A case study for wild honeybees’ contribution to biodiversity economy and considerations for sustainable harvesting

By

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To the

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Abstract

South Africa is recognised as one of the countries that still have high populations of wild honeybee colonies. Honey harvesters benefit from these wild colonies through harvesting honey and other honeybee products whereas beekeepers benefit by trapping these wild swarms. The importance of managed honeybees is also well recognized when it comes to crop pollination, honey production and other bee related products. However, the economic contribution of wild honeybees to these practices is not well documented. Furthermore, the benefits of harvesting honey from wild honeybee colonies has received little attention in South Africa. This study documents the contribution of wild honeybees to biodiversity economy in two separate approaches. Firstly, by exploring swarm trapping by beekeepers, an important practice for the increase or replenishment of lost colonies. Secondly, the harvesting of honey from wild honeybee colonies by honey harvesters. The economic assessment was carried out by accounting for beekeeper’s different uses of trapped swarms and documenting income generated by honey harvesters from harvesting honey as well as other bee products. Respective data sets were generated by the use of two questionnaire surveys.

The selected study areas were Vhembe District in Limpopo Province and the Western Cape Province. The questionnaire from Vhembe generated 24 respondents for beekeepers and 19 for honey harvesters. In the Western Cape, a total of 28 beekeepers responded to the questionnaire. The results indicated that beekeepers in both provinces rely on wild honeybee colonies for maintaining their colony stocks and generate money by either selling trapped swarms, using them for pollination and honey production. However, the trapping frequencies differed between the two provinces. Beekeepers trapped wild swarms throughout the four seasons, with spring being the mostly preferred in the Western Cape and summer in Vhembe. Trapping rate success was also different between the two provinces. Each beekeeper has different uses for the trapped swarms depending on what practice benefit them most.

Honey harvesters, in Vhembe, indicated that the honeybee products they harvest contributes positively to their livelihoods. In the process of harvesting these products, some bees are negatively affected as they do die - this was confirmed by 80% of the honey harvesters. In assessing the status of wild honeybee populations in respective areas, covered in both questionnaires, it was evident that the populations are generally doing well. Beekeepers and honey harvesters’ responses were mostly balanced when reporting both increases and declines. The study succeeded in exploring the set aim and objectives, and revealed a strong element of dependence on wild colonies that is linked to income generation. This answers the research
question by confirming that indeed wild honeybee colonies to contribute to the biodiversity economy. At the same time, the viability and sustainability of these benefits require that wild colonies are well looked after in relation to habitat requirement and general environmental wellbeing.
1. Introduction

1.1 Background

South Africa is home to two indigenous sub-species of honeybees; Apis mellifera scutellata (referred to as the African bee from here forth) found in the northern region of the country, and Apis mellifera capensis (referred to as the Cape bee from here forth), which is found in the western and southern Cape regions (Calis et al., 2002; Smith, 1961). The two subspecies are separated by a hybrid belt that extends from the mid-west coastal region to the south coastal region, through the mountains bordering on the Klein Karoo. This mountain barrier maintains the stability of the Cape bee and African bee as separate sub-species because of topography, climate, and vegetation changes on either side of the border. The two sub-species diverged through adaptation to these different climatological and ecological zones (Hepburn et al., 1991).

Before the formal or more commercialised beekeeping practices developed, honey harvesting from wild colonies was practiced for centuries. The historical evidence of honey harvesting is prevalent through rock paintings (dated about 6000 to 4000 BC during the Mesolithic period) discovered in Spain in 1942 (Crane, 2019). More rock paintings were then found in India and Australia. In southern Africa, the largest rock art collection that depicts honey harvesting practices by San Bushman was found in the Drakensberg area. Some of these rock paintings date back five centuries but most of them are considered comparatively recent, in some areas they continued up until the 19\textsuperscript{th} century (Johannsmeier, 2001; Guy, 1972). Not much is known about the history of honey harvesting/beekeeping in the other parts of South Africa as the vegetation was not very supporting of the practice because forest trees were absent and the bush veld was not suitable enough to support regular honey flow and/or consistent honey production (Johannsmeier, 2001).

1.1.2 Beekeeping in South Africa

Beekeepers manage bees by building them artificial homes called hives in the form of a wooden box with frames inside, so it is easier when working with the bees or extracting honey. Due to the two distinct rainfall regions in South Africa, beekeepers actively manage two locally adapted subspecies for honey production, pollination of agricultural crops and other honeybee related products (Johannsmeier, 2001; Masehela, 2017).
The beekeeping industry in South Africa is well-developed, existing in both small and large scale enterprises (Dietemann et al., 2009; Pirk et al., 2014). Annual colony losses are a common event for beekeepers and have been recorded in highly increasing rates across South Africa (20-30%) (Pirk et al., 2014). Habitat fragmentation and disturbance, disease, pests, pesticides and parasites are amongst the many threats affecting wild and managed honeybee colonies globally (Vanbergen, 2013). In order for beekeepers to maintain their beekeeping practices, they need to frequently replace the colony losses imposed by these threats (Masehela, 2017; Pirk et al., 2014). The common methods used to replace the colonies include; trapping wild swarms, hive splitting, removal of problem colonies and buying colonies from other beekeepers to increase their number of colonies. However, trapping wild swarms is the primary method in South Africa, rather than breeding queens, because it is cheaper and requires less labour (Mouton, 2011; Masehela, 2017; Pirk et al., 2014).

1.1.3 Swarming of honeybees

Swarming is a natural phenomenon in the annual life-cycle of African honeybees. Wild colonies swarm naturally during a swarming season, which occurs in early spring-summer (Johannsmeier, 2001). During this season, there is high availability of nectar and pollen. These factors increase honeybee colony size, impairing the ability of the queen to stop the rearing of new queens due to overcrowding. The old queen then leaves the colony with some worker bees and looks for another nesting site (Allsopp and Hepburn, 1997). In managed colonies, beekeepers prevent swarming by either splitting the hive into two when it is about to swarm or by destroying queen cells to prevent the production of new queens and modifying the hive to give it more space to accommodate the increased population. Thus, swarming is prevented in order to protect the productivity of the hive (Pirk et al., 2014).

1.1.4 Swarm trapping benefits the beekeeping industry

South Africa’s beekeeping industry is heavily reliant on trapping swarms from wild populations (Dietemann et al., 2009). Beekeepers take advantage of the swarming season by trapping wild swarms from wild populations using trap boxes. They do this by putting out catch boxes with bait to lure in passing wild swarms that are looking for a nesting place. Some beekeepers use lemongrass oil and while others use old frames that still have beeswax scent to attract bees (Johannsmeier, 2001). Passing wild swarms occupy these catch boxes and immediately start working to store food. Trapping is successful in areas where there are still
plenty of wild honeybee colonies. To ensure high trapping rates, beekeepers place their boxes in apiary sites with certain vegetation types. After the wild swarm has occupied the box, beekeepers then include the trapped swarm as part of their managed colonies to increase their colony stock, or sell it to other beekeepers. Beekeepers charge an amount of between R250 to R750 for new colony (Clark, 2012). These prices are based on the wellbeing (health) of the colony, such as the size of the colony, number of frames with brood and the structure. In cases where they use trapped swarms to increase their colonies, these trapped swarms contribute to honey production and rendered pollination service (Mouton, 2011; Masehela, 2017). In South Africa, declines in numbers of both managed and wild honeybee colonies have been recorded in recent studies (Pirk et al., 2014). The increased rate of losses experienced in South Africa might soon lead to a threshold where high trapping rates will lead to unsustainable beekeeping practice in South Africa (Pirk et al., 2014; Dietemann et al., 2009). Therefore, it is crucial to keep a healthy wild population and conserve their natural habitats.

1.1.5 Honey hunting (harvesting)

Besides trapping wild swarms for beekeeping, indigenous (rural) communities also practice honey harvesting from wild populations (Johannsmeier, 2001). Honey harvesting involves harvesting honey from wild honeybee colonies without actually trapping or removing bees. In some instances, other honeybee products such as beeswax, bee larvae, bee venom and propolis may also be harvested. This is practised widely in places where wild honeybee colonies are abundant, especially by rural communities, in order to maintain their daily livelihoods (Bradbear, 2009). This practice dates back to 1497 and is still commonly practised in South Africa, although restricted to certain areas (du Preez, 2010).

San Bushmen (hunter gathers) are the earliest human beings that are associated with honey harvesting in South Africa. They had ways of tracking bee’s colonies by tracking the honey guide birds, shining of bee’s wings when the sun sets and also studying the flight patterns of the bees (Bradbear, 2009). The San Bushmen used mammal and leguan skin bags to store and transport their honey. They served honey as survival food during the drought and depression years (Johannsmeier, 2001). In addition, the healing properties of honey and bee related products have been highly recognized in the ancient culture (Cramp, 2011).
At present, honey harvesting helps people generate income to support their families by selling the harvested honey. Other bee products are consumed as food and used for medicinal purposes, with no financial costs. Honey harvesting has been discouraged in many countries due to concerns of the unsustainable way in which harvesting is conducted (Dietemann et al., 2009). Some harvesting practices, especially the use of fire, may result in deaths of wild honeybees and habitat destruction as a result of forest fires (Bradbear, 2009; Clauss, 1991; Dietemann et al., 2009).

1.2 Problem statement

Current research in South Africa shows that managed bees are used to provide pollination services and for the production of other bee related products. At the same time, the existence of beekeeping is dependent on the trapping of wild bees. However, the economic value attached to the trapped bees (once managed) is not fully understood. In addition, instances where bees are not trapped, but products such as honey are harvested from wild nests, are not well documented. These two aspects are imperative to explore, given the importance of honeybees in South Africa. Moreover, quantifying the link of this importance to the biodiversity economy is critical. Two provinces, the Western Cape and Limpopo, were selected as study areas to explore swarm trapping and address each aspect respectively. In addition, Limpopo was also chosen to explore honey harvesting.

