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A great example of Gorongosa National Park, Mozambique

Dissertação no âmbito do Mestrado em Ecologia, orientada pelo Professor Doutor José Paulo Filipe Afonso de Sousa e pelo Doutor Henrique Azevedo Pereira e apresentada ao Departamento de Ciências da Vida da Faculdade de Ciências e Tecnologia da Universidade de Coimbra.

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INTERNATIONAL MASTER in APPLIED ECOLOGY

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BEEKEEPING AS A TOOL TO PROMOTE COMMUNITY SELF-RELIANCE AND RESTORE THE LANDSCAPE:

A GREAT EXAMPLE OF GORONGOSA NATIONAL PARK, MOZAMBIQUE?

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Abstract

Beekeeping is a traditional activity commonly used to answer modern challenges and strengthen self-reliance in rural areas, as it can contribute to alleviate poverty, ensure decent livelihoods, promote women inclusion, while enhancing environmental resilience and food security. Besides having the potential to offer reliable high-value products, beekeeping provides pollination services that can increase crop yields and supplement farming activities, thus promoting rural diversification. That is why Gorongosa National Park (GNP), located in central Mozambique, established in 2016 the GNP Honey Project as a tool to address challenges faced by the local population and the landscapes by strengthening sustainable self-reliance in the buffer zone. This study aims to assess the impact of a community-based beekeeping program – GNP Honey Project – in rural landscapes and livelihoods in sub-Saharan Africa. It first explores the historical evolution of the park's landscapes and inhabitants, from the severe repercussions of the civil war (1977-1992) to the community-based National Park that it is today. This analysis set the ground to understand how beekeeping has emerged as an answer for environmental and economic problems while relying on the culture of the local people. Then, by analysing the Honey Project's economic and ecological impacts in the buffer zone's districts, it is demonstrated that the programme has successfully implemented a way towards self-reliance in beekeeping activities – especially in the Gorongosa district. Challenges faced by beekeepers were district-specific and called for a closer focus on Cheringoma, as its population's involvement in apiculture appeared to be more precarious and uncertain than in other districts, even though beekeepers were, on average, more experienced. In contrast, Gorongosa's beekeepers seemed to be more resilient in their beekeeping practice, requiring less help from the GNP, although they have more recently started apiculture activities. As the project also focuses on women's empowerment through beekeeping, monitoring its effects on gender norms' evolution and women's socio-economic conditions also contributes to analysing the benefits societies acquire through enhancing women inclusion in rural livelihoods. Yet, inconsistent data on its financial effects prevented demonstrating whether or not it has improved a fruitful economic cycle by increasing household revenues. The GNP Honey Project establishes a way towards self-reliance in rural Mozambique and requires to be regularly assessed to ensure the consistency of its impacts.

Keywords: self-reliance, rural livelihoods, landscapes, beekeeping, conservation, protected areas, women empowerment, community-based conservation strategies

Resumo

A apicultura é uma atividade tradicional comumente empregada para responder aos desafios modernos e fortalecer a autossuficiência em áreas rurais, pois pode contribuir para aliviar a pobreza, garantir meios adequados de subsistência, promover a inclusão das mulheres e, ao mesmo tempo, aumentar a resiliência ambiental e a segurança alimentar. Além de ter potencial para gerar produtos confiáveis de alto valor, a apicultura fornece serviços de polinização que podem aumentar a produtividade das culturas e complementar as atividades agrícolas e, desta forma, promover a diversificação rural. É por isso que o Parque Nacional da Gorongosa (PNG), localizado no centro de Moçambique, estabeleceu em 2016 o Projeto Mel do PNG como uma ferramenta para enfrentar os desafios enfrentados pela população local e pelas paisagens, através do fortalecimento de uma autossuficiência sustentável na zona tampão. Este estudo visa avaliar o impacto de um programa de apicultura de base comunitária - Projeto Mel do PNG - nas paisagens rurais e nos meios de subsistência em África. Começa por explorar a evolução histórica das paisagens e habitantes do parque, desde as severas repercussões da guerra civil (1977-1992) até ao Parque Nacional comunitário que existe atualmente. O Projeto Mel estabeleceu as bases para entender como a apicultura surgiu como uma resposta para os problemas ambientais e económicos, contando com a vertente cultural da população local. Ao analisar os impactos económicos e ecológicos do Projeto Mel nos distritos da zona tampão, foi demonstrado que o programa implementou sucessivamente um caminho para a autossuficiência nas atividades apícolas - especialmente no distrito de Gorongosa. Os desafios enfrentados pelos apicultores eram específicos de cada distrito e exigiam uma abordagem mais próxima em Cheringoma, já que o envolvimento da população mostrou ser mais precário e incerto do que qualquer outro, mesmo que os apicultores, em média, sejam mais experientes. Por outro lado, os apicultores de Gorongosa mostraram ser mais resilientes na sua prática apícola, necessitando de menos ajuda do GNP, embora tenham iniciado as atividades de apicultura mais recentemente. Como o Projeto também se concentra no empoderamento das mulheres por meio da apicultura, monitorizar os efeitos do Projeto na evolução das normas de género e nas condições socioeconómicas das mulheres, contribui para a análise dos benefícios globais derivados da inclusão das mulheres nos meios de subsistência rurais. No entanto, dados inconsistentes sobre os efeitos financeiros do Projeto impediram de demonstrar se aumentou ou não um ciclo económico frutífero ao aumentar as receitas das famílias. O Projeto Mel do PNG estabelece um caminho para a autossuficiência na zona rural de Moçambique e precisa de ser avaliado regularmente para garantir a consistência de seus impactos.

Palavras-Chave: Auto-suficiência, Meios de subsistência rurais, Paisagens, Apicultura, Conservação, Áreas protegidas, Empoderamento das mulheres, Estratégias de conservação baseadas na comunidade

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Any opinions, findings, conclusions, or recommendations expressed in this material belong to the authors. They do not necessarily reflect the views of the GNP or the IMAE program.

