Local Community's Awareness and Perception of Bee-Plant Interaction and The Contribution of Beekeeping to Ecosystem Conservation and Livelihood Improvement in Northern Tanzania.

Project Detailed Final Report

The Rufford Foundation

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1.0 Introduction

Beekeeping is among other income-generating activities that improve people's livelihoods and help ensure sustainable ecosystem conservation (Mpondo et al., 2021). Local communities' engagement and participation in beekeeping should be maximized to benefit from the activities' products and services. Nonetheless, the conservation of bees and the plants they prefer in a landscape remain the backbone of keeping bees. This conservation of bees is highly influenced by the availability of forages and the continuous provision of resources from bees' preferred plant species, which varies from landscape (Rikohe et al., 2023). Equipping the local community with the knowledge of bee-plant interaction and assessing their Indigenous knowledge on the potential contribution of beekeeping activity in improving their livelihood will aid in motivating and increasing peoples' engagement in keeping bees while conserving them and the ecosystem at large(Bajracharya et al., 2006; de los Angeles Somarriba-Chang and Gunnarsdotter 2012). The current project continues the first project funded by Rufford, which based on assessing plant species diversity and honeybees' foraging preferences on the identified plants in the areas bordering Mkomazi National Park in Northern Tanzania. This project aimed to assess the local community's awareness of honeybees' preferred plant species in their regions and the contribution of beekeeping activities to conservation and livelihood improvement. Also, the project equipped the local community with awareness of bee-plant interaction in their areas and related conservation techniques for such plants and bees. Also, the project provided people with knowledge and skills on modern beekeeping practices to keep bees profitably, which is advantageous in both ecosystem conservation and the development of the beekeeping sector.

Figure 1: Team members during the project activities.

2.0 Project Area Description and Justification

The study areas were located in the Same district (-3.3725, 36.694444), Northern Tanzania, in four wards (Figure 2): Kisiwani, Vumari, Ruvu and Maore. A total of 200 participants (questionnaires), three key informants and four groups of more than eight people were included in the data collection. These study areas were selected purposely as the areas where beekeeping activities are conducted. These areas also border Mkomazi National Park, Pare Mountains, and other protected areas. Generally, the district is bordered to the north by the Mwanga District, to the northeast by Kenya, to the south and southeast by the Tanga Region, and to the west by the Manyara Region. About 300303 people inhabit the district with 76.4% living in the rural areas (MFP 2022). Maore and Ruvu are

the highly populated wards, with 19129 and 19105 inhabitants, respectively, followed by Kisiwani 10738 people, and Vumari 6117 people. The areas experience annual rainfall ranging from 1000 to 2000 mm, divided into two seasons: a short rain season occurs between November and January, while a long rain season starts from February to May (Prins & Loth, 1988). The main economic activities in the areas are agricultural, where people are involved in both commercials by cultivating sisal and food production; besides agriculture, tourism is among other growing economic activities (Mwanyoka & Lopa, 2016).