1.3 Research question

How does wild honeybees (indigenous) contribute to South Africa’s biodiversity economy?

1.4 Aims of the study

This study is designed to generate data on the value of derived products from trapped swarms (e.g. honey, propolis, beeswax and other related products) or direct sale of the trapped swarms. Also, direct quantification to sustainable livelihoods or income generation through honey harvested from wild colonies.

---

1 The biodiversity economy of South Africa, encompasses the businesses and economic activities that either directly depend on biodiversity for their core business or that contribute to conservation of biodiversity through their activities.
1.5 Objectives

a. Document and account for the number/ percentage of trapped swarms and how much income has been generated from rented pollination services, honey production and other bee related products;

b. Document how many hives have generated income for the beekeepers from trapped swarms by direct sales; and

c. Document how much income is generated by indigenous communities from honey harvesting (from wild colonies) in cases where they sell what they harvest.
2. Methods

2.1 Study areas

The surveys were conducted in two provinces of South Africa; the northernmost Limpopo Province which receives summer-rainfall and the southernmost Western Cape Province which receives winter rainfall. These provinces represent the African and Cape honeybee subspecies respectively. The two provinces are at least 1340 km apart with very distinct climatic conditions and vegetation types. The Western Cape is one of the biggest beekeeping provinces in the country with an estimated 843 beekeepers and 77088 colonies (DAFF, 2019). Limpopo province has a lower number of beekeepers compared to the Western Cape, with about 453 beekeepers and 8033 colonies (DAFF, 2019). Beekeeper and colony numbers for other provinces are given in Table 1 below.

Table 1: Beekeeper and colony numbers in different provinces across the country (Source: DAFF, 2019).

<table>
<thead>
<tr>
<th>Province</th>
<th>No. of beekeepers</th>
<th>No. of colonies</th>
<th>No. of apiary sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limpopo</td>
<td>453</td>
<td>8033</td>
<td>859</td>
</tr>
<tr>
<td>Western Cape</td>
<td>843</td>
<td>77088</td>
<td>6065</td>
</tr>
<tr>
<td>Eastern Cape</td>
<td>120</td>
<td>8636</td>
<td>681</td>
</tr>
<tr>
<td>Free State</td>
<td>72</td>
<td>4442</td>
<td>254</td>
</tr>
<tr>
<td>Gauteng</td>
<td>639</td>
<td>21966</td>
<td>2462</td>
</tr>
<tr>
<td>Kwazulu Natal</td>
<td>181</td>
<td>14126</td>
<td>1112</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>181</td>
<td>11719</td>
<td>577</td>
</tr>
<tr>
<td>Northern Cape</td>
<td>34</td>
<td>4098</td>
<td>439</td>
</tr>
<tr>
<td>North West</td>
<td>118</td>
<td>11500</td>
<td>557</td>
</tr>
</tbody>
</table>

The sampled area in Limpopo was restricted to the Vhembe district, which is located in the Northern part of the province (figure 2.1). Vhembe is predominately rural to semi-rural and largely dominated by agricultural activities. The sampled area in the Western Cape was not restricted to any district but was based on the availability of beekeepers. The Western Cape is located on the south western part of South Africa and the southernmost region of Africa (figure
2.1). The Western Cape has a mixture of a metropolitan city (Cape Town) surrounded by smaller towns well known for different agricultural activities.

![Figure 2.1: Map showing the study area in the Western Cape and Limpopo (Vhembe district).](image)

2.2. Questionnaire distribution

Beekeepers and honey harvesters were approached to complete the questionnaires in Vhembe and the Western Cape. In Vhembe District, 16 villages were randomly visited and a total of 43 individuals were approached to complete the questionnaire (24 beekeepers and 19 honey harvesters). In the Western Cape, beekeepers from 16 areas were randomly approached at beekeeping association meetings, field days and workshops, to complete the questionnaire (28 beekeepers).

2.3 Questionnaire validation process

There are various approaches and methods available to explore when it comes to any data validation process. However, none is best or can overrule the other. Moreover, the investigator
(person using the questionnaire) can only use a representative sample to determine whether the questionnaire measures what it was designed to measure. In essence, the validation process has to succeed in order to render the questionnaire valid. For the specific processes of the two questionnaires used in this study, the following validation process was followed:

**Vhembe questionnaire survey:** A representative sample (33%) of the survey respondents was selected for the validation process. Physical visits were conducted together with informal interviews to evaluate the relevant aspects of the questionnaire that details the activities completed/captured through the different responses. These visits were in the Vhembe district of the Limpopo Province, although restricted to communal areas (16 villages) where the selected respondents reside.

I. I physically accompanied honey harvesters (7, constituting 37% of the total study respondents) around the villages where they demonstrated how they locate wild honeybee colonies, and harvest honey and other products from the colony. During this activity I noted the method used and how it affects honeybees, other products harvested, and what the honey harvested and other products would be used for.

II. I also accompanied the beekeepers (8, constituting 33% of the total study respondents) to the sites where they placed their empty catch hives and noted the numbers accordingly, as well as the area – for example, whether the catch hives are placed within natural vegetation or agricultural landscapes. These activities were carried out in early spring, as most of the honey harvesting commenced at this time due to bloom periods which signal bee forage abundance, and subsequently activity. This period coincided with high hive activity, honey production and potential swarming.

III. I then accompanied the beekeepers when they checked and subsequently collected hives that had caught bees successfully; and noted what they would be used for (e.g. honey production, pollination etc.).

**The Western Cape questionnaire survey:** Similar to the Vhembe questionnaire, a representative sample of 28% (eight beekeepers) of the survey respondents was selected for the validation process. As in Vhembe, physical visits were conducted, together with informal documentation and interviews, to evaluate the relevant aspects of the questionnaire that detail the activities completed/captured through the different responses. In particular:
I. I physically accompanied the beekeepers to the sites where they placed their empty catch hives and noted the numbers accordingly, as well as the area – for example, whether the catch hives are placed within natural vegetation or agricultural landscapes. This activity was carried out in late winter to early spring (end July to early August). This is because the Fynbos flowers in winter, while crops such as canola flower towards the end of July, a good opportunity that beekeepers utilize to trap swarms.

II. I then accompanied the beekeepers when they checked and subsequently collected hives that had caught bees successfully; and noted what they would be used for (e.g. honey production, pollination etc.).

2.4 Data analysis

Section 2: Swarm trapping/ Honeybee harvesting from the wild

I summarized the responses of beekeepers (also referred to as respondents) and noted their patterns. Some questions provided for more than one answer option for the respondents. Therefore, percentages displayed for all results are based on total (average) entries per category/response given. The questions that fit these criteria are as follows: 2d, 2f, 3a, and 4b. For section 2a, b (trapping frequency), c (Number of catch hives put out), d (Season preferred), and f (areas where they trap), I calculated the frequency of each selected option by counting the number of occurrence of every option. In section 2e (number of sites used) I noted the lowest and highest number of sites used and calculated the average of number of sites used for swarm trapping. Therefore, the total number of sites are averaged by the number of respondents.

In section 2g (status of wild honeybee population) I calculated the average of the percentage for each option (still the same, decline and increase). The formula used is:

\[
\text{Total percentage} = \frac{\text{Percentage}}{\text{Number of respondents}}
\]
Section 3: Different uses of trapped swarms

In section 3a (uses of trapped swarms), I calculated the frequency of each use by counting the number of each use occurrence from the selected options. In section 3b (trapped swarm price) I calculated the frequency of each price range.

Section 4: Harvesting honey from the wild colonies of honeybees

In section 4a (number of harvests), I calculated the frequency of each option being selected by counting the number of occurrence of every option. In section b (uses of harvested honey) I calculated the frequency of each use and then calculated the percentage of each using this formula:

\[
\text{Total percentage} = \frac{\text{Number of respondents}}{} \times 100
\]

Section 5: Sustainable harvesting

In section 5a (Effects of the method used) and b (status of wild honeybee population) I calculated the frequency of each option being selected by counting the number of occurrence of every option. In section 5c (Status of wild honeybee’s population) I counted the number of occurrence of every option between (1) still the same; (2) decline; and (3) increase. I then averaged the percentages for increase and decline.

2.5 Questionnaire responses and demographics

A total of 71 beekeepers completed both questionnaires. A total of 43 respondents from Vhembe (18 honey harvesters and 25 swarm trapping beekeepers) and 28 swarm trapping beekeepers from the Western Cape. Taking into account the current DAFF stats (see section 2.1), the survey respondents for Vhembe represent 5% of total beekeepers in Limpopo and 3% for the Western Cape. Looking at gender representation, the Western Cape, had 7% female beekeepers compared to 93% of male beekeepers. In Vhembe, for swarm trapping, 35% were female beekeepers and 65% male beekeepers. All honey harvesters in Vhembe were males (100%). In terms of race profile, all respondents in Vhembe were black. In contrast, the
Western Cape had a 10% representation of black (includes Coloureds, but not Indians) beekeepers, whereas the remaining 90% were white. The minimum number of years in terms of beekeeping experience in Vhembe was one (1) year and the maximum 33 years, while the average was 11 years. In the Western Cape, the minimum years of experience was two (2), the maximum 35 years and the average was 12 years.
3. Results

3.1 Swarm trapping

3.1.1 Comparison of swarm trapping frequency

Vhembe district: The majority of beekeepers trapped between once and three times per year. About 29% of beekeepers trap twice, other beekeepers (25%) trap once, 25% trap three times and 21% of beekeepers reported to trap more than five times (figure 3.1).

Western Cape: In the Western Cape, the majority of beekeepers (44%) trap once per year, 19% trap twice, whereas 30% trap more than five times and only 7% of beekeepers reported that they trap four times (figure 3.1).