Abbreviations

ADB – African Development Bank

ADEL SOFALA – Agency of local economic development of the Sofala province

CBNRM – Community-Based Natural Resource Management

DUAT – *Portuguese Direito de Uso e Aproveitamento dos Terras,* 'the right of land use and benefit of land'

FAO – Food and Agriculture Organization of the United Nations

FRELIMO – *Frente de Libertação de Moçambique*, Liberation Front of Mozambique

FSC – Forest Stewardship Council

GIS – Geographic Information System

GNP – Gorongosa National Park

GRP – Gorongosa Restoration Project

GIZ – *Deutsche Gesellschaft für Internationale Zusammenarbeit*, German Corporation for International Cooperation

IMAE – International Master in Applied Ecology

IMF – International Monetary Fund

INE – *Instituto Nacional de Estatistica*, National Institute of Statistics of Mozambique

IPBES – Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem

IPCC – Intergovernmental Panel on Climate Change

KTB – Kenyan-top bar hives

MDM – Movimento Democrático de Moçambique

MZN – Mozambique Metical (currency of Mozambique)

NGO – Non-governmental organization

PDD – Partido Para Desenvolvimento e Democracia

RENAMO – *Resistência Nacional Moçambicana*, opposition party in Mozambique

TCT – TCT Dalmann, Mozambican forestry company

UNDP – United Nations Development Programme

UNFCCC – United Nations Framework Convention on Climate Change

USAID – United States Agency for International Development

WWF – World Wildlife Fund

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FIRST CONSIDERATIONS

The relationship between bees and humans is as old as humans themselves (Crane, 1999). Even though honey-collecting is hard to detect through archaeology (Dunne et al., 2021), proofs of the human manipulation of bees have been found in palaeolithic rock art depicting honey collection and bee-related topics, the vast majority of which is located in Southern Africa, spanning the period 40,000–8000 years ago (Crane, 1983, 1999; Crittenden, 2011; McGrew, 2014). During both the Palaeolithic and Mesolithic periods, when food was still obtained by hunting and gathering, the search for honey and its harvesting was not only a major source of fructose, glucose, fat, protein, vitamins, and minerals but also of components that act as preservatives (including a-tocopherol, ascorbic acid, flavonoids, glucose oxidase, catalase, and peroxidase) (Crane, 1999; Crittenden, 2011; Nagai et al., 2006). Humans eventually realised they were able to derive numerous benefits from bees and their by-products; thus, the constant search for honey led to honeybees' “domestication” through their placement into hives and the establishment of apiaries.

The relationship between bees and humans offers an answer to the ongoing ecological, economic, and social crisis, since it enhances and strengthens self-reliance, especially in rural areas. Indeed, in response to the modern-day crisis caused by the impact of capitalist-driven human activities (Brockington et al., 2008; Castel-Branco, 2014; N. Klein, 2015; Marques, 2020a; Ripple et al., 2017) on global biodiversity – that the scientific community has predicted to led to “catastrophic and potentially irreversible devastation”(IPBES secretariat, 2019; Massarella et al., 2021) and to the sixth mass extinction event in Earth's history (Ceballos et al., 2015; Newbold et al., 2015; Pimm et al., 2014; UN Environment, 2019), the urgent need for conservation strategies has been a significant concern for scientists, policy-makers, Non-Governmental Organisations (NGOs) and the international community (Pacheco et al., 2018).

Beekeeping is a crucial instrument that directly contributes to strengthening food security, alleviating poverty, ensuring decent livelihoods for the rural population while also enhancing environmental resilience (Bigsten & Tengstam, 2011; Carroll & Kinsella, 2013; Gupta et al., 2014; Illgner et al., 1998; Kimaro et al., 2013). It has the advantages of being a low-cost practice that easily adapts to almost any environment, and hives can be built with long-last and local materials which have a low environmental impact if sustainably sourced. In addition, the spin-off of enhanced plant pollination by bees is an invaluable one, with pollination considered one of the essential ecosystem services (Häussler et al., 2017; Vanbergen & the Insect Pollinators Initiatives, 2013). Besides being vital for the pollination of wild plant species

(Blaauw & Isaacs, 2014a, 2014b; Hung et al., 2018; Richards, 2001), bees represent a major part of the pollinating insects that contribute to the yields of 75% of global crop species (Aslan et al., 2016; Hung et al., 2018; A. Klein et al., 2007). Indeed, except for some vegetables and grain crops, the central part of the global crop depends on biotic pollination for the reproductive process of flowering plants (A. Klein et al., 2007; Ollerton et al., 2011; Paudel et al., 2015).

Besides supplementing farming activities by providing pollination services essential to increase crop yields, beekeeping offers reliable high-value products for rural farmers. Not only does it provides an additional source of food with nutritional and medicinal properties (Crane, 1999; Crittenden, 2011; Mesele, 2021; Zumla & Lulat, 1989), but beekeeping can also be an alternate source of income and employment, hence promoting rural diversification if integrated with other farming practices (Amulen et al., 2017, 2019; Breeze et al., 2019; Carroll & Kinsella, 2013; Gupta et al., 2014; Kimaro et al., 2013). At their best, incomes and products generated by beekeeping activities can enable rural farmers to endure times of economic crisis by diversifying income and food source (Illgner et al., 1998; Nel & Illgner, 2004). In areas prone to economic crises and to environmental shocks due to changes in climate, land use, and land cover or pressure on land resources, the ability to pursue diversified livelihood activities engender greater flexibility and resilience and reduces risk (Bryan et al., 2013; Carroll & Kinsella, 2013; Cunguara et al., 2011; Newman et al., 2021; Osbahr et al., 2008). Moreover, in times of stress and crises, both honey and beeswax do not necessitate specialised facilities for storage and transport and can be stored for a considerable amount of time (Illgner et al., 1998; Nel & Illgner, 2004).