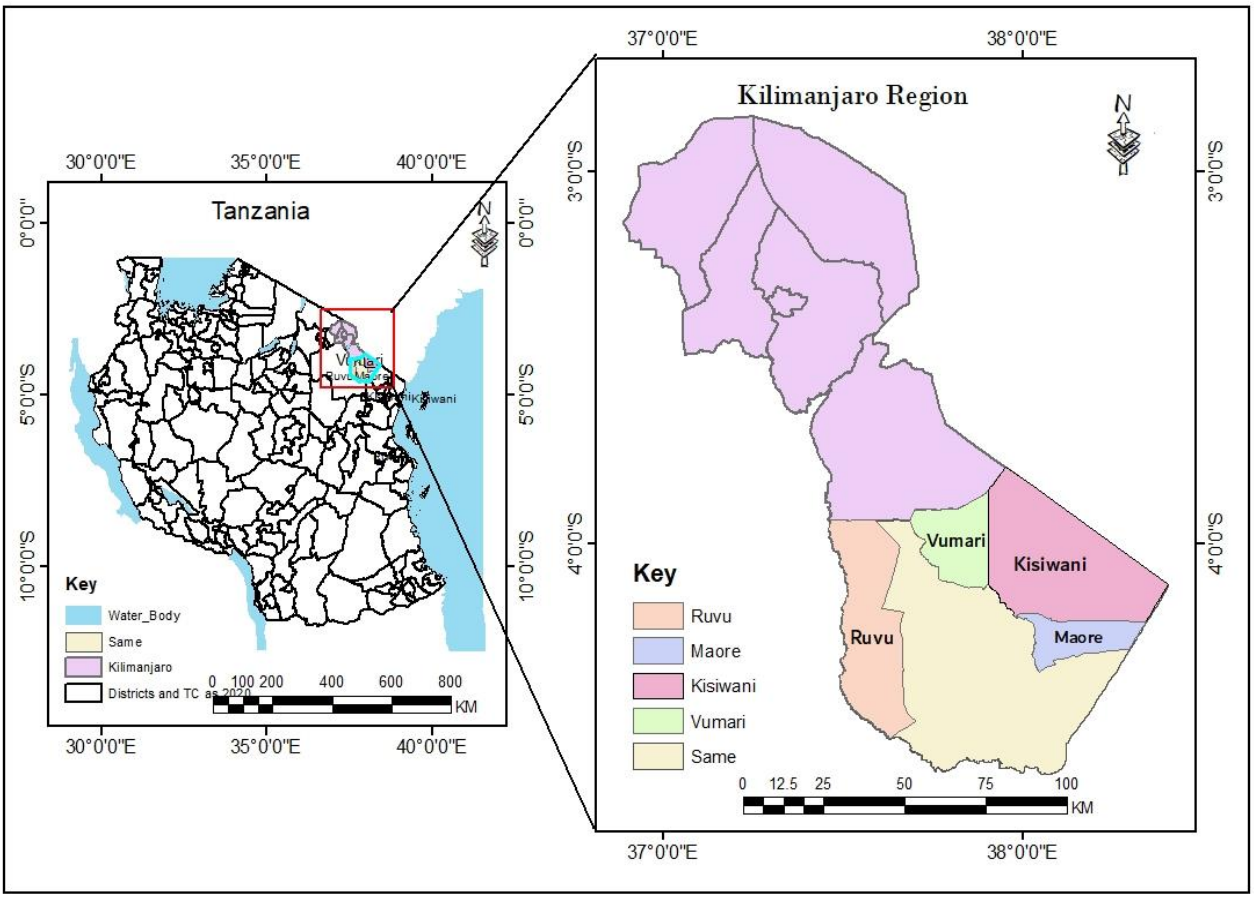

Figure 2: The diagrammatical representation of the study areas, showing the region, district, and wards where the study was conducted in 2024.

3.1 Data collection and analysis

The study employed a Questionnaire, Focus group discussion (FGD), and key informant interview techniques of data collection to study the communities in the selected wards around the Mkomazi National Park (Fig 3-7). A semi-structured questionnaire was administered to 200 respondents; four FGDs, each with 10 participants were conducted; and five key informants from the district council office, conservation authorities, and non-governmental organizations were interviewed. Moreover, before data collection, permits were obtained from the district council and ward leaders. The research team, consisting of researchers, beekeeping officers, and three field assistants, ensured that the targeted population and respondents were reached. Descriptive statistics such as means, ranges, frequencies, and percentages were computed in IBM SPSS ver.29 and Microsoft Excel software. Analysis results are presented in tables and graphs. The Graphpad Prism ver.8 software was used to plot the graphs.

Figure 3: Data collection from different participants from the study areas.

Figure 4: Data collection from different participants from the study areas.

Figure 5: Data collection from different participants from the study areas.

Figure 6: Data collection from different participants from the study areas.

Figure 7: Data collection from different formed focus groups

4.0 Results

The data were collected from participants and analyzed purposely to assess the awareness and perception of local communities on the bee-plant interaction and the contribution of beekeeping to ecosystem management and livelihood improvement. A total of 200 were involved in the questionnaires, 50 from each ward. Overall, there were more male participants than females in all areas. Out

of 200 participants, 118 were beekeepers, equal to 59% of all participants, while 82, equal to 41%, were non-beekeepers. Most non-beekeepers (67.1 %) showed interest in keeping bees when provided support and sorting the hindering factors, while 32.9% of participants showed no interest in keeping bees.