![Swarm trapping frequency per year](image)

**Figure 3.1:** Comparison of swarm trapping frequency per year between Vhembe and the Western Cape.

3.1.2 Trap boxes put out and collected per year

Vhembe district: In Vhembe, 46% of the beekeepers put out less than 10 trap boxes. However, beekeepers collect fewer trap boxes than initially put out. In fact, 33% reported to put out 10-15 boxes, but only 13% collected 10-15 boxes. Also, 17% of beekeepers put out 15-20 boxes but only 8% of beekeepers collected 15-20 boxes (figure 3.2 and figure 3.3).

Western Cape: The majority of the beekeepers (61%) in the Western Cape put out more than 30 trap boxes. The trapping success rate was high, with 50% of the beekeepers collecting
more than 30 catch boxes. In addition, 18% of the beekeepers put out 25-30 trap boxes and 14% collected 20-25 trap boxes (figure 3.2 and figure 3.3).

**Figure 3.2:** Comparison of the number of trap boxes put out per year in Vhembe and the Western Cape.

**Figure 3.3:** Comparison of the number of trap boxes collected per year in Vhembe and the Western Cape.
3.1.3 Preferred trapping season

**Vhembe:** The summer season was the most preferred for trapping, favoured by 62% of beekeepers followed by winter (22%). The remaining percentage favoured spring and autumn (figure 3.4).

**Western Cape:** Spring was the most preferred trapping season for beekeepers (55%), followed by summer (23%). Autumn and winter were the least with 11% and 7% respectively (figure 3.4). Only 5% of beekeepers that indicated to have no specific preference of season for trapping - they put out trap boxes throughout the year.

![Preferred trapping season](image)

**Figure 3.4:** Comparison of preferred trapping season(s) for Vhembe and the Western Cape.

3.1.4 Preferred locations and number of sites for trapping swarms

**Vhembe:** On average, beekeepers use two sites for trapping. The maximum number of sites used were five (5) and the minimum was a single (one) site. Beekeepers preferred agricultural and natural vegetation sites for trapping, while a few utilizing semi-natural and residential sites. It is important to note that the landscapes used for trapping were not utilized in equal proportion. Agriculture was the most favoured (36%) and semi-natural the least favoured (12%) (figure 3.5).

**Western Cape:** On average, beekeepers use seven sites for trapping. The maximum number of sites used was 24 and the minimum was one site. All landscapes are used for trapping,
although not in equal proportions. Agriculture was the most favoured (35%) and semi-natural the least favoured (15%) (figure 3.5).

![Preferred trapping areas](image)

**Figure 3.5:** Comparison of the preferred trapping locations in Vhembe and the Western Cape.

### 3.1.5 Status of wild honeybee populations

**Vhembe:** Some beekeepers (29%) estimated the population of honeybees in Vhembe to be declining with an average of 31% within their trapping sites. In contrast, 54% of beekeepers estimated the population of honeybees to be increasing, with an average of 33%. Only 17% estimated the population to still be the same (figure 3.6).

**Western Cape:** A balanced reporting in the declines and increases was reported for the Western Cape. In fact, an equal percentage (38%) was reported for both categories by the same number of respondents (31%). In addition, 38% of the respondents reported the population to be still the same (figure 3.6).
3.1.6 Different uses of the trapped swarms

**Vhembe:** Most of the trapped swarms were used for honey production (38%) and pollination (36%). Only 17% of the beekeepers reported to use trapped swarms to produce other bee related products (figure 3.7). The selling of trapped swarms was not a common practice, with only 7% of beekeepers indicating their preference for this category (figure 3.7).

**Western Cape:** Most of the trapped swarms were used for honey production (39% of beekeepers) and pollination (31% of beekeepers) with a few used to produce other bee related products (13% of beekeepers) and for direct sale (16% of beekeepers) (figure 3.7).
3.1.7 Income generation for Vhembe and the Western Cape

Unlike in Vhembe district, the practice of selling trapped swarms is more common in the Western Cape, where 12 beekeepers (42%) indicated that they sell trapped swarms, whereas in Vhembe only 6 beekeepers (34%) sell trapped swarms.

**Western Cape:** In the Western Cape 8% of beekeepers indicated that they sell their trapped swarms for less than R500, 25% sell for R500-R600, 8% sell for R600-R700, 17% sell for R700-R800 and 42% sell for more than R800 (figure 3.8). It is worth noting that beekeepers had more than one option to choose from for these questions (figure 3.8).

**Vhembe:** A total of six people indicated that they sell their trapped swarms. Of these, 50% sell the trapped swarms for less than R500 and another 50% percent sell for more than R800 (figure 3.8).
Figure 3.8: The different price ranges for selling trapped swarms in Vhembe and the Western Cape.

3.2 Honey harvesting

3.2.1 Harvesting honey from wild colonies

On average, honey was harvested twice per colony per year (40% of honey harvesters). Only 16% of honey harvesters indicated to harvest once a year and 32% harvested more than five times in a year (figure 3.9). Honey harvested was primarily used for family consumption (40% of honey harvesters), followed by selling (33% of honey harvesters), then producing other bee related products (27% honey harvesters) (figure 3.10). Honey sales generated a maximum range of R1500 to R2000 a year for 33% of honey harvesters and a minimum of R500 (or less) for 33% of honey harvesters. Others manage to generate between R500 to R1000 (27% of honey harvesters) and R1000 to R1500 (7% of honey harvesters) (figure 3.11).
Figure 3.9: The number of harvests per colony per year.

Figure 3.10: Proportional usage of harvested honey in Vhembe.
3.2.2 Harvesting other related products from wild colonies

All honey harvesters indicated that they also harvest other products from wild colonies besides honey. Products indicated were as follows: propolis (harvested by 28% of honey harvesters); brood (28% of honey harvesters); a combination of nectar, brood, and propolis (22% of honey harvesters); brood and propolis (11% of honey harvesters); as well as nectar and propolis (11% of honey harvesters) (figure 3.12).

![Figure 3.11: The different price ranges for selling harvested honey.](image)

![Figure 3.12: Other products harvested from wild honeybee colonies in Vhembe.](image)
3.2.3 Sustainable harvesting

Honey harvesters indicated that the methods used when harvesting honey from wild colonies does not kill all the bees. However, 84% of honey harvesters indicated that some of the bees die, whereas 16% of honey harvesters indicated that at times none of the bees die (figure 13). During honey harvesting, 63% of harvesters indicated that they do leave food for the bees and 37% of honey harvesters do not leave food for the bees. Honey harvesters indicated that the population of wild colonies has declined by an average of 22%, contrary to some who indicated that the populations have increased by an average of 29% (figure 3.14).

![Figure 3.13: The effects of methods used when harvesting honey from wild colonies in Vhembe.](image-url)
Figure 3.14: Status of wild honeybee populations in Vhembe.
4. Discussion

4.1 Swarm trapping

4.1.1 Comparison of swarm trapping frequency

Beekeeping in Africa is strongly reliant on trapping wild swarms (Dietemann, 2008). This is also true for South Africa, as wild honeybee populations have been shown to sustain beekeeping practices across the different provinces (Masehela, 2017). This is at the backdrop of colony losses annually and the need to replenish them for beekeeping purposes. In fact, a comparison was made on methods that beekeepers use to replenish their stock and swarm trapping was ranked highest compared to other methods such as splitting, removals and buying new colonies (Mouton, 2011; Masehela 2017). In this study, all beekeepers in Vhembe and the Western Cape indicated that they trap swarms every year to increase stocks and/or replace colonies lost. However, the trapping frequencies differed between the provinces. The trapping frequencies are reliant on the area, season, availability of resources, access to trapping sites and the number of colonies they lose per year. Results in this study showed that beekeepers in Vhembe trap more frequently compared to the Western Cape. Subsequently, beekeepers in Vhembe trap between one and three times per year whereas beekeepers in the Western Cape (44%) mostly trap once. Although there is no clear explanation on this variation, limited access to sites could be a factor. In the Western Cape, beekeepers used more sites, meaning they had a better chance to trap more swarms. Another possible explanation could be that beekeepers in the Western Cape have enough boxes to put out all at once.

4.1.2 Trap boxes put out and collected per year and preferred trapping season

Honeybees swarm when the population of bees outgrows the hive in size, which results in the colony dividing by swarming (Seeley, 2003). The growth of the colony is induced by abundance of food (pollen and nectar) during the flowering seasons – usually after good rain (Free, 1981; Dietemann, 2004; Masehela, 2017; Johannsmeier, 2001). Food availability for bees in the two provinces differs due to the different rainfall patterns/seasons. Vhembe receives summer rainfall and the Western Cape winter rainfall. This means different triggers for food availability, colony activity and size, and therefore swarming ability. The results showed beekeepers trap throughout the four seasons, with spring the most preferred season in the Western Cape, whereas summer was preferred in Vhembe. The findings are consistent with that of Allsopp and Hepburn (1997), who alluded that swarming, and subsequently trapping,
peaks between September and December for South African provinces. Although this is the case, beekeepers also trap during other seasons. The leading factor could be that different floral resources are available or offer food to the bees in different seasons. For instance, agricultural crops as a floral resource in the Western Cape becomes available in late winter to early spring. In contrast, natural vegetation fluctuates depending on the rainfall, but for the Western Cape these become more abundant in winter – but in summer for Vhembe (Melin, 2018).

There were differences in the number of trap boxes that beekeepers put out for trapping and later collected. This applied to both provinces. Results also showed differences in the trapping success rate between the two provinces. The overall collection rate for trapping boxes was higher in the Western Cape compared to Vhembe. Since this is the first study to document this trend for any region in the country, it is difficult to ascertain the possible drivers of this observed outcome. However, it is likely that the variability in seasons, therefore forage availability, might be key to this observation. Also, beekeepers use different methods, including baits, to trap swarms. For example, there are differences in how beekeepers prepare the trap boxes and the type of lure (bait) they use to lure in bees to their trap boxes. As a result, some strategies may work better than the others. Although this study did not explore the efficiency of the different methods to prepare and lure bees into boxes, various discussions with beekeepers revealed that the use of old brood boxes is most favoured. These boxes are baited with old brood combs that still have beeswax scent, a scent very familiar to an existing bee hive (Guy, 1972). Beekeepers that do not own old boxes indicated that they apply melted beeswax mixed with lemon grass on (inside) their trap boxes and they find this method to work better than other methods, for instance, using lavender as a bait.

