 2021).

According to ref Eswatini beekeepers generally lack the technical knowledge to produce at their full capacity and sell most of their honey on the informal marketplace, limiting their potential income. About 51% of the apiculture farmers have attained secondary education (51.0%) and have not been adequately trained in beekeeping. As a result, about 31% of the small-scale beekeeping farmers still use traditional and Swazi top bar hives. There is a need to intensify efforts in training and introducing apiculture farmers to modern production technologies. Further, there is a need to mobilize women to participate in the industry. Beekeeping has the potential to improve livelihood for the marginalized Eswatini community members who do not have enough resources (land & finances) to sustainably implement other agriculture enterprises such as crop production and animal husbandry. Further, beekeeping can improve food production and biodiversity as it improves pollination services. Eswatini has both native *Apis cerana* honey species and foreign *Apis mellifera* honey species. The latter are reared in modern beehives while the former are found in wooden logs and under rocks in the natural forest (Kugonza, 2021; Yagound et al., 2020).

Challenges of sustainable forest management (SFM) and beekeeping

Predators, uncontrolled forest fires, parasites and diseases are some of factors affecting both SFM and beekeeping (Djafar, 2023). These challenges impact negatively on the lifecycle of bees which impact negatively crop production and biodiversity because crops and forest sustainability depends on pollinators (Patel et al., 2020; Liu et al., 2023). Beekeeping and SFM problems could be attributed to lack of adequate knowledge of proper forest management strategies (Yan et al., 2021; Javed et al., 2022). Therefore, it is important for beekeepers and foresters to jointly establish training

programs to ensure long term sustainability. SFM and beekeeping challenges can be addressed by developing policy frameworks, strengthening of governance and capacity building.

Conclusions and recommendations

Besides the role of pollination, beekeeping has proven to be one of the potential enterprises for rural sustainable livelihood development. This is due to the fact that the enterprise does not require a lot of resources (finances, labour, land holdings etc.). Beekeeping faces challenges in the winter season when there is not enough nectar. Beekeepers opt to migrate the beehives to warm places throughout the winter as a strategy to significantly increase honey production. The economical migratory system of beekeeping, which involves moving beehives Beekeeping has limitations due to the following factors; lack of basic infrastructure, un-qualified labour, lack of training and poor extension facilities. The government and other stakeholders should intervene and assist beekeeping farmers deal with the challenges. There is a need to engage qualified personnel throughout all the stages of the beekeeping value chain. Deforestation and forest fragmentation are two of the most widely recognized, vital factors responsible for the degradation of the environment. It is therefore important to increase awareness among farmers, forest communities and communities living around forests, about the important role that bees play in agriculture and in maintaining biodiversity and ecosystems.

References

Abro Z, Kassie M, Tiku HA, Taye B, Ayele ZA and Ayalew W (2022) The impact of beekeeping on household income: Evidence from north-western Ethiopia. Heliyon 8(5).

Andrieu J, Bernal-Jurado E, Mozas-Moral A and Fernández-Uclés D (2023) Sustainable Development Goal in the beekeeping sector and its cooperative network: Universitat de València.

Attia YA, Giorgio GM, Addeo NF, Asiry KA, Piccolo G, Nizza A, Di Meo C, Alanazi NA, Al-qurashi AD, Abd El-Hack ME (2022) COVID-19 pandemic: Impacts on bees, beekeeping, and potential role of bee products as antiviral agents and immune enhancers: Environ Sci Pollut Res 29:9592–9605.

Bernauer OM, Tierney SM and Cook JM (2022) Efficiency and effectiveness of native bees and honey bees as pollinators of apples in New South Wales orchards: Agriculture, Ecosystems and Environment. 337:108063.

Bislimi K (2022) Determinants of family entrepreneurship in the beekeeping sector: Journal of Family Business Management. 12(1):106-119.

Box JE, Colgan WT, Christensen TR, Schmidt NM, Lund M, Parmentier FJW and Olsen MS (2019) Key indicators of Arctic climate change: 1971–2017: Environmental Research Letters. 14(4):045010.

Brown IL and Campbell AD (2020) Beegining the Implementation of Appropriate Beekeeping Technology: In 9th International Conference on Appropriate Technology.

Camacho-Bernal GI, Cruz-Cansino NDS, Ramírez-Moreno E, Delgado-Olivares L, Zafra-Rojas QY, Castañeda-Ovando A and Suárez-Jacobo Á (2021) Addition of bee products in diverse food sources: Functional and physicochemical properties. Applied Sciences. 11(17):8156.

Debonne N, van Vliet J, Ramkat R, Snelder D and Verburg P (2021) Farm scale as a driver of agricultural development in the Kenyan Rift Valley: Agricultural Systems. (186): 102943.