Table 1: Frequencies of Wards

Wards	Gender	Counts	% of Total	Cumulative %
More	Male	32	16.0 %	16.0 %
	Female	18	9.0 %	25.0 %
Vumari	Male	32	16.0 %	41.0 %
	Female	18	9.0 %	50.0 %
Kisiwani	Male	33	16.5 %	66.5 %
	Female	17	8.5 %	75.0 %
Ruvu	Male	33	16.5 %	91.5 %
	Female	17	8.5 %	100.0 %

Even though most people are still involved in keeping bees, beekeeping is not the primary source of income for most of them, and there is no income change for some livelihoods. For instance, other sources were 67.5%, while only 32.5% for beekeepers who depend on beekeeping as their primary source of income. For beekeeping activity to have a significant role in household income, change should be practised in modern ways. At the same time, beekeepers are involved in harvesting different bee products and adding value to the products, purposely to increase the products and widen markets.

Table 2: Frequencies of participants who keep bees and non-beekeepers.

If_keeping_bees	Counts	% of Total	Cumulative %
Beekeepers	118	59.0 %	59.0 %
Non-beekeepers	82	41.0 %	100.0 %

Most beekeepers stayed in a place for more than 20 years, for instance, 71.6%, and the income generated by beekeeping through selling products ranged from 100000-500000 to most beekeepers (47.2%). Most of the beekeepers (37.6%) were at the age of 36-50, followed by 18-35 years (21.3%) (Fig 6).

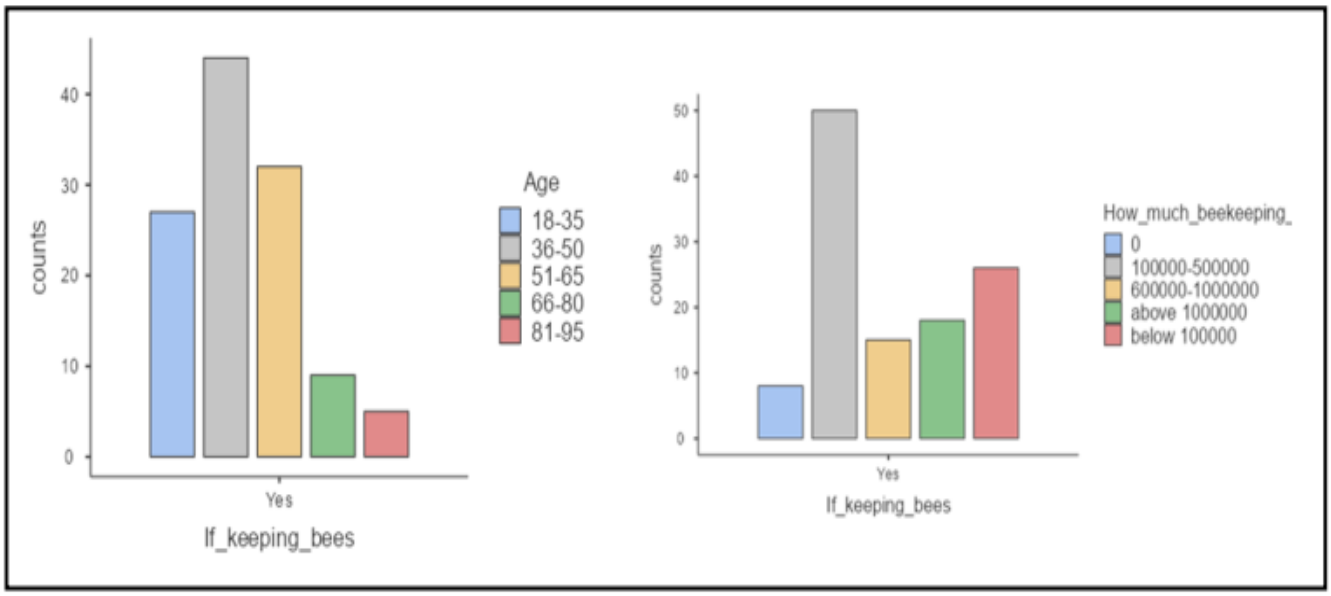

Figure 8: Income generated from beekeeping and household-age participation in beekeeping activity.