4.1.3 Preferred locations and number of sites for trapping swarms

Swarm trapping locations differs in different provinces depending on the availability and access to foraging areas (Masehela, 2017). The results in this study showed that beekeepers in the Western Cape preferred trapping in agricultural landscapes. This is consistent with current reports and literature that show that beekeepers in the Western Cape mostly use agricultural landscapes, as the protected area management plan restricts the placing of hives within nature reserves, including trapping of wild swarms in these areas (Masehela, 2019). This approach of precautionary principle was implemented because managed honeybees are believed to increase nectar competition and negatively impact other pollinators (BIS, 2017). The good relationship
between commercial farmers and beekeepers in the Western Cape offers beekeepers reasonable trapping location in agricultural landscapes. Beekeeping in the Western Cape is to a large extent dominated by commercial beekeepers rather than hobbyists, while most beekeepers in the Vhembe region were either hobbyists\(^2\) or small scale (DAFF, 2019). During my interaction with beekeepers in Vhembe, it was clear that they do not own many boxes, hence they use their backyards as apiary sites. Their yards have different crop (fruit) trees, including macadamia, citrus, avocado, litchis and mango. This explains why most of their apiary sites (for swarm trapping) are listed as agricultural. Also, this brings into perspective the difference in site numbers (being less) compared to the Western Cape. This once more provides evidence that residential areas are becoming more common for beekeeping given that more people are becoming interested in being hobbyist beekeepers. This trend was observed and supported by Allsopp and Cherry (2004). In addition, hobbyists, unlike commercial farmers, mostly keep their hives on their own land or private places (Nortje and Conradie, 2008). The preference for natural vegetation in Vhembe was higher than in the Western Cape and this is likely because of beekeepers in Vhembe having easy access to natural vegetation as compared to the Western Cape. Vhembe has abundant natural vegetation because of good rainfall and a more rural setting, hence beekeepers have easy access to natural vegetation landscapes when trapping swarms. In contrast, the Western Cape has issues of urbanisation, drought, fires and clearance of vegetation for farming purposes.

4.1.4 Status of wild honeybee populations

Honeybees are endemic to Africa and Europe. The estimated number of colonies in Africa is 310 million, with about 10 million colonies estimated for South Africa (Dietemann, 2008). Dietemann (2008) states that the high number of wild colonies in Africa could easily misinform conservationists about the need to conserve honeybee populations. However, it is important that we maintain and protect the genetic diversity within each population. Beekeepers were asked to estimate the status of wild honeybee populations (according to their experience) in the areas were they trap swarms. Average estimations in Vhembe showed honeybee populations

\(^2\) Beekeepers with 1-50 hives can be classified as hobbyists, 51-250 semi hobbyists and 250+ hives as commercial beekeepers (Allsopp and Cherry, 2004).
to have increased by 33%, while populations remained the same in the Western Cape. Because there wasn’t a year or period given on the questionnaire in reference to the population estimates, beekeepers used annual fluctuations as per experience and personal observations. Overall, there was no clear indication as to why beekeepers saw this pattern of increase, decrease or no change. Previous drought (2017-2018) in the Western Cape might be one of the factors contributing to these estimates. However, during my interactions with the beekeepers, they mentioned that the availability of resources also affects the population dynamics of honeybees. For an example, during drought, populations decline and then recover quickly with good rain as this sparks forage availability.

4.1.5 Different uses of trapped swarms

Beekeepers that are hobbyist, small scale and commercial have different needs for their practices. In South Africa, hobbyists and semi commercial beekeepers focus more on honey production, whereas 2004 statistics show that commercial beekeepers carry out 90% of pollination contracts and yield 75% of honey production (Allsopp and Cherry, 2004). The Bee Industry Strategy (2018) recently showed a pollination to honey ratio of 50:50, whereas it is the country’s goal to reach a pollination to honey ratio of 80:20 (BIS, 2018). Each beekeeper has different uses for the trapped swarms depending on what practice benefits them most. The findings of this study ranked the use of trapped swarms for honey production highest, followed by pollination contracts, and then selling of the trapped swarms. Allsopp and Cherry (2004) stated that the decrease in the production of honey could reflect the increase of pollination services of beekeepers in the Western Cape. This is evident in this study as there seems to be a sudden change of focus for beekeeping, with honey production becoming less of a priority compared to pollination contracts. However, there could be other drivers to this trend – for example, lack of forage discourages honey production. At the same time, the rate of honey importation into South Africa has increased tremendously over the last decade and local beekeepers are not able to compete with prices (rates) on the retail market. Moreover, the demand of managed honeybees for crop pollination increases annually, creating a lucrative market for beekeepers to cash in on pollination contracts.
4.1.6 Income generation for Vhembe and the Western Cape

When it comes to the selling of swarms, the price ranges were previously estimated to be between R250 to R750 (Mouton, 2011; Masehela, 2017). However, in this study the results showed that the price ranges from less than R500 to more than R800 per trapped swarm. Beekeepers indicated that the selling price depends on the strength of the hive as they charge by a fully drawn brood frame (R95). In addition, the trapped swarm could be sold with different components of the hive. For example, the trapped swarm together with the box and frames.

4.2 Honey harvesting

4.2.1 Harvesting honey from wild colonies

Dietemann (2001) indicates that a high number of people in most African countries still practice traditional beekeeping as compared to South Africa, where modern beekeeping is dominant (Dietemann, 2001). Rural communities maintain their daily livelihoods through honey harvesting (Johannsmeier, 2001). This practice is regarded as one of the hunter gatherer (Bushman) practices that still exists (Johannsmeier, 2001; Dietemann, 2008). Extensive literature and rock paintings of honey gathering scenes show that honey and bee related products were important in the Bushman economy (Guy, 1972). Early literature shows that honey was retrieved through the chewing of honeycombs. Additionally, literature postulates that honey was used to make alcoholic drinks as well as an added sweetener to rice and flour. In this study, honey harvesters indicated that they use harvested honey for direct sales, consumption as food, for flavouring or sweetener, and also as medicine. The use of honey for flu and sore throat medication was more prevalent, which supports the recognition of healing properties of honey in ancient Rome, whereby honey was used to heal sore throats, respiratory problems and bladder inflammations (Cramp, 2011).

For honey sales in particular, the amount of money generated depends on the number of harvests per year and the demand of honey at that season. Honey harvesters indicated that the honeybee products they harvest contribute positively to their livelihoods, although they struggled to make ends meet during drought seasons (hot summers with no rain and long dry winters). A new emerging trend, uncovered while conducting the validation interviews, was that beekeepers are not very fond of honey harvesters as they believe they are no longer harvesting honey from wild colonies but harvesting illegally from their managed bee hives.
This is fuelling conflict between the two groups; and beekeepers maintain that the activities of honey harvesters contribute to escalating rates of theft and vandalism in the area.

### 4.2.2 Harvesting other related products from wild colonies

Apitherapy, the use of honey products for medicinal properties, has been practiced for decades globally. Apitherapy includes the use of honey, propolis, pollen, bee venom and royal jelly from wild honeybee colonies for medicinal purposes (Crane, 1999; El-Soud, 2002). At the same time, these honeybee products from wild colonies may not be that different from the products in managed hives. The healing properties of honeybee products have been of indigenous knowledge in ancient cultures and elders in rural communities pass this knowledge to their descendants (Crane, 1999). In this study, honey harvesters much indigenous knowledge about medicinal properties of bee related products during validation interactions. In fact, they indicated that they harvest honey, nectar, brood, pollen and propolis for different uses. They use brood stored in the honey combs as source of protein and pollen as a nutritional source, this is meant to boost health and wellbeing. This finding concurs with a study that investigated the use of honeybee products for traditional remedies and the properties that make them effective in order to give them recognition in the modern market, and brood was reported to contain antioxidant activity. Additionally, propolis was proven to contain antioxidant activity, aldehydes, amino acids, flavonoids, phenolic acids, terpenes and steroids (El-Soud, 2002). Brood was indicated to be in demand and makes for good sales amongst the villagers - they ingest it either cooked or raw. In essence, brood could be used as a protein substitute or supplement in their diet – a good source for those who cannot afford other sources of protein.

### 4.2.3 Sustainable harvesting

Beekeeping development programmes discourage honey harvesting from the wild because they use destructive methods when harvesting honey (Dietemann, 2009; Snook et al., 2012). For instance, irresponsible harvesting could result in runaway fires or the unnecessary cutting down of trees. Also, other conflicts between beekeepers and honey harvesters have been reported, where beekeepers claim that sometimes fires that wipe out their hives start from a piece of rag left behind by honey harvesters (Guy, 1972). Honey harvesting from wild colonies can be unsustainable given the use of destructive methods when harvesting honey. A study done by
Snook et al. (2012) indicated that some traditional practices that ensured sustainable harvesting need to be implemented to allow continuous sustainable harvesting.