Devkota, K (2020) Beekeeping: Sustainable livelihoods and agriculture production in Nepal. Modern Beekeeping-Bases for Sustainable Production 26:1-11.

Dlamini WM and Loffler L (2023) Tree Species Diversity and Richness Patterns Reveal High Priority Areas for Conservation in Eswatini: In Ecosystem and Species Habitat Modeling for Conservation and Restoration 141-167. Singapore: Springer Nature Singapore.

Djafar EM, Widayanti TF, Saidi MD and Muin AM (2023) Forest management to Achieve Sustainable Forestry Policy in Indonesia. In IOP Conference Series: Earth and Environmental Science, IOP Publishing. 1181(1):012021.

Djurabaev OD and Rashidov J (2021) The main directions of effective management and development of the beekeeping industry: In E3S Web of Conferences. EDP Sciences. 282: 02002.

Durazzo A, Lucarini M, Plutino M, Lucini L, Aromolo R, Martinelli E and Pignatti G (2021) Bee products: A representation of biodiversity sustainability and health Life. 11(9): 970.

Encerrado-Manriquez AM, Pouv AK, Fine JD and Nicklisch SC (2024) Enhancing knowledge of chemical exposures and fate in honey bee hives: Insights from colony structure and interactions. Science of the Total Environment 170193.

Etxegarai-Legarreta O, Sanchez-Famoso V (2022) The Role of Beekeeping in the Generation of Goods and Services: The Interrelation between Environmental, Socioeconomic, and Sociocultural Utilities. Agriculture 12: 551.

Ferenczi A, Szűcs I and Bauerné A (2023) Economic Sustainability Assessment of a Beekeeping Farm in Hungary. Agriculture 13(6): 1262.

Garrett KA, Nita M, De Wolf ED, Esker PD, Gomez-Montano L and Sparks AH (2021) Plant pathogens as indicators of climate change: In Climate change. Elsevier. 499-513.

Gbolahan YSF, Ebenezer AB and Oluwaseun PO (2023) Mapping the Conceptual Structure of Beekeeping from 1980 to 2020. Journal of Scientometric Research.12(1):187-196.

González MA and Barragán A (2023) Sustainability and Innovation in the Beekeeping Sector: A First Approach in Digital and Sustainable Transformations in a Post-COVID World: Economic, Social, and Environmental Challenges. Cham Springer International Publishing 161-189.

Gratzer K, Wakjira K, Fiedler S and Brodschneider R (2021) Challenges and perspectives for beekeeping in Ethiopia: A review Agronomy for Sustainable Development 41(4):1-15.

Gring-Pemble L and Perilla G (2021) Sustainable beekeeping, community driven-development, and tri-sector solutions with impact. Corporate Governance: The International Journal of Business in Society 21(2):359-372.

Hadjur H, Ammar D, Lefèvre L (2022) Toward an intelligent and efficient beehive: A survey of precision beekeeping systems and services. Comput. Electron. Agric. 192: 106604.

Hasan A, Qazi JI, Tabssum F and Hussain A (2023) Increased bee venom production in Apis mellifera workers on the provision of probiotics and organic acids. Biocatalysis and Agricultural Biotechnology (48): 102616.

Hatfield JL, Antle J, Garrett KA, Izaurralde RC, Mader T, Marshall E and Ziska L (2020) Indicators of climate change in agricultural systems. Climatic Change 163: 1719-1732.

Hlophe NS, Hung RJ and Dlamini SI (2021) Factorial Analysis of Challenges Encountered by Smallholder Cotton Growers in Eswatini: Global Journal of Agricultural Research 9(1): 8-25.

Javed A, Ali E, Afzal KB, Osman A and Riaz S (2022) Soil fertility: Factors affecting soil fertility, and biodiversity responsible for soil fertility. International Journal of Plant, Animal and Environmental Sciences 12(1): 21-33.

Jeil EB, Abass K and Segbefia AY (2022) Challenges to sustaining beekeeping livelihoods in Ghana. GeoJournal. 87(2): 991-1008.

Kugonza DR (2021) Africa under attack: a continent-wide mapping of pathogens, parasites and predators afflicting the hived honey bee Apis mellifera L (Hymenoptera: Apidae). African Journal of Rural Development 5(2): 1-27.

Liu H, Liu S, Wang F, Liu Y, Han Z, Wang Q and Sun J (2023) Multilevel driving factors affecting ecosystem services and biodiversity dynamics on the Qinghai-Tibet Plateau. Journal of Cleaner Production (396): 136448.

Richardson K (2023) Beekeeping role in enhancing food security and environmental public health. Health Economics and Management Review 4(4): 69-79.