From the collected data, the local people understand and strongly agree (91.5%) on the importance and role of keeping bees in ecology and nature conservation, regardless of whether they keep or do not keep bees. The local community mentioned how keeping bees would be potential for conservation, where conserving plants was highly mentioned (40%), followed by the role of bees in pollination (21.9%), protecting inversion of wild animals to people's residences and farms (14%), and avoiding anthropogenic activities in the reserved areas for beekeeping (20%) (Fig.7)

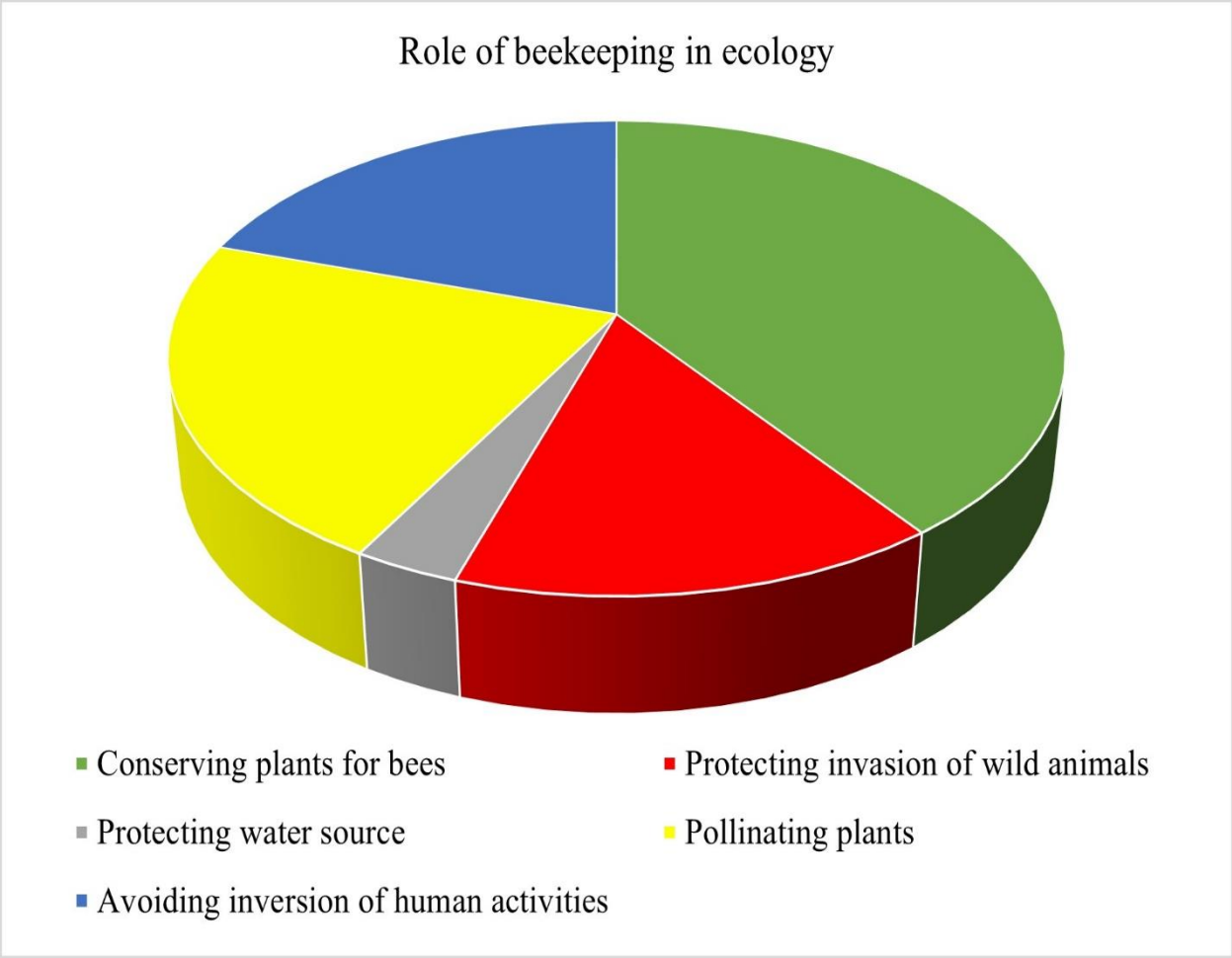

Figure 9: Role of keeping bees in ecology conservation.