Beekeeping has also been proven to endorse gender mainstreaming and women empowerment since it offers social, financial, and nutritional benefits without requiring land ownership or large capital investment (Gawaya, 2008; Kimaro et al., 2013; Mburu et al., 2017; Pocol & McDonough, 2015; Wolff & Gomes, 2015). As women bear a disproportionate share of domestic labour obligations while working long hours, this unequal division of labour among gender increases time poverty for women worldwide, especially in rural areas (Bain et al., 2018; Bardasi & Wodon, 2010; Chatzitheochari & Arber, 2012; Lyon et al., 2017; Najam-us-Saqib & Arif, 2012; Qi & Dong, 2018; Wodon & Blackden, 2006). Being an activity that requires a low amount of time besides routine maintenance, honey extraction, and hive construction (Nel & Illgner, 2004), beekeeping is more accessible than other forms of agriculture in contexts where women do not have control over household productive aspects such as land (Mburu et al., 2017; Pocol & McDonough, 2015). In addition, studies also show that it can increase women's community participation and agency (Pocol & McDonough, 2015; Shackleton et al., 2011).

The above-described benefits are why this millenary activity is now used as a tool to promote self-reliance as an answer to current challenges. According to the Oxford Dictionary (2021), the common definition for self-reliance is “the reliance on one's own powers and resources rather than those of others». Applied at the scale of a country or a society, self-reliance refers to the desire and ability to think, decide, and act without the help or influence of foreign stakeholders (Nwoke, 2020). Self-reliant participatory development processes are usually undergone with an external impetus to facilitate the start of the process and support its growth in the early phases (Nel et al., 2000). Rather than relying on international investments, institutions, operators, and policies, self-reliance offers a road to a country's ownership and control over its environmental and economic resources (Fonchingong & Fonjong, 2002; Nwoke, 2020). As this concept is based on the country's governance and initiative upon such resources and its population's traditions, knowledge, and cultural values, it offers an alternative to donor dependency in some countries (Fonchingong & Fonjong, 2002; Gooneratne & Mbilinyi, 1992). For example, the sovereignty of Mozambique has been questioned (de Renzio & Hanlon, 2008) as it appears to be a country dependant on international financial inputs and is often described as a *donor-darling* (Castel-Branco, 2014; Cunguara, 2012; Diallo, 2015; Hanlon, 2010; Whitfield, 2008).

Located in the eastern sub-Saharan African region, Mozambique is one of the world's most aid-dependant countries, with the total amount of foreign aids in 2004 representing 23% of the national income according to the OECD Development Assistance Committee (de Renzio & Hanlon, 2008). The history of the country explains this current reliance on external help. After 1975 when Mozambique broke away from the yoke of Portugal, the socialist government of Frelimo (*Frente de Libertaçao de Moçambique*) took over and was supported by the communist bloc during the Cold War. From 1977 to 1992, a civil war between Frelimo and the rebel movement Renamo (*Resistência Nacional Moçambicana)* destroyed most of the country's infrastructures. It caused the death of more than one hundred thousand people and a large-scale social upheaval of almost five million Mozambicans, which led to an estimated 50% of the rural population displacement from their homes and forced to become refugees (Hatton et al., 2001; Robinson, 2006). From 1995 to 2005, Renzion & Hanlon (2008) argued that the government's policy agenda did not have a nationalised and independent development vision, being largely controlled by international institutions - such as the International Monetary Fund (IMF), the World Bank (WB), and western donors.

In the last decades, Mozambique has been not only seriously affected by warfare, political instability, and economic collapse (Egger et al., 2020; French, 2010; Newitt, 2017) but also by extreme natural events such as droughts, as well as the cyclone Idai that devastated

the country in 2019 (Arndt et al., 2011; Brida et al., 2013; Charrua et al., 2021; Cunguara et al., 2011; Eriksen & Silva, 2009; Hoffmann et al., 2009). Ranked as one of the poorest countries in the world by the United Nations Development Programme (UNDP) and the WB, Mozambique was able to decrease poverty levels from 59% to 48% of the population from 2008 to 2014 (World Bank, 2018), yet inequality between the population has increased (Castel-Branco, 2014; Gradín, 2020; Gradín & Tarp, 2019b, 2019a). The gap of inequality among gender has widened over time due to the relatively lower level of female human capital, the lower attained education rate, literacy, and Portuguese aptitude rate, as well as the lower conditional employment probabilities of married women when compared to men (Arora & Rada, 2017; Girma & Gardebroek, 2015; Wodon & Blackden, 2006). In a study quantifying the contribution of a subpopulation to inequality, Gradín (2020) demonstrates that people responsible for the most significant shares of inequality and for its increasing trend over time are the richest part of the population, that is, people living in Maputo and urban areas in general, with higher educational level, or in the top of the consumption distribution. Global inequality in Mozambique results from high inequality within urban areas and a large gap among regions and between urban and rural areas (Egger et al., 2020; Gradín & Tarp, 2019b). Hanlon (2010) emphasises that the main problem is the limited redistributive capacity of the state, limiting financial support for the rural economy, deterring its development. And since almost 70% of the population live below the poverty line, and over 80% of the poor are located in rural areas (P. Virtanen, 2005), socio-political, economic, and ecological shocks have led to a decline of farm yields over time and left many households without sufficient food or income to meet their basic household amenities (Kimaro et al., 2013).