In this study, a question was posed to the honey harvesters regarding the different methods used for honey harvesting and how these affect bees. The results revealed that some of the bees die in the process of extracting honey from wild colonies. This was indicated by 80% of the honey harvesters. In contrast, only 16% indicated that none of the bees die during the honey harvesting process from wild colonies. During interactions with honey harvesters, the method used to harvest honey was starting a fire using grass in order to burn cow dung to create smoke. No fire accidents were caused as they extinguished the fire when they were done. In instances where the swarm was in a tree trunk (high above ground), they climbed up to harvest honey instead of cutting the tree. This is considered to be sustainable harvesting. This is supported by a study done in the miombo woodlands, whereby honey harvesters were taught sustainable ways of harvesting honey from wild colonies. The study shows that this can be achieved through climbing trees rather than cutting them down. This prevents the original colonies from being entirely destroyed (Snook et al., 2012). Also, the traditional way of preventing bee stings using repelling plants is recommended over creating fire to use smoke (Snook et al., 2012). This method was effective in a study where they tested if plants can indeed prevent bee stings; *Hoslundia opposita* and *Adenia cissampeloides* were amongst plants that were reported to be effective (Kraft, 2015).

Honey harvesting from wild colonies can be considered destructive if not done properly (Free, 1981). If bees are disturbed or chased away by honey harvesters, they move to a nearby branch, location or area. If harvesters leave the brood comb and only take the crest of the comb they can rework the comb and start storing honey again (Free, 1981). This practice is not sustainable as honey harvesters often take both brood and honey and the colony struggles to recover. In this study, 37% of honey harvesters indicated that they do not leave food for the bees and they harvest both honey and brood. According to a study done by Free (1981) this harvesting practice gives honeybees less chance of replenishing the combs. Free (1981) further advises that communities who practice honey harvesting should engage in meetings where people share traditional methods of harvesting. This type of engagement has been shown to be more effective than awareness campaigns.

There is great concern about the decline of wild populations of honeybee (Pirk et al., 2014), with honey harvesting considered one of the threats to wild honeybee populations (Dietemann,
In this study, honey harvesters were asked to estimate if the population of wild honeybees is declining, increasing or unchanged within their respective harvesting areas. Honey harvesters indicated that the population of wild colonies has increased by an average of 29%. Their estimations are based on the number of colonies they find for potential harvesting per season. Unfortunately, there are no other studies that have looked at population dynamics within the Vhembe area, therefore no previous evidence to compare to these current findings. Honey harvesters also mentioned that populations of wild colonies decline if beekeepers trap swarms around the area they harvest. At the same time, this might not be the only factor contributing to the colony decline, as Vhembe experienced a mild drought in 2016, and only started getting good rains in the past three years (Kenabatho, 2012). The recent good rains might have allowed enough time for colony recoveries in the area, while trapping might have a potential future impact on the colony numbers.

4.3 Conclusion

Wild honeybee populations play an important role in beekeeping practices across South Africa. Beekeepers rely heavily on trapping swarms to either increase or replenish lost colonies. This study concurs with other previous studies on this aspect, and the trend was strongly supported in both Vhembe and the Western Cape. In this study, the different aspects of income generation by beekeepers from wild swarm was evident. In particular, the direct sales of swarms, honey harvest and for the provision of pollination services. Previous studies indicated that areas and seasons where beekeepers trap swarms tend to vary – and this was also confirmed and well supported by the study findings. In assessing estimates for population’s declines, which was covered in both questionnaires, it can be concluded that the populations are in general doing well. However, there were indications, from personal communication with the beekeepers and honey harvesters, that populations are likely affected by different factors such as fires, drought and possibly over trapping in some areas (i.e. Vhembe). When exploring the benefits of harvesting honey from wild colonies, honey harvesters outlined several benefits from this practice. Above all, there was a strong element of income generation from selling the honey as well as household use for various purposes. From these findings, it is clear that wild honeybee colonies are of great importance for the two practices – swarm trapping and honey harvesting. Both practices contribute directly and indirectly to the livelihoods of beekeepers and honey harvesters, an important element demonstrating the benefits of the biodiversity economy.
However, this benefit would not be possible without wild colonies. Therefore, in order for both practices to be sustainable and continuously provide for the benefits, wild colonies should remain viable, healthy and productive. This would be a critical element for both conservation planners and biodiversity managers going forward, in ensuring the sustainability of wild colonies. At the same time, additional knowledge generation and further understanding of these practices (and benefits) would be necessary for thorough planning and implementation of management (conservation) measures for wild colonies.
5. Study synthesis
Honeybees are recognized as important pollinators. Beekeepers manage honeybees for pollination services, honey production and other honeybee related products (Dietemann et al., 2009; Pirk et al., 2014). South Africa is one of the countries where wild honeybee populations are still high, with an estimation of 10 million wild colonies. Furthermore, the beekeeping industry is heavily reliant on swarm trapping to maintain their colony stock as they lose some of their colonies every year (Dietemann et al., 2009). Hence, wild honeybee colonies play an important role in the beekeeping industry as well as in livelihoods for people in the rural communities through the harvesting of honey and other bee products from wild honeybee colonies. However, not much is known on the economic contribution of wild honeybees to biodiversity economy. This study was thus designed to fill in the gap in the economic value (Biodiversity Economy) attached to wild honeybees.

To cover both sub-species, two study areas were selected in order to represent each subspecies respectively. The areas selected were Vhembe region in the Limpopo province and the Western Cape Province. Data was generated through the use of questionnaires that were distributed to beekeepers and honey harvesters. Figure 5.1 below, captures and summarises the overall results of this study and outlines distinctive links to the economic benefits associated with wild colonies, for both beekeepers and honey harvesters.

As projected in figure 5.1, the health and strength of wild colonies depends on forage – plants that provide both nectar and pollen at different times of the year. Honeybees forage in different landscapes, which can either be in natural vegetation, agricultural farms, semi natural areas and residential areas - these areas encompasses both native and exotic plants (Masehela, 2017). These landscapes also serve as nesting habitats for the colonies. Beekeepers utilize the different landscapes when trapping wild swarms, although they might prefer one over the other depending on access issues or the previous success rate in that area (Dietemann, 2009; Masehela, 2017). In this study, beekeepers from both study regions mostly preferred trapping in agricultural farms. In the Western Cape, 98% of the validation respondents were trapping in the canola fields, whereas in the Vhembe region they preferred a mixture of macadamia and avocado fruit trees. Besides choosing the trapping area, beekeepers also prefer a certain season to trap swarms. This is because swarming is part of the seasonal cycle of honeybee colonies. This is triggered by availability of more pollen and nectar, also the climate. In the Western Cape beekeepers mostly preferred spring compared to other seasons whereas in Vhembe,
beekeepers preferred to trap in summer. Therefore, the landscape (suitability thereof for bees),
drives the choice for trapping, the season and the frequency. Other environmental factors also
have a role to play in influencing any of these aspects, however, these were not investigated
nor documented in this study.

Beekeepers indicated that they use the trapped swarms to replenish their colony stock and also
make money through the direct sales of trapped swarms (right side of figure 5.1). In cases
where they add the trapped swarms to their colony stock, they contribute in the production of
honey, pollination contracts and other bee related products. Through this practice, they generate
money indirectly from trapped swarms which they use to fund their business, pay employees
and also provide for their family. A benefit referred to in this study as Biodiversity Economy.

With regard to honey harvesters (left side of figure 5.1), they indicated that they harvest honey,
brood, propolis and beeswax direct from wild colonies. Honey harvesters use the different
products for family consumption as either food or for medicinal purpose without any cost. Also,
they sell some of these products to people around the community and generate income which
helps in providing for their family – also, a benefit of Biodiversity Economy.
Figure 5.1: Illustration of the uses for wild honey colonies by honey harvesters (left) and beekeepers (right); and the respective benefits derived. Both honey harvesters and beekeepers cannot derive these benefits without utilizing wild bee colonies.

The results of this study show that wild honeybees contribute highly to beekeeping practices in South Africa; all beekeepers that were approached indicated that they trap wild swarms every year. Without wild honeybees, beekeepers wouldn’t be able to maintain their stock with this
rate of managed colony loss every year. Increasing their stock with trapped swarms and/or direct sales of trapped swarms, beekeepers increase their business income. Honey harvesters generate direct income through selling harvested products, without wild colonies honey harvesters would have nothing to sell. As can be observed in figure 5.1, the Economic Benefits for harvesters and beekeepers can also be unpacked in the different levels, depending on their mode of contribution. And in summary, the following are worth noting:

- Direct and indirect benefits: for honey harvesters, all benefits are direct from wild colonies. In contrast, the benefits for beekeepers rely on their success in catching the swarm, maintaining the swarm then harnessing any benefits provided the swarm remains productive if not viable;
- Benefits from wild bees are vary between harvester and beekeepers: the economic benefits for both harvesters and beekeepers are susceptible to fluctuations in terms of scale (i.e. amount, size, etc.) and availability as they rely on wild populations and other factors that influence (affect) the populations;
- Variable level of predictability: this aspect is closely linked to the above, as they are both reliant on factors not controlled by either harvesters or beekeepers. These factors dictate where and when the wild population can be accessed (for harvesters) and trapped (for beekeepers) and they can be natural (environmental attributes) or man-made (cropping systems). As a result, their potential for access and use, underpins the respective benefits to be derived; and
- Rely on sustainable wild bee populations: as the study successfully concludes that wild honeybees contribute greatly to beekeepers and honey harvester’s economic benefits; it simply means that less to no wild honeybees compromises the respective benefits. Therefore, the protection and conservation of the wild populations is of great importance for their viability and the economic benefits for both harvesters and beekeepers.
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Appendix 1: Beekeeper Questionnaire Survey to assess the economic benefits of trapped swarms in Western Cape Province (English)

Beekeeper Questionnaire Survey to assess the economic benefits of trapped swarms in the Western Cape Province

Honeybees are the most valued pollinators worldwide, pollinating over 30% of crop species. The general concern in bee declines (and other insect pollinators) is projected to have adverse effects on natural and agricultural systems that depend on the pollination services they provide. This can negatively influence food security and most global economic activities. Global concern over the decline in bees has led to studies focused on managed bees and their importance, with an attempt to find conservation strategies that will negate this trend.

In South Africa, as it is in the rest of Africa, managed beekeeping depends on the trapping (harvesting) of wild honeybee populations. However, the value chain, of wild honeybees’ contribution to beekeeping and its related activities is poorly documented and understood.