The study also targeted to understand the challenges facing the beekeeping industry in their areas; local communities mentioned different challenges, including lack of skills/knowledge (19.9%) as the highly mentioned challenge, followed by lack of equipment (19.6%), forest fire (10.6%), and deforestation (15.6%). Deforestation and forest fires negatively impact bees as they compromise the availability of plant species for bees. Other researchers have mentioned these as significant factors for bee colony decline. Lack of equipment also hinders people's participation in the activity, compromising the quality and quantity of the produced products.

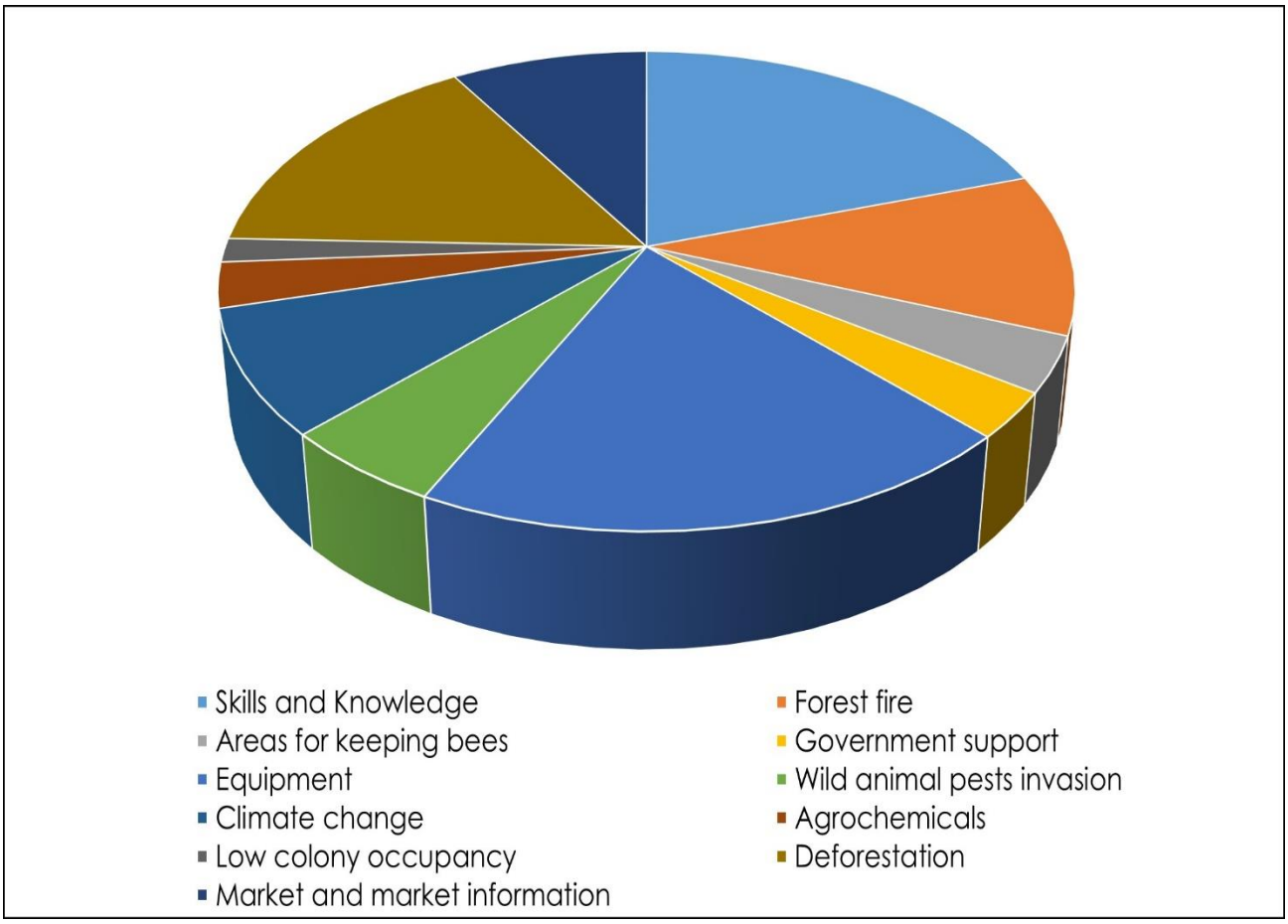

Figure 10: Challenges mentioned by respondents hindering beekeeping development.