Yet, innovative coping strategies are emerging, paving the way for the country to become self-reliant, particularly in rural areas (Maunganidze, 2016; Nel et al., 2000). The need for local communities to secure economic thrive has encouraged a focus on indigenous knowledge and self-reliance strategies such as beekeeping (Berkes et al., 2000; Burkey, 1993; Illgner et al., 1998; Lodhi & Mikulecky, 2010). Beekeeping plays a significant role as a source of employment in rural areas, especially in sub-Saharan African countries, as suggested by the fact that, for example, for approximately 400,000 people living in the North-Western Province of Zambia, nearly 15,000 are beekeepers (Clauss, 1992; Nel & Illgner, 2004). Many studies have already assessed the impacts of beekeeping practices and their effectiveness on alleviating poverty and improving rural livelihoods in other sub-Saharan countries, such as the research on rural beekeeping for improving socio-economic conditions through the example of the Bondolfi Beekeeper's Association in a rural community located in central Zimbabwe (Illgner et al., 1998; Nel et al., 2000; Nel & Illgner, 2004). The association has overcome the constraints that individual beekeepers encountered in the harvesting, storage, manufacturing, and

transportation processes and counted seventy active members, forty of whom were women in 1998. It also generated local employment opportunities for carpenters to manufacture hives and for the establishment of a beehive-smoker enterprise, a small leather-processing industry that manufactures gloves, and a sewing group to produce protective veils for the harvest.

However, most of those studies advocate for changes in the project they assessed, and their conclusion paves the way for future projects to emerge. In the primary honey-producing areas of Uganda, Amulen et al. (2017) demonstrated that the well-being scores of beekeepers' households were significantly lower than the non-beekeepers' family units. This study highlights the need for more training in bee husbandry and protective equipment provisions such as suits, gloves, and smokers and calls for future research to evaluate the effectiveness of development agencies' inputs to the beekeeping sector. In a later study in Northern Uganda, Amulen et al. (2019) assessed the income-generating potential of farmers with beekeeping activities, demonstrating that the increasing production volumes of hive products were contingent upon achieving the appropriate combination of hive type, number, and the addition of a year-round forage crop. They emphasised that the beekeepers' skill level and financial capacity should drive the adoption of modern hives.

Similarly, in Kenya's Rift Valley, Carroll & Kinsella (2013) evaluated the potential of beekeeping as an appropriate livelihood strategy for smallholder farm households, finding that honey yields remain comparatively low despite high income earning potential and call for the need to build human capital for beekeeping rather than just promoting modern beehives. A study from Kimaro et al. (2013) also determined several factors that have been barriers to broader adoption of beekeeping in Tanzania: the lack of appropriate beekeeping skills among local people, financial constraints, and environmental factors. Researchers have suggested improving extension services, tree planting campaigns, and microfinance services to promote and sustain beekeeping among the rural communities under study. Lastly, research undertaken among the Ogiek people in the Mau forest of Kenya studied the answer of the Indigenous people to the promotion and intensification of beekeeping through the introduction of modern beehives (Zocchi et al., 2020). While it indicated a complementarity of traditional and modern beekeeping knowledge and practices within the livelihoods of the Indigenous people, it also suggests that the process of honey production intensification may undermine the relationship between the Ogiek and the woods by prejudicing the Ogiek's role of guardians of the forest.

Having in mind outcomes and conclusions drawn by previous studies, this research focuses on a similar ongoing beekeeping project implemented in the 3,300 km² buffer zone of

the Gorongosa National Park (henceforth GNP or “the park”), in the southernmost portion of the Great Rift Valley in the geographic centre of Mozambique, in the Sofala province (fig.2). The park's core mission is to protect ecosystems, wildlife species, and landscapes of Gorongosa while unlocking its economic potential and empowering local populations. The GNP and its surroundings were a major battlefield of the civil war that not only caused untold suffering, traumatism and enormous loss of human life, fragmented societies, and shattered economies (Hanlon, 2010; Igreja, 2003a, 2015b; Shambaugh et al., 2001), but also ravaged the landscapes and ecosystems and almost wiped out local wildlife, specifically megafauna (Hatton et al., 2001; Pringle, 2017, 2020; Stalmans et al., 2019; Stalmans & Beilfuss, 2008). However, the park is now remerging as one of the most biodiverse places on Earth (Wilson, 2014) and is often considered a conservation *“*success story”(Pringle, 2020; Quammen, 2018; Rooks, 2017; UNDP, 2019). The blooming resurgence of these landscapes and their population through innovative restoration and rewilding strategies is an example of rehabilitation of degraded ecosystems that is deeply interconnected with the cultural fabric of human societies (Pringle, 2017) and is therefore a powerful example of self-reliance in rural sub-Saharan Africa.

Throughout the socio-historical events that have shaped landscapes and people, beekeeping has always been a traditional activity that supports the subsistence economy of people living in what is now the park's buffer zone (Tinley, 1977). Local beekeeping traditionally uses bark and log hives, but recent studies showed that a recent increase in the demand for honey had driven a growing number of local beekeepers to cut and burn trees (promoting uncontrolled fires), which can be a massive risk to local forests (Rodrigues, 2020). Therefore, in the context of post-war ecological, social and economic restoration, the GNP implemented a Honey Programme that promotes environmentally sustainable beekeeping practices with high-income potential for smallholder farmers to foster local livelihoods. The project was set up in 2016 and provided the beekeepers with intensive training and access to locally sourced long-lifespan beehives from sustainably managed forest and local handmade bee suits (Rodrigues, 2020). The Park buys raw honey in combs at a premium price, and it is then processed, bottled, and labelled at the park's honey house in Vila Gorongosa before being sold in domestic markets. The project keeps growing and currently (June 2021) comprises 357 beekeepers, including 82 women. The project also wants to use beekeeping to endorse women's empowerment through financial and social inputs. As the Honey Project is now five years old, the assessment of its social, economic, and environmental impacts on the buffer zone’s landscapes and its inhabitants is necessary.