The intention of the survey is to generate baseline data on how wild honeybees contribute to different beekeeping practices. By participating in this study, you will be contributing to the little understood, yet important, aspect of the role of wild honeybee populations in beekeeping and the economy in general.

You have been selected to participate in this survey due to your experience as a beekeeper. Should you agree to participate, you will be required to complete the attached questionnaire, which should take approximately 20 minutes. Participation is voluntary and you are free to withdraw at any time. Please note that providing information in Section 1 (Personal details) is optional. If completed, the information will be treated as confidential and not be shared with third parties. There will be no negative consequences should you decide not to participate or to withdraw.
Questionnaire ethical clearance reference: HS19/6/23

This study forms part of a BSc Honours Degree for Ms Vhuawelo Simba (Student no: 3969818), Department of Biodiversity and Conservation Biology, University of the Western Cape, in collaboration with the South African National Biodiversity Institute (SANBI).

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Supervisors: Dr T Masehela (SANBI); Dr P Mothapo (US) & Dr V Couldridge (UWC)

HSSREC contact details:
Research Development
Tel: 021 959 4111
Email: research-ethics@uwc.ac.za

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3 The ethical clearance for this study was submitted and approved by the HSSREC
Informed consent for completing the questionnaire:

I_________________________________ (full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

I consent / do not consent to this interview being recorded (if applicable).

SIGNATURE OF PARTICIPANT ________________ DATE ________________

Section 1: personal details (Optional)

Beekeeper’s name: ____________________________

Contact number: ______________________________

Email Address: ________________________________

Town (nearest): ________________________________

Years of beekeeping experience: _______________________

Section 2: Swarm trapping/Honeybee harvesting from the wild

a) Do you trap swarms from the wild: Mark with an x (make a cross)

Yes [ ] No [ ]

b) If yes, how many times per year: Mark with an x (make a cross)

Once [ ] Twice [ ] Three times [ ] Four times [ ]

Five times [ ] More than five times [ ]

c) How many caught hives to you put out per year? This should be in relation to the number of trappings you indicated in b above: Mark with an x (make a cross)
d) From the caught hives you put out, how many do you collect per year? **Mark with an x (make a cross)**

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<tr>
<th>Less than 10</th>
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<th>15 - 20</th>
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e) Which season of the year do you prefer to trap swarms? **Mark with an x (make a cross)**

- Spring
- Autumn
- Winter
- Summer
- No preference

f) How many different locations (areas) do you use for trapping swarms? _________

g) In which areas are the locations referred to in g above situated? **Mark with an x (make a cross)**

- Agricultural
- Natural vegetation (Fynbos)
- Semi natural
- Residential

h) In your opinion/view, the number of wild honeybees where you are/have been harvesting is/has: **Mark with an x (make a cross)**

- Still the same
- Increased
- Declined

i) Estimate the % of your choice if possible ____________________________
Section 3: Different uses of trapped swarms

a. Do you use any of your trapped swarms for the following? More than one answer can be selected: Mark with an x (make a cross)

<table>
<thead>
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<td>Honey production</td>
</tr>
<tr>
<td>Direct sale of trapped hives</td>
</tr>
<tr>
<td>Other bee related products (e.g. beeswax)</td>
</tr>
</tbody>
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b. In instances where a trapped swarm is sold, at what price is the sale (in Rand)? Mark with an x (make a cross)

<500 □ 500 – 600 □ 600-700 □ 700-800 □

>800 □

Thank you for taking the time to complete this survey.
Appendix 2: Beekeeper Questionnaire Survey to assess the economic benefits of trapped swarms in Western Cape Province (Afrikaans)

Byeboer Vraelys Opname om die ekonomiese voordele van beperkte swerms in die Provincesie van die Weskaap

Heuning bye is die mees waardevolle bestuiwers wereldwyd. Die bye bestuif meer as 30% van gewassespesies. Die algemene bekommernis in bye vermindering (asook ander insek bestuiwers) is geprojekteer op ongunstige effekte op die natuurlike boerdery sisteme wat staatmaak op die bestuiwing wat bye voorsien. Dit kan voedsel sekuriteit en meeste wereldwyse ekonomiese aktiwiteite negatief beinvloed.

Werelwye kommer oor die vermindering van bye het gelei tot studies gefokus op beheerde bye en hul belangrikheid, in ‘n poging om ‘n bewaring strategie te skep wat hierdie neiging sal negeer.

In Suid Afrika, soos in die res van Afrika, maak beheerde byeboerdery staat op die vasvang van wilde heuningby populasies. Ongelukkig is die waarde ketting van wilde heuningbye se bydrae tot byeboerdery en hulle verwante aktiwiteite swak gedokumenteer en word dus ook nie goed verstaan nie.

Die doel van die opname is om basiese data oor hoe wilde heuningbye bydra tot verskillende byeboer praktyke te versamel. Deur deel te neem aan die studie, sal u ‘n bydrae lever tot die redelik onbekende en tog baie belangrike aspek van die rol van die wilde heuningby populasies in byeboerdery en die ekonomie in die algemeen.

U is gekies om deel te neem aan die opname as gevolg van u ondervinding as byeboer. Sou u deelneem aan die opname word u versoek om die aangehegte vraelys te voltooi. Die proses sal ongeveer 20 minute neem. Deelname is vrywillig en sou u besluit om nie langer deel te neem

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nie is u vry om te onttrek. Let asseblief daarop dat die verskaffing van informasie in Seksie 1 (Persoonlike besonderhede) opsioneel is.

Die informasie is konfidensieel en sal nie met derde partye gedeel word nie. Daar sal geen negatiewe gevolge wees sou u besluit om nie deel te neem of te onttrek nie.

**Vraelys etiese vrywaring verwys**: HS19/6/23

Hierdie studie vorm deel van ‘n BSc Honeurs Graad vir Me Vhuawelo Simba (Student no: 3969818), Department van Biodiversiteit en Bewarings Biologie, Universiteit van die Weskaap, in samewerking met die Suid Afrikaanse Nasionale Biodiversiteit Instituut (SANBI).

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Toesighouers: Dr T Masehela (SANBI); Dr P Mothapo (US) & Dr V Couldridge (UWC)

Kontakte van die HSSREC
Research Development
Tel: 021 959 4111
Email: research-ethics@uwc.ac.za

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4 Die etiese vrywaring vir hierdie studie was voorgele en goedgekeur deur HSSREC
Ingeligte toestemming afdeling in voltooiing van die vraelys: Byeboer Vraelys Opname om die ekonomiese voordele van beperkte swerms in die Provinsie van die Weskaap

Ek______________________________ (volle name van deelnemer) bevestig hiermee dat ek die inhoud van hierdie dokument verstaan asook die aard van die navorsingsprojek en ek is bereid om deel te neem aan die navorsingsprojek.

Ek verstaan dat ek vry is om te onttrek van projek te enige tyd, sou ek dit so verkies.

**Ek gee toestemming/gee nie toestemming** dat hierdie onderhoud opgeneem mag word (indien van toepassing).

HANDTEKENING VAN DEELNEMER ________________ DATUM ________________

**Seksie 1: persoonlike besonderhede (Opsioneel)**

Naam: ________________________________________________________________

Kontak nommer: ______________________________________________________

E-pos Adres: __________________________________________________________

Dorp (naaste): _______________________________________________________

Ondervindingin byeboerdery (in jare): ________________________________

**Seksie 2: Vasvang van swerms/Heuningby vasvanging in die natuur**

a. Vang u swerms in die natuur vas?: **Merk ‘n x (maak ‘n kruisie)**
   Ja [ ] Nee [ ]

b. Indien ja, hoeveel keer per jaar?: **Merk ‘n x (maak ‘n kruisie)**
   Eenkeer [ ] Tweekeer [ ] Driekeer [ ] Vierkeer [ ]
c. Hoeveel vasgevangde swerms sit u uit per jaar? Die getal moet ooreenstem met die getal vasvangings wat u aangedui het in afdeling b: Merk met ‘n x (maak ‘n kruisie)

Minder as 10  [ ]  10 - 15  [ ]  15 - 20  [ ]
20 - 25  [ ]  25 - 30  [ ]  Meer as 30  [ ]

d. Van die vasgevangde korwe wat u uitsit hoeveel kollekteer u per jaar? Merk met ‘n x (maak ‘n kruisie)

Minder as 10  [ ]  10 - 15  [ ]  15 - 20  [ ]
20 - 25  [ ]  25 - 30  [ ]  Meer as 30  [ ]

e. Watter seisoen van die jaar verkies u om swerms vas te vang? Merk met ‘n x (maak ‘n kruisie)

Lente  [ ]  Herfs  [ ]  Winter  [ ]  Somer  [ ]
Geen voorkeur  [ ]

f. Hoeveel verskillende areas gebruik u om swerms vas te vang? ________

g. In watter omgewings is die areas genoem in afdeling g: Merk met ‘n x (maak ‘n kruisie)

Landbou  [ ]  Natuurlike plantegroei (Fynbos)  [ ]  Semi natuurlik  [ ]
Residensieel  [ ]

h. Het die getal wilde heuningbye waar u vasvangings gedoen het in u opinie: Merk met ‘n x (maak ‘n kruisie)

Dieselfde  [ ]  Vermeerder  [ ]  Afgeneem  [ ]
Gee asseblief ‘n persentasie skatting van u keuse indien moontlik:

____________________________

Seksie 3: Verskillende gebruike vir vasgevangde swerms.

a) Gebruik u die vasgevangende swerms vir enige van die volgende doeleindes? Meer as een antwoord kan gekies word: Merk met ‘n x (maak ‘n kruisie)

<table>
<thead>
<tr>
<th>Doelendes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollinasie</td>
<td></td>
</tr>
<tr>
<td>Heuning produksie</td>
<td></td>
</tr>
<tr>
<td>Direkte verkope van vasgevangde korwe</td>
<td></td>
</tr>
<tr>
<td>Bye verwante produktes (bv. byewas)</td>
<td></td>
</tr>
</tbody>
</table>

b) In gevalle waar vasgevangde swerms verkoop word, vir watter prys (in Rand) word dit verkoop? Merk met ‘n x (maak ‘n kruisie)

<table>
<thead>
<tr>
<th>Prijs</th>
<th></th>
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<tr>
<td>&lt;500</td>
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<td>&gt;800</td>
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</tbody>
</table>

Baie dankie vir tyd en samewerking om die vraelys te voltooi
Appendix 3: Beekeeper Questionnaire Survey to assess the economic benefits of trapped swarms in Vhembe (English)

Beekeeper Questionnaire Survey to assess the economic benefits of trapped swarms in Vhembe, Limpopo Province

Honeybees are the most valued pollinators worldwide, pollinating over 30% of crop species. The general concern in bee declines (and other insect pollinators) is projected to have adverse effects on natural and agricultural systems that depend on the pollination services they provide. This can negatively influence food security and most global economic activities. Global concern over the decline in bees has led to studies focused on managed bees and their importance, with an attempt to find conservation strategies that will negate this trend.