Many plants were mentioned as preferred by bees in their areas. However, *acacia mellifera* were highly cited, followed by Maize trees, *Grewiabicolar*, Sunflower, *Terminalia brownii*, *Cordia monoica*, *Ziziphus mucronata*, Beans, *Hoslundia opposita*, *Terminalia brownii* and *Oxygonum sinuatum*, other mentioned plant species were, Orange plants Triumfetta_rhomboidea, *Bidens pilosa*, Banana plant, *Waltheria indica, Justicia matammensis*, Sunflower, *Ocimum basilicum*, *Solanum incanum*, *Aspilia mossambicensis, Combretum molle, Mangifera indica, Moringa oleifera, Ocimum gratissimum,* Tarmarind, *Acacia nilotica, Oxygonum sinuatum,* Sisal and Sorghum (Fig 9).

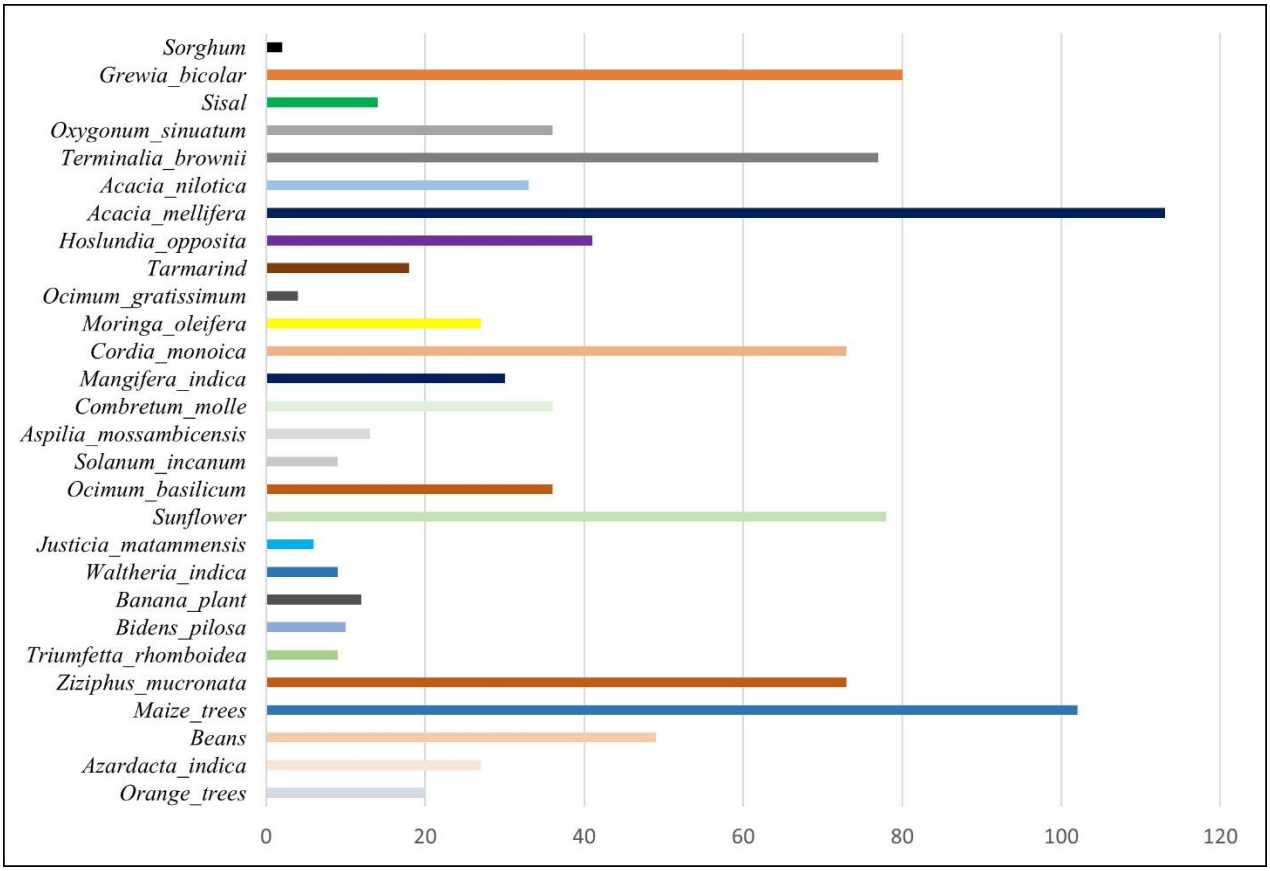

Figure 11: Plant species preferred by honeybees in study areas.

6.0 Training to communities

After the data collection, training was conducted to create awareness and provide knowledge to the local people on the bee-plant interaction and the contribution of keeping bees in conservation and household income generation. Other participants during training were government officials, including district beekeeping officers and wildlife conservation officers. The training covered different issues, including plants available in the study areas and which plants are highly preferred by bees (bee-plant interaction); this part was supported by the study conducted previously (Rikohe et al., 2023) and summarized information from the current study also, modern beekeeping practices.

Regarding modern beekeeping practices, the participants were trained in general bee colony management practices and the whole production chain in beekeeping, from the hive occupation to the harvesting of hive products. The training was provided in two ways: presenting the critical issues to participants and an open discussion among members to share the acquired knowledge and cement their understanding. Nonetheless, the training involved practical (hands-on) sessions where all participants from different project areas made modern hives.

Also, with the planned issues to be addressed during training, some of the issues raised during data collection were included in the problems to be trained; most of these issues were raised from the challenges facing the beekeeping industry and beekeepers at large in their respective areas. For example, the problems of marketing their products, bees' pest management, colony stocking, maximizing bee colonies, and the general concept of value addition to bees' products.

Figure 12: Some pictures were taken while preparing materials for practical sessions.

Figure 13: Some pictures taken during a practical session of the training.

Figure 14: Some pictures taken during a practical session of the training.

Figure 15: Some pictures during theoretical training sessions.

7.0 Conclusion and Recommendation