To do so, secondary data were gathered from anthropological, historical and ecological books, articles, assessments and reports. Then, primary data were collected through a quantitative and qualitative structured questionnaire aiming at understanding the beekeepers' perception towards honey production and their environment. It was displayed among fifty beekeepers (14% of the total beekeepers involved in the project) that were randomly selected in the Honey Project's database – with the only filters being a minimum number set to integrate gender balance and the location – throughout four of the five districts of the Buffer Zone (Cheringoma, Gorongosa, Maringue, and Muanza). The interviews were carrying out by local members of the park's honey team who were trained and translated the questionnaire from Portuguese to Sena, Shona or other regional languages. The survey was conducted over a period of two months between May and June 2021, and I was able to be part of the interviews in the Gorongosa districts and be on the field between the 12 to the 21 of June – Covid has made fieldwork more complex to carry out.

PURPOSE OF THE STUDY

This study explores the history of the GNP, the concept of ecological restoration, the different cultural perceptions behind the park's landscapes, and the conflicting narratives generated by its establishment to understand the need to implement self-reliance strategies in this area.

This thesis aims to create a database crossing historical data and an assessment of the impact of the ongoing community-based beekeeping program to develop forecasts and guidelines for the future. Thus, it can make space for further studies to compare and follow the role of beekeeping and honey production throughout the park's buffer zone.

If the Honey Project meets its short to long-term goals, more and more local people, especially women, could be engaged in the honey value chain. While promoting sustainable beekeeping practices, it must also enhance the comprehension of beekeepers towards their environment, promoting women's inclusion and promoting stakeholders' income during the seasonal cycle of beekeeping. Economic, ecological, and cultural questions frame this transdisciplinary study.

THESIS STRUCTURE

This thesis comprises three chapters, two of which are intended to be published in different journals, and the third one introduces and leads the way for more specific and in-depths future studies. While this choice of structure has enabled the development of reflections around three separate questions, it has also naturally generated repetition in explaining the main topics of this thesis.

The first Chapter is a brief historical review of the implementation of the GNP. It focuses on historical and anthropological articles to understand its history, from the reconstruction of the Gorongosa ecosystem in the aftermath of the civil war (1977-1992) to the community-based National Park as it exists when this thesis is being written (2021). The aim is to set the ground to understand how, in a national park “for the people” (Gorongosa National Park, 2019), beekeeping has emerged as an answer for environmental and economic problems while relying on the culture of the local people.

The second Chapter evaluates how beekeeping can be used as a sustainable model to promote change and improve livelihood in the buffer zone. Beekeepers have been interviewed and, through the prism of cultural, ecological, and economic factors, data gathered are compared with historical findings. It lays the ground for further studies to assess the ongoing Honey Project of the park.

The third Chapter is an extension of the second one, it relies on the same materials, methods, and results; it aims at introducing how beekeeping can be an inclusive model to enhance women's empowerment in rural Mozambique. It reflects on women’s role in Mozambican rural societies and address the possibility offered by beekeeping for women.

CHAPTER 1 - DECONSTRUCTING THE EDEN, REUNITING NATURE AND CULTURE IN THE GORONGOSA NATIONAL PARK

1. Introduction

As the sixth mass extinction event in Earth's history is raging (Ceballos et al., 2015; Newbold et al., 2015; Pimm et al., 2014; UN Environment, 2019), critical rates of biodiversity loss, along with the climate and economic crisis are leading *nature*[1] towards a "catastrophic and potentially irreversible devastation" (IPBES secretariat, 2019; Massarella et al., 2021). Since these crises are the results of capitalist-driven human activities upon the planet's resources (Ceballos et al., 2015; N. Klein, 2015; Marques, 2020b; Ripple et al., 2017) and of the commodification of many components of the biosphere (Descola & Palsson, 1996; Maier, 2018; Olanya et al., 2021), it raises the urgent need not only to preserve biodiversity through conservation but also to understand and address the current interaction between humans and other living and non-living components of their surroundings (B. King, 2010). How, in the 21st century, can conservation strategies aid in averting the apparent ongoing biodiversity ecocide in the most effective and ethical ways?

The traditional Western division between *nature* and *culture* (Descola, 2005; Descola & Palsson, 1996; Merchant, 2004; Smith, 1990) has been spread and imposed on places and people where this dichotomy did not previously exist (Strathern, 1980; P. West et al., 2008), notably through the implementation of protected areas. Such areas offer a space through which people can see, understand, experience, and use the different parts of the planet, often referred to as *nature* or *environment* (Ferraro & Hanauer, 2011; P. West et al., 2008). Through their implementation worldwide, they displayed a new cosmology of the natural – i.e., a way of seeing and being in the world based upon a society's understanding of the order of the universe (Campion, 2017; Descola, 2005; Descola & Palsson, 1996) – perceived as right, just, and moral (P. West et al., 2008). Over the last century, protected areas were proclaimed for the "recreation of the human spirit" (Muir, 1911) and as "a refuge from the ills of civilisation" (Colchester, 1994, p. 2), representing the supposedly *wild* and *pristine* landscapes preserved from any human despoliation that promotes the myth of Eden. As the number of protected

[1] Nature and culture are written in italic as this study emphasis on the fact that those categories referred to social constructions that vary across societies, rather than inherent separate entities (Descola, 2005; Descola & Palsson, 1996; Merchant, 2004; Smith, 1990).

areas have dramatically increased (IUCN, 2017; Pringle, 2017; P. West et al., 2008), so have the expectations placed on them by a growing diversity of stakeholders: not only are they expected to protect iconic landscapes and seascapes and provide habitat for endangered wildlife, but also to contribute to the livelihood of local communities, to reduce poverty, to bolster national economies through tourism revenues, and to play a crucial part in the mitigation of, and adaptation to climate change, among many other functions (Infield, 2010; Soares-Filho et al., 2010; UNFCCC, 2021; Watson et al., 2014).