Kowalczuk I, Gębski J, Stangierska D and Szymańska A (2023) Determinants of Honey and other bee products use for culinary, cosmetic and medical purposes. Nutrients, 15(3): 737.

Maderson S (2023) Co-producing agricultural policy with beekeepers: Obstacles and opportunities. Land Use Policy (128): 106603.

Mokgomo MN, Chagwiza C and Tshilowa PF (2022) The impact of government agricultural development support on agricultural income, production and food security of beneficiary small-scale farmers in South Africa. Agriculture 12(11): 1760.

Nath R, Singh H and Mukherjee S (2023) Insect pollinators decline: an emerging concern of Anthropocene epoch. Journal of Apicultural Research. 62(1): 23-38.

Oravecz T (2020) A comparative study on beekeeping sectors between the visegrad countries. Selye e-Studies.

Patel V, Biggs EM, Pauli N and Boruff B (2020) Using a social-ecological system approach to enhance understanding of structural interconnectivities within the beekeeping industry for sustainable decision making. Ecology & Society 25(2).

Pearce-Higgins JW, Antão LH, Bates RE, Bowgen KM, Bradshaw CD, Duffield SJ and Morecroft MD (2022) A framework for climate change adaptation indicators for the natural environment. Ecological Indicators. (136): 108690.

Pejić J, Milovanović M, Božilov A and Pejić P (2022) Impact of the precision beekeeping on the living environment. Facta Universitatis, Series: Working and Living Environmental Protection 049-061.

Pocol CB, Šedík P, Brumă I S, Amuza A and Chirsanova A (2021) Organic beekeeping practices in Romania: Status and perspectives towards a sustainable development. Agriculture 11(4): 281.

Puranik SI, Akbar and Ghagane SC (2023) Economic Benefits of Honey and Honey Products. Honey: Composition and Health Benefits 330-339.

Schouten CN (2020) Factors influencing beekeepers' income, productivity and welfare in developing countries: a scoping review. Journal of Apicultural Research 60(2): 204-219.

Singwane SS, Beckedahl HR and Manyatsi AM (2023) Community Forest Resource Utilization and Associated Land Degradation in Eswatini–The Case of Ezikhotheni and Ngcayini Chiefdoms. Science 4(3): 49-62.

Singh AS, Kibirige D and Malaza PS (2023) Analytical Study of Small Scale Beekeeping Farming in Eswatini: A Case Study in Manzini Region, Eswatini. Asian Journal of Advances in Agricultural Research 23(1): 1–9.

Spash CL and Guisan A (2021) A future social-ecological economics. Real World Economics Review 96: 203-216.

Sponsler DB and Bratman EZ (2021) Beekeeping in, of or for the city? A socioecological perspective on urban apiculture. People and Nature 3(3): 550-559.

Topal E, Adamchuk L, Negri I, Kösoğlu M, Papa G, Dârjan MS and Mărgăoan R (2021) Traces of honeybees, api-tourism and beekeeping: From past to present. Sustainability 13(21): 11659.

Tutuba NB and Kapinga C (2022) Beekeeping Productivity: Why is the Beekeeping Sector less Productive in Tanzania? International Journal of Economics, Business, and Management Research 6(09): 199-211.

Yagound, Boris, Kathleen A. Dogantzis, Amro Zayed, Julianne Lim, Paul Broekhuyse, Emily J. Remnant, Madeleine Beekman et al. (2020) A single gene causes thelytokous parthenogenesis, the defining feature of the cape honeybee Apis mellifera capensis. Current Biology 30(12): 2248-2259.

Yan K, Dong Y, Gong Y, Zhu Q and Wang Y (2021) Climatic and edaphic factors affecting soil bacterial community biodiversity in different forests of China. Catena (207): 105675.

Zalilova ZA, Mannapov AG, Lukyanova MT and Kovshov VA (2021) Strategies of regional economic and sustainable development: The case of the beekeeping industry. In The Challenge of Sustainability in Agricultural Systems 1: 855-862.

Veereshkumar, Kaushik SK, Rajarajan K, Kumaranag KM, Uthappa AR, Sridhar KB and Handa AK (2021) Pollination biology of Pongamia pinnata (L) Pierre: a potential biodiesel plant. Genetic Resources and Crop Evolution. 68(1): 59-67.

Author Contributions
CD and SD conceived the concept, wrote and approved the manuscript.

Acknowledgements
Not applicable.

Funding
Not applicable.

Availability of data and materials
Not applicable.

Competing interest
The authors declare no competing interests.

Ethics approval
Not applicable.

Citation: Dlamini C and Dlamini S (2024) Role of Apiculture in Sustainable Livelihoods, Socio-economic Development and Improving Ecosystem Services. Environ Sci Arch 3(2): 12-19.