In South Africa, as it is in the rest of Africa, managed beekeeping depends on the trapping (harvesting) of wild honeybee populations. However, the value chain, of wild honeybees’ contribution to beekeeping and its related activities is poorly documented and understood.

The intention of the survey is to generate baseline data on how wild honeybees contribute to different beekeeping practices. By participating in this study, you will be contributing to the little understood, yet important, aspect of the role of wild honeybee populations in beekeeping and the economy in general.

You have been selected to participate in this survey due to your experience as a beekeeper. Should you agree to participate, you will be required to complete the attached questionnaire, which should take approximately 20 minutes. Participation is voluntary and you are free to withdraw at any time. Please note that providing information in Section 1 (Personal details) is optional. If completed, the information will be treated as confidential and not be shared with third parties. There will be no negative consequences should you decide not to participate or to withdraw.
Questionnaire ethical clearance reference:

This study forms part of a BSc Honours Degree for Ms Vhuawelo Simba (Student no: 3969818), Department of Biodiversity and Conservation Biology, University of the Western Cape, in collaboration with the South African National Biodiversity Institute (SANBI).

Contacts: 0794972696 & simba.vhuawelo@gmail.com

Supervisors: Dr T Masehela (SANBI); Dr P Mothapo (US) & Dr V Couldridge (UWC)

HSSREC contact details:
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Email: research-ethics@uwc.ac.za

Informed consent for completing the questionnaire: Beekeeper Questionnaire Survey to assess the economic benefits of trapped swarms in Vhembe, Limpopo Province

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5 The ethical clearance for this study was submitted and approved by the HSSREC
I ______________________________ (full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

**I consent / do not consent** to this interview being recorded (if applicable).

SIGNATURE OF PARTICIPANT ___________________ DATE ________________

**Section 1: personal details (Optional)**

Beekeeper’s name: ________________________________________________________

Contact number: __________________________________________________________

Email Address: ____________________________________________________________

Town (nearest): ___________________________________________________________

Years of beekeeping experience: _____________________________________________

**Section 2: Swarm trapping/Honeybee harvesting from the wild**

a) Do you trap swarms from the wild: **mark with an x (make a cross)**

Yes [ ] No [ ]

b) If yes, how many times per year: **mark with an x (make a cross)**

Once [ ] Twice [ ] Three times [ ] Four times [ ]

Five times [ ] More than five times [ ]

c) How many caught hives do you put out per year? This should be in relation to the number of trappings you indicated in b above: **mark with an x (make a cross)**

Less than 10 [ ] 10 - 15 [ ] 15 - 20 [ ]

20 - 25 [ ] 25 - 30 [ ] more than 30 [ ]
d) From the caught hives you put out, how many do you collect per year? **mark with an x (make a cross)**

- Less than 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- more than 30

e) Which season of the year do you prefer to trap swarms? **mark with an x (make a cross)**

- Spring
- Autumn
- Winter
- Summer
- No preference

f) How many different locations (areas) do you use for trapping swarms? ___________

g) In which areas are the locations referred to in e above situated: **mark with an x (make a cross)**

- Agricultural
- Natural vegetation
- Semi natural
- Residential

h) In your opinion/view, the number of wild honeybees where you are/have been harvesting is/has: **mark with an x (make a cross)**

- Still the same
- Increased
- Declined

Estimate the % of your choice if possible ____________________________
Section 3: Different uses of trapped swarms

a) Do you use any of your trapped swarms for the following? More than one answer can be selected: **mark with an x (make a cross)**

| Pollination | | | | |
| Honey production | | | | |
| Direct sale of trapped hives | | | | |
| Other bee related products (e.g. beeswax) | | | | |

b) In instances where a trapped swarm is sold, at what price is the sale (in Rand)? **mark with an x (make a cross)**

| <500 | 500 – 600 | 600-700 | 700-800 | >800 |

Section 4: Harvesting honey from wild colonies of honeybees.

a) Do you harvest honey from wild honeybee hives without actually trapping/removing the bees? **mark with an x (make a cross)**

Yes [ ] No [ ]

b) If yes, how many times do you visit the same hive in a year? **mark with an x (make a cross)**

Once [ ] Twice [ ] Three times [ ] Four times [ ]

Five times [ ] More than five times [ ]

c) What do you do with the honey you harvest? **mark with an x (make a cross)**

Sell [ ] Use to make other products (e.g. Mead) [ ]

Self/Family consumption [ ]
d) If you sell, how much do you generate per year (in Rands)? mark with an x (make a cross)

<R500   R500-R1000   R1000-R1500   R1500-R2000   >R2000

e) Do you take/harvest any other product from the hive besides honey? mark with an x (make a cross)

Yes   No

f) If yes, please name the product__________________________________________

Section 5: Sustainable harvesting.

a. Does the method used when harvesting honey harm the bees in any manner? mark with an x (make a cross)

Not at all   Some of the bees die   All the bees die

b. Do you leave some honey for the bees when you harvest honey? mark with an x (make a cross)

Yes   No

c. In your opinion/view, the number of wild honeybees where you are/have been harvesting has: mark with an x (make a cross)

Remained the same   Increased   Declined

Estimate the % of your choice if possible ____________________________

Thank you for taking the time to complete this survey.
Appendix 4: Beekeeper Questionnaire Survey to assess the economic benefits of trapped swarms in Vhembe (Tshivenda)

Mbudzisavhathu ya Tsedzuluso ya Mufuwaŋotshi u itela u ṭhaṭhuvha mbuelo dza ikonomi ya Ṉotshi dzo fuiwaho kha Vhembe, Vunduni ḽa Limpopo

نزشي nga mutoli ndi dzone dza ndemesa kha nyandadzo ya muvula kha shango nga vhuphara, dzi anđadza muvula kha zwiliṅwa zwi fhiraho presenthe dza 30. Mbilaelo i re hone kha u fhungudzea ha Ḉotshi (na zwiṅwe zwianđadzi zwa muvula kha zwikhokhonono) i vhonala i na masiandaitwa a si avhuɖi kha sisteme dza zwa vhulimi na mupo zwiṅe zwa dhiṭika nga tshumelo dza nyandadzo ya muvula ine dza Ḉetsedza. Izwi zwi nga Ḉīsa nyimele i si yavhuɖi kha u vha hone ha zwiliwa na kha mishumo ya ikonomi fhethu hunzhi u mona na shango. Mbilaelo ya shango Ḉōṭhe ya u fhungudzea ha Ḉotshi zwo livhisa ngudo iyi kha u sedzesa kha Ḉotshi dzi no anđadza muvula na ndeme yadzo, hu na ndingedzo ya u wana maitele a u dzi vhulunga uri ri kone u lwa na nyimele hei.

Afurika Tshipembe, sa zwine zwa vha hone kha Afurika Ḉōṭhe, ndango ya vhufuwanoŋtshi yo dhiṭika kha u vhufuwi( vhurafha) ha lushaka lwa Ḉotshi dza mutoli. Naho zwo ralo, thevhekano ya ndisedzo ya tshibveledzwa, zwi tshi ya nga ha u shela mulenzhe ha Ḉotshi dza mutoli kha vhufuwaŋotshi na mishumo i elanaho nazwo a zwi pfesesei nahone a zwo ngo ńwaliwa zwavhuɖi.

Ndivho ya tsedzuluso iyi ndi u wana data ya mutheo nga ha uri Ḉotshi dza mutoli dzi shela mulenzhe hani kha maitele o fhambanaho a vhufuwaŋotshi. Nga u dzhenelela kha ngudo iyi, vha Ḉo vha tshi khou shela mulenzhe kha u pfesesa nyana, hone zwi zwa ndeme, tshipiɖa tsha mushumo wa lushaka lwa Ḉotshi dza mutoli kha vhufuwaŋotshi na kha ikonomi nga u angaredza.
Vho nangwa uri vha dzhelele kha tsedzuluso iyi zwo bva kha tshenzhemo yavho sa mufuwa oti. Arali vha tended u dzhenela, vha ḍo ṭea u ḍadza mbudzisavhathu yo ṭumetshedzwaho, ine ya ḍo dzhia minethe ya henehe kha 20. U dzhenela ndi ha u tou funa nga iwe muŋe nahone vha a tendelwa u ḍibvisa tshifhinga tshiṅwe na tshiṅwe. Vha hubela u dzhiela nzhele zwauri u ṭetshedza mafhungo kha khethekanyo 1 (zwidombedzwa zwa vhuŋe) a zwi kombetshedzwi ndi u tou funa iwe muŋe. Arali yo ḍadzwa yoṱhe, mafhungo a ḍo dzhiiwa sa tshiphiri ha nga kovhiwa na muŋwe muthu wa vhuraru. A hu nga vhi na masiandaitwa a si avhudi arali vha hubula u sa dzhenela kana u ḍibvisa.