The modern concept of protected areas has been developed and refined over the last century. Yet, considering that, according to Watson (2014), global studies point to a significant shortfall in protected area effectiveness — with only 20-50% of protected areas assessed found to be effectively managed (Burke et al., 2012; Geldmann et al., 2013; Laurance et al., 2012), it appears of a major necessity to understand the dynamics behind successful protected areas. Gorongosa National park (hereafter mentioned as GNP or the Park) in central Mozambique, south-eastern Africa (fig.2), for example, is often quoted as a conservation *"*success story" (Pringle, 2020; Quammen, 2018; Rooks, 2017; UNDP, 2019). For Robert Pringle (2017), the innovative restoration and rewilding programs in the GNP highlight "how degraded ecosystems can be rehabilitated, expanded, and woven into the cultural fabric of human societies".

But the question remains on what aspects of the past are restoration projects attempting to restore (French, 2010). Whose vision, whose history counts when reconstructing a landscape? Gorongosa's landscapes and ecosystems have faced many challenges resulting from both natural and anthropogenic causes (Muala, 2015). Not only is the Park particularly vulnerable to various climatic events such as floods, droughts, or cyclones (Matos et al., 2021). But also, the Park's region was at the core of major socio-ecological events throughout the last century, during which a plethora of actors shaped and reshaped the political boundaries of the GNP (fig.1). From 1921, with the creation of Gorongosa Game Hunting Reserve and subsequent boundary expansions, to 1974, Mozambique was under Portugal colonialism, and the GNP's landscape was a land of multiple human claims, resulting in intense disputes among indigenous peoples, the Portuguese colonial regime, and many other resource exploiters from outside Gorongosa (French, 2010; Muala, 2015; Newitt, 2017). Between 1976 and 1992, Gorongosa was the key battlefield of the civil war, causing major disruptions to Gorongosa's ecosystem, to native life and the diverse wildlife, which all suffered considerable slaughtering and associated trauma (French, 2010; Hatton et al., 2001; Stalmans et al., 2019). Between 1993 until the present day, landscapes and ecosystems have been subjected to restoration, where 2004 marked the beginning of an ambitious public and private restoration program conceived by the Mozambican government and the US-based Gregory C. Carr Foundation

(hereafter mentioned as the foundation), with the reopening of the Park to tourists and scientists (Daskin & Pringle, 2018; Muala, 2015; Pringle, 2017).

This chapter gives an insight into the evolution of the landscape of Gorongosa, its establishment as a park, and the ongoing restoration project. As the Gorongosa Restoration Project (GRP) was implemented to restore the area and repair the damage that the civil war caused to both people and wildlife, Gorongosa as a ravaged battlefield is the starting point to analyse the different relationships multiple stakeholders share with Gorongosa's landscape. The definition of a reference state for restoration is more cultural and political rather than technological (French, 2010; Higgs, 2003). Therefore, to fathom the ongoing politic of the Park, this chapter appeals to some anthropological and geographical concepts. The aim is to attempt to unravel the complex ramifications of the different discourses and competing visions of past livelihoods and landscapes at stake in Gorongosa that have shaped, are shaping, and will shape this space and define its boundaries. The colonial legacies of protected areas and Mozambican territories would allow to understand better the creation of the park; however, because data about this period were too scarce, it was decided that this chapter would focus mainly on the post-war of Independence period. The creation of Gorongosa as a national park has been affected by colonialist historical precedents and institutional structures implemented by dominant ideologies and actors (Dahlberg et al., 2010), which will be referred to as the myth of Eden (J. S. Adams & McShane, 1996; Blanc, 2020). For a long time, this dominant vision has obliterated and affected the relationship that local people share with their customary lands and their "memories of an ancestral" landscape (French, 2010).

Afterwards, considerations are made on how the GRP proposes a way out of the deadlock and is trying to build a junction between different narratives around the same space. Indeed, since 2004 and especially since the establishment of the buffer zone as an inherent part of the GNP's restoration project in 2010, the Park has been focusing on the inclusion of local people in nature conservation. The Park's efforts represent well the multi-oriented approach based not only on conservation and science but also on creating "a park for the people" (Gorongosa National Park, 2019), with an emphasis on women inclusion, through the implementation of community conservation and Community-Based Natural Resources Management (CBNRM) strategies. Finally, it is argued that the propensity of the GNP to emphasise community conservation (i.e., that *nature* cannot be protected without society playing a role) goes hand in hand with the emergence of a new essential scientific paradigm. Offering new cosmologies to understand the relationship between humans and their surroundings is crucial regarding the current social and ecological crisis.

2. Gorongosa's landscape: an Eden devastated by wars?

2.1 The Fall or how two consecutive wars damaged landscapes, wildlife, and people in Gorongosa

Today, restoring the landscapes, protecting biodiversity and wildlife species while empowering the local communities of what National Geographic refers to as "Africa's Lost Eden" (Byrne et al., 2010) is at the core mission of the GNP. The need for the actors involved in and around the Park to prevent further deterioration of the landscapes and restore livelihoods in Gorongosa arises from the tragic consequences of outbreaks and recurrences of armed confrontations (fig.1). The war of national liberation between the 1960s and 1974, the civil conflict between Frelimo (*Frente de Libertação de Moçambique*) and Renamo (*Resistência Nacional Moçambicana*) from the end of the 1970s to 1992 and, more recently, the resurgence of tensions between Frelimo and Renamo since the 2010s (Diallo, 2019; Newitt, 2017; Nordstrom, 1997) have had severe repercussions upon the landscape and its inhabitants. Not only have those conflicts caused untold suffering, traumatism and enormous loss of human life, fragmented societies, and shattered economies (Hanlon, 2010; Igreja, 2003a, 2015b), but they also wreak "devastating harm on the environment, biodiversity, and the natural resources upon which people depend - impacts that are suffered long after hostilities end" (Shambaugh et al., 2001, p. 2). There is a need to understand how those conflicts affected the relationships local Gorongosa people have with the land and transformed the landscape into what it is today.