The development of the beekeeping industry and the effective utilization of bees as a potential resource in our ecosystem is highly influenced and triggered by effective conservation strategies of the bees themselves and their resources from preferred plant species in a particular landscape by local communities. This effective participation of local communities is highly attributed to the knowledge and awareness among the community regarding the importance of bees and the beekeeping industry, as well as the role of bees in the ecosystem and how to conserve them. This study paved the way and gave us essential information on what the local people in the project areas know and perceive regarding bee-plant interaction, the role of bees in ecosystem conservation and improving livelihood, and to what extent. Here are some recommendations: Beekeeping activities improve people's livelihood and play a vital role in nature conservation. Therefore, there should be an initiative to increase the participation of the locals in keeping bees in the study areas. According to the study, most people traditionally conduct beekeeping, and many seem not to see the financial contribution of the activity. Therefore, people should be well facilitated and encouraged to conduct beekeeping modernly. Many participants reported the invasion of different wild animals into peoples' residences, and bees have been reported to restrict the invasion of wild animals (elephants)(Dror et al., 2020; King et al., 2017). Therefore, the local community should be encouraged to establish apiaries in the identified areas of elephant invasion to reduce the damage from the animals and help settle human-wildlife conflict. Deforestation and forest fires were highly mentioned as significant challenges of beekeeping activities in the areas; the problem should be addressed by local people's awareness of the consequences of these practices on the ecosystem, and initiatives regarding the conservation of such areas should be implemented. Most of the plants reported as bee plants were reported in the previous study (Rikohe et al., 2023) as preferred plants; however,

these plants were reported to be less abundant in the project areas due to the reported deforestation and charcoal-making by the local community, thus, bee plants plantation program should be implemented to ensure the sustainable provision of bee resources and enhance their survival. Beekeeping activities, when appropriately conducted, will help the local community in income generation while helping in the conservation of nature in different ways, including reducing total dependence on natural resources as a source of income, especially for the areas living close to Mkomazi National Park and other protected areas and their services in pollinating both crop and wild plants.