Ndauli ya tendelo ya zwa vhuṱifari ya mbudzisavhathu6: HS19/6/23
Ngudo iyi ndi tshipiṅda tsha Digirii ya Onasi ya Vhuawelo Simba (Nomboro ya Mutshudeni: 3969818.) Muhasho wa Biodiversity and Conservation Biology, Yunivesithi ya Western Cape, hu na tshumisano na vha South African National Biodiversity Institute (SANBI)
Vhukwamani: 0794972696 & simba.vhuawelo@gmail.com
Vhafhaṱusı: Dokotela Vho T Masehela (SANBI); Dokotela Vho P Mothapo (US) & Dokotela Vho V Couldridge (UWC)

Vhukwamani nga HSSREC
Research Development
Tel: 021 959 4111
Email: research-ethics@uwc.ac.za

6 Thendelo ya zwa vhuṱifari ya ngudo iyi yo ṭetshedzwaho na u tendelwa nga HSSREC
Tshipiḍa tsha thendelamfuvhazuwa kha u ṣadza mbudzisavhathu iyi: Mbudzisavhathu ya Tsedzuluso ya Mufuwaŋtshi u itela u ṭaṭhuvha mbuelo dza ikonomi ya ṣotshi dzo fuiwaho kha Vhembe, Vunduni ja Limpopo.

Nṭe _____________________________________ (Madzina nga vhudlalo a mudzheneli) ndi khou khwaṭhisenda urí ndi a pfesesa mafhunga re ngomu a jiṅwalo iļi na vhuvha ha thandela ya ṭhojisiso iyi, nahone ndi khou tenda kha u ḗidzhenisa kha thandela ya ṭhojisiso iyi.

Ndi a pfesesa urí ndo vhofhololwa kha u ḗibvisa kha thandela iyi tshifhinga tshiṅwe na tshiṅwe, arali ndo zwi funa u ita zwenezwo.

Ndi a tenda / a thi tendi urí inhaviyu iyi i rekholiwe (arali zwo tea).

TSAINO YA MUDZHENELI ____________ DATUM ____________

Tshipiḍa tsha 1: zwidodombuzwa zwa vhuge (a zwi kombetshezwi ndi u tou funa iwe muȝe)

Dzina ḍa mufuwaŋtshi: ______________________________________________________

Nomboro ya vhukwamani: ___________________________________________________

Ḍiresi ya emeiḷi: ___________________________________________________________

Ḍorobo (ya tsinisa): _______________________________________________________

Miṅwaya ya tshenzhemo kha vhufuwaŋtshi: ______________________________________

Tshipiḍa 2: Vhufuwaŋtshi/Vhurafhi ha ṣotshi dza mutoli ġakani

a) Vha a fuwa ṣotshi ġakani: Kha vha swaye nga x (kha vha ġite tshifhambano)

Ee [ ] Hai [ ]

b) Arali phindulo hu ee, ndi lungana kha ņwaha: Kha vha swaye nga x (kha vha ġite tshifhambano)

Luṭihi [ ] Luvhili [ ] Luraru [ ] Luŋa [ ]
Luṭanu [ ] Lu fhiraho luṭanu [ ]

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c) Ndi zwiṱaha zwa ṱotshi zwingana zwine na zwi vhea kha ñwaha? Izwi zwi tea u elana na tshivhalo tsha u fuwa tshe vha sumbedza kha b afho nthá: **Kha vha swaye nga x (kha vha ite tshifhambano)**

<table>
<thead>
<tr>
<th>Zwa fhasi ha 10</th>
<th>10 - 15</th>
<th>15 - 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 - 25</td>
<td>25 - 30</td>
<td>Zwi a fhira 30</td>
</tr>
</tbody>
</table>

**d)** U bva kha zwiṱaha zwa ṱotshi zwe vha vhea, vha bvisa zwingana kha ñwaha? **Kha vha swaye nga x (kha vha ite tshifhambano)**

<table>
<thead>
<tr>
<th>Zwa fhasi ha 10</th>
<th>10 - 15</th>
<th>15 - 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 - 25</td>
<td>25 - 30</td>
<td>Zwi a fhira 30</td>
</tr>
</tbody>
</table>

**e)** Ndi khalaṅwaha ifhio kha ñwaha ine vha takalela u fuwa ṱotshi? **Kha vha swaye nga x (kha vha ite tshifhambano)**

<table>
<thead>
<tr>
<th>Tshifhefho</th>
<th>Luṱavula</th>
<th>Vhuriha</th>
<th>Tshilimo</th>
</tr>
</thead>
</table>

A huna ine nda to i takalela

**f)** Ndi (vhupo) fhethu hungana ho fhambanaho hune vha hu shumisa u fuwa ṱotshi?

_________

**g)** Ndi kha vhupo vhufhio vhune fhethu hune ha khou ambiwa ngaho afho nthá kha e ha wanala hone: **Kha vha swaye nga x (kha vha ite tshifhambano)**

<table>
<thead>
<tr>
<th>Vhulimi</th>
<th>zwimela zwa ġaka</th>
<th>hayani na ġakani</th>
</tr>
</thead>
</table>

hayani
h) Nga kuhumbulele/kuvhonele kwavho, ndi tshivhalo tshingafhani tsha ṭotshi dza mutoli tsha hune vha raflha hone/tsha he vha vha vha tshi khou raflha hone: **Kha vha swaye nga x (kha vha ite tshifhambano)**

Tshi a fana □ □ □ Tsho aluwa □ □ □ Tsho tsela fhasi □ □ □

Anganyelani phesenthe ine na tou funa arali zwi tshi konadzea __________

**Tshipiďa 3: Mashumisele o fhambanaho a ṭotshi dzo fuwiwaho**

a) Vha a shumisa dziṅwe dza ṭotshi dze vha fuwa kha zwi tevhelaho? Phindulo dzi no fhira nthihi dzi nga nangwa: **Kha vha swaye nga x (kha vha ite tshifhambano)**

<table>
<thead>
<tr>
<th>Nyanḑadzo ya muvula</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mveledzwa ya mutoli</td>
<td></td>
</tr>
<tr>
<td>Thengiso ya zwiṱaha zwa ṭotshi zwo fuwiwaho</td>
<td></td>
</tr>
<tr>
<td>Zwĩṅwe zwibveledzwa zwi elanaho na ṭotshi (tsumbo. tshinda)</td>
<td></td>
</tr>
</tbody>
</table>

b) Fhethu hune ṭotshi dzo fuwiwaho dza rengiswa, dzi rengiswa nga vhugai (nga dzirannda)?

**Kha vha swaye nga x (kha vha ite tshifhambano)**

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<thead>
<tr>
<th>&gt;500</th>
<th>500 – 600</th>
<th>600-700</th>
<th>700-800</th>
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<tbody>
<tr>
<td>&lt;800</td>
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</tbody>
</table>

**Tshipiďa 4: U raflha mutoli ḍakani ja ṭotshi dza mutoli.**

a) Vha a raflha mutoli kha zwiṱaha zwa ṭotshi dza mutoli zwi no wanala ḍakani vha songo thoma vha bvisa ṭotshi? **Kha vha swaye nga x (kha vha ite tshifhambano)**

Ee □ □ Hai □ □
b) Arali phindulo hu ee, ndi lungana lune vha dalela tshiṱaha itsho kha ńwaha? **Kha vha swaye nga x (kha vha ite tshifhambano)**

Luthihi ☐ Luvhili ☐ Luraru ☐ Luņa ☐
Luṱanu ☐ Lu fhiraho ɭuṱanu ☐

c) Vha ita mini nga mutoli we vha rafha? **Kha vha swaye nga x (kha vha ite tshifhambano)**

Ndi a rengisa ☐
Ndi a u shumisa u ita zwiṅwe zwibveledzwa (e.g. mead) ☐
U nwa hayani/iwe muņe ☐

d) Arali vha rengisa, vha ita vhugai kha ńwaha (nga dzrannda)? **Kha vha swaye nga x (kha vha ite tshifhambano)**

< R500 ☐ R500-R1000 ☐ R1000-R1500 ☐ R1500-R2000 ☐
> R200 ☐

e) Vha a wana/bveledza zwiṅwe zwibveledzwa kha tshiṱaha nga nnḓani ha mutoli?

**Kha vha swaye nga x (kha vha ite tshifhambano)**

Ee ☐ Hai ☐

f) Arali phindulo i ee, vha humbelwa u bula uri ndi zwibveledzwa zwifhio______________

60
Tshipiđa 5: U rafha ho bveledzaho.

a) Maitele ane vha a shumisa musi vha tshi rafha mutoli a vhaisa ṇotshi nga iṅwevho ndila? Kha vha swaye nga x (kha vha ite tshifhambano)

Ahuna na huthihi □□□□

Dziṅwe dza ṇotshi dzia fa □□□□

ṇotshi dzoṱhe dzi a fa □□□□

b) Vha a siaela ṇotshi muṅwe mutoli musi vha tshi rafha mutoli? Kha vha swaye nga x (kha vha ite tshifhambano)

Ee □□□□ Hai □□□□

c) Nga kuhumbulele/kuvhonele kwavho, ndi tshivhalo tshingafhani tsha ṇotshi dza mutoli tsha hune vha rafha hone/tsha he vha tshi khou rafha hone: Kha vha swaye nga x (kha vha ite tshifhambano)

Tsho dzula tsho ralo □□□□

Tsho engedzea □□□□

Tsho fhungudzea □□□□

d) Anganyelani phesenthe ine na tou funa arali zwi tshi konadzea ___________

Ndì khou vha livhuwa kha u dzhia havho tshifhinga vha fhindula tsedzuluso iyi yoṭhe.