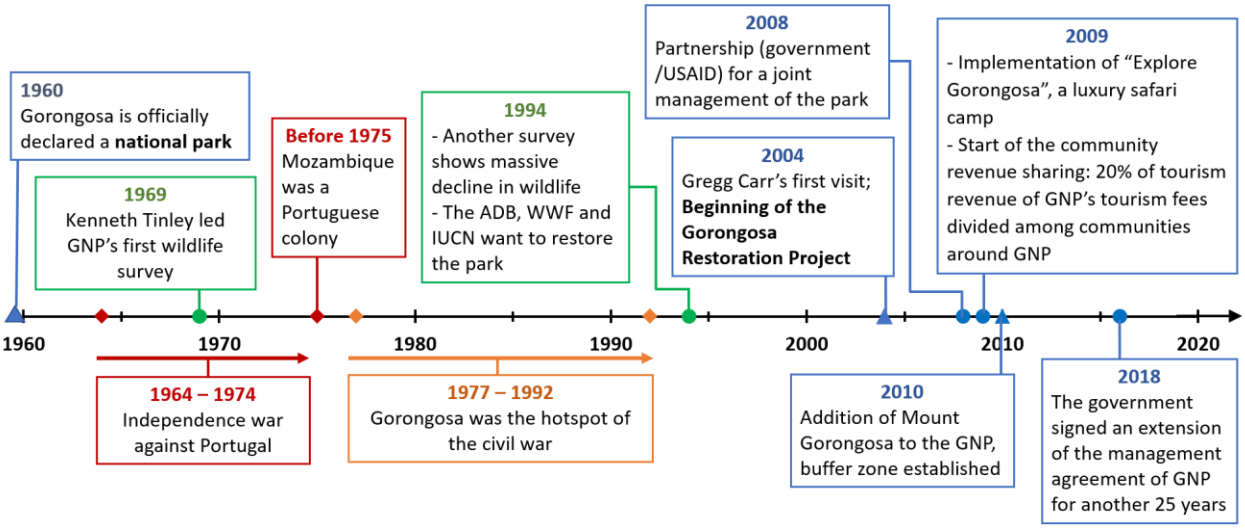

Figure 1 - Timeline of the historical key events that structured and shaped landscapes and livelihoods of the Park, from its implementation in 1960 to the extension of the management agreement between the GNP, the Mozambican government and the Carr Foundation in 2018.

After the Mozambican fight for independence against Portugal from 1964 to September 1974, Frelimo's new government inherited a crippled country (Hanlon, 1991, 2010). In the context of the Cold War, the new centralised socialist government of Frelimo claimed possession of land, wildlife, and other resources across the country (Muala, 2015; Nordstrom, 1997). To manage the redistribution of scarce resources and services like marketing, health care, and education, leaders implemented communal villages called "the backbone of rural development" (Hanlon, 1991; Lorgen, 2000). In the 1980s, largescale forced villagisation began in part as a response to the opposition group Renamo, a rebellion movement supported by South Rhodesia and later by South Africa (Diallo, 2015). Villagisation made Gorongosans move into communal farms, buy cooperative shops, and coerced them to attend communal meetings under layered new socialist leadership. The new government undermined the established headmen by installing its leadership all over rural Gorongosa (Muala, 2015). It resulted in a major shift in traditional interaction habits with their surroundings. Not only did villagisation alter the interactions with indigenous vegetation and fauna (Muala, 2015), but it also diminished the relationship between local people and their land, erasing their identity. The new policy denied the historical value of their customary rural lands, ancestral graves and other sacred places, independent huts, home-yards, and family farms inscribed in specific locations (Lorgen, 2000; H. West, 1997a). West (1997b, p. 212) explains that "Frelimo proved incapable of fulfilling the promises of socialist modernisation" and was rather perceived as using the villages to monitor the population and to try to maintain state security and control. In addition to the forced villagisation, popular resentment stemmed from the fact that new socialist elites grabbed colonial relics left by the Portuguese such as housing and infrastructure, and moved into these colonial enclaves which were disconnected from indigenous settlements (Finnegan, 1992). This resentment against Frelimo inspired a widespread national discontent that paves the way for the Renamo, the rebel movement, to spread and grow throughout the country (Diallo, 2019; Finnegan, 1992; Lorgen, 2000; Newitt, 2017).

Gorongosa was a hotspot during this civil war opposing Frelimo and Renamo, a long and bloody armed conflict that lasted from 1977 until the signing of the Peace Accord in 1992. The battle of both groups to take control over infrastructures affected the way Gorongosa space was used during the war (Muala, 2015; Nordstrom, 1997). Muala (2015) refers to the change in the GNP ecosystems during this period: Gorongosa became a battlefield for both parties to destroy what could be of economic importance for the other party. That is why tourist attractions and natural resources like the GNP, along with infrastructures such as communication (roads, bridges, and railways), commercial sites (shops, markets, and factories), social structures (hospitals, schools) were destroyed by both Renamo and Frelimo

and its allies, notably Zimbabweans (Muala, 2015; Nordstrom, 1997). Besides landscapes and infrastructures in and around the Park, social, economic, and agroecological lives were ravaged by both parties.