8.0 Feedback from the communities

Beekeepers from various beekeeping groups received comprehensive training, both theoretical and practical, on modern beekeeping techniques. This training covered key areas such as apiary and colony management practices, as well as the construction of modern bee hives. The effectiveness of this knowledge was significantly evident during subsequent project evaluations and monitoring guided by placed action plans during the training. Several beneficiary groups showed marked improvement in their ability to properly site their hives, manage their apiary, and capture bee colonies, also some beekeeping groups successfully constructed their beehives, utilizing the skills and knowledge they had acquired during the training.

Figure 16: Some project beneficiaries are constructing modern beehives by applying the knowledge and skills provided through the project.

9.0 Project budget

The following is the budget used for this current project.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Field Research Assistants in data collection will receive 15 £ per day, and they will stay for 30 days; here in each ward, there will be six (6) days of data collection, while the last (sixth) day will be used to organize the data and to move to another ward of interest).	£450	£600	£150	The budget was exceeded because we added one research assistant. There were two research assistants instead of one.
Two technical staff will be involved in a field to help during the capacity building and training session and will be paid 20£ periderm for 30 training days; in each ward, there will be six days (6) for both theory and practical sessions, each session will have three days.	£1,200	£1,200	£0	The budgeted amount was used as planned. However, there were some changes: the technical staff received £30 per day to fulfill the basic requirements in the field and the number of days decreased from 30 to 20 training days. Hence, there were no changes to the budget.
Transport costs to different study areas during data collection and training sessions will cost 150£ per month for two months of data collection and capacity building. The transport will take trainers during training and data collectors (assessment) part to move from one area of interest to another.	£300	£480	£180	The actual amount exceeded the budgeted amount as there was an increase in the car hire price. The price was £12 per day, including driver fee and fuel, and the activity was conducted for 40 days of data collection and training.
Stationary materials for participants during training	£60	£60	£0	The budgeted amount was used as planned.

sessions (notebooks, pens, and marker pens) (lamp sum).				
Accommodation and meals for the project leader will cost £200 per month for two (2) months of data collection and training.	£400	£400	£0	The budgeted amount was used as planned.
Graphics, printing, and publishing (to minimize costs for publication, I will search for a reputable open-access journal with an article publishing charge waiver/discount); graphics and printing will include making fliers, t-shirts, and burners that will be used in different sessions of the project	£400	£800	£400	The amount spent exceeded the budget due to price changes and the need for quality publicity materials.
Materials during capacity building: The material will be used to make modern hives for each beekeeping group; here, there will be ten beekeeping groups, two from each ward, with 15 people per group. Per each group, they will make ten modern bee hives. For hive making, a. Three timbers of 12 feet for one hive @ soft timber will cost 4£ = 12£ for all ten groups will cost 1200 £. b. Nails 4 kgs (mixed sizes) @ 2£ = 8£ for all groups will need 40kgs which will cost	£1390	£1,020	£328	There were some modifications to the budgeted amount; the amount decreased as the number of beekeeping groups decreased from 10 to 8 groups from 4 wards. The timber cost £768 for 64 hives, eight from each group; this was different from the budgeted amount of £1200 for 100 hives. Nails cost £64 for eight groups, each using 4 kgs. Carpentry and machine services cost £158, including electricity and carpenters' allowances (Carpenters were involved during the study to give an idea and guidance on using machines).

80£. c. 10 bottles (500ml) wood glue@ 3£ which will be 30£ for all ten groups. d. Carpentry machines service for preparing wood after all measurements by participants and before assembling; the members will do this as part of training at the nearby carpentry workshops; this is expected to cost 50 £ (lump sum). Other carpentry equipment including hammer, measurement tape) will cost £30.				
Meal costs (food and drinks) per participant during a training session estimated that participants are 30 from each ward, making 150 total participants from five (5) wards. Each participant is expected to spend 12 £ for all six training days, which is 2£ per day. The meal will be for lunch only.	£1800	£1,440	£360	The amount varied from the budget as the number of wards changed from 5 to 4.

10. References

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