The civil war resulted in the death of one hundred thousand Mozambicans as a direct result of the conflict, along with up to a million more deaths caused by war-induced starvation and the denial of medical services (Robinson, 2006). It also engendered a large-scale social upheaval, with almost five million Mozambicans and an estimated 50% of the rural population displaced from their homes and forced to become refugees (Hatton et al., 2001; Robinson, 2006). In addition, in studies analysing the impacts of this last war upon Gorongosa's wildlife, it was estimated that wildlife was decimated and reduced Gorongosa's large animal populations by 90% or more (Hatton et al., 2001; Pringle, 2017, 2020; Stalmans et al., 2019). Indeed, before the war, in 1969, Kenneth Tinley and Paul Dutton underwent the first aerial wildlife survey in the Park – at that time a fraction of the actual size –, reporting a considerable number of mammal species (GNP, 2017; Tinley, 1977). However, during the war, wildlife resources, especially large mammal species, were hunted for meat and trophies by both Renamo and Frelimo troops, which led to a massive wildlife decline. Furthermore, during the immediate post-war period, uncontrolled (and often illegal) hunting/harvesting of wildlife and forestry resources in and around the Park (Hatton et al., 2001).

As the war has had ravaging consequences on the landscapes of Gorongosa, the first goal of the GNP is to restore wildlife and ecosystems. While comparing data from 15 aerial wildlife surveys conducted before (1968–1972) and after the civil war (1994–2018), Stalmans *et al*. (2019) demonstrated that wildlife recovery had accelerated since 2004 (when public-private management started). The restoration project of the landscapes of Gorongosa emerged in a post-war economic context that was favourable for conservation philanthropy.

2.2 Nationalising and privatising Gorongosa

In 1974, while Mozambique broke away from the yoke of Portugal, the transition to the post-colonial era resulted in expanded control of local landscapes and people by external actors (B. King, 2010; Muala, 2015). King (2010), when studying the conservation geographies in sub-Saharan Africa, noted that the expansion of conservation areas within Africa is linked with the state's role in classifying and controlling natural resources and territories. Mozambique illustrates the politics of global environmental governance where states are increasingly incorporated into transnational networks of actors and institutions (Brockington & Duffy, 2010; Diallo, 2015; Duffield, 2001). Since the end of the 1970s, and even more since the end of the

civil war in 1992, Mozambique has become a “donor darling”, receiving fundings (from government agencies, transnational networks of donors, NGOs and private foundations, and companies) notably for the elaboration and management of conservation areas (Diallo, 2015). The state abandoned many features of its state-centred economy favouring a free-market, neoliberal economy and marketised its *environmental goods*, notably because of the World Bank’s and IMF’s pressure to privatise lands (Lunstrum, 2008).

Those dynamics have engendered the acceleration of the privatisation and pricing of *environmental goods*, the expanding rhetoric of consumerism have transformed *nature* into a market-place (Descola & Palsson, 1996). In this context, contemporary conservation philanthropy projects emerged in Mozambique, and philanthropists were encouraged to take over state functions such as national parks. Such projects provide an alternative source of money and expertise and enhance a new business-like approach to conservation management, referred to as “philanthrocapitalism” (Bishop, 2009; Diallo, 2015). In Gorongosa, the US-based entrepreneur Gregg Carr visited the Park in 2004 and decided to actively participate in its protection, which enhanced the beginning of the restoration project, supported by Carr’s philanthropic entity, the European Union and the African Bank for Development (AFD). Nowadays and since 2008, as mentioned earlier, the Carr Foundation is at the heart of the restoration project of the Park, which grew into a public-private partnership with the Mozambican government and numerous other partners – notably the WWF, USAID, and many travels and tour companies (Schuetze, 2015; Walker, 2015).

Then, to understand the creation of the landscape of Gorongosa as a park to be restored, it is necessary to first appeal to some anthropological and geographical concepts. The aim is to understand how this space has been shaped, is being shaped, and will be shaped by different discourses and competing visions.

2.3 Creation of space and definition of boundaries: cultural sedimentation of contrasting perceptions

The boundaries of the Park and its buffer zone (fig.2) are not self-reliant but have been produced through a set of social, legal, and economic relations (Dahlberg et al., 2010; Walker, 2015). To understand the creation and ongoing evolution of this area as a natural park, it is necessary to consider the different historical strata of symbolic representations that constitute its landscapes and comprehend what projections and memories it is the object. The underlying questions are which land is protected, by whom, and from whom. Since the perceptions of environmental degradation and human influence shape landscapes as much as biophysical

processes (Walker, 2015), one must grasp the different angles through which the area under study has been lived, conceived, and perceived (Lefebvre, 1992, p. 42).

The landscapes of the Park and its buffer zone represents a variety of ecosystems that makes it "one of the finest wildlife ecosystems in Africa" (Hatton et al., 2001) and is divided in four regions (Stalmans & Beilfuss, 2008; Tinley, 1977): the Gorongosa Mountain, Midlands, Rift Valley, and Cheringoma Plateau. The Midlands region is covered by mixed woodland and dry and moist miombo landscapes, a broad deciduous forest and woodland (Tinley, 1977). The Great Rift Valley has the greatest variety of ecosystems in the region, supported by the mosaic of different types of alluvia and the seasonal flooding of the plains (Tinley, 1977), offering an alluvial fan, the lake Urema as well as floodplain grasslands and woodland, while western miombo woodlands and forests cover the Cheringoma Plateau. In addition, this area encompasses the isolated Gorongosa Mountain, which rises to 1863m, supporting tropical to mountain rainforest, with heath grasslands on its summits (Hatton et al., 2001; Stalmans & Beilfuss, 2008). The climate in this region varies with altitude but generally, the region is under a tropical savanna climate, except for Gorongosa mountain which has a warm rainy climate (BirdLife International, 2021).

The Eastern portion, from Coutada 12 to the Marromeu National Reserve (fig.2), covers the southern half of the Zambezi Delta (at the downstream terminus of the Zambezi River) and the bordering Cheringoma escarpment (Stalmans & Beilfuss, 2008). As illustrated in figure 2, the management of the parks also currently comprises two forest reserves (Nhampacué and Inhamitanga), large commercial agricultural lands (BirdLife International, 2021), and four hunting concessions (Coutada no. 10, 11, 12, and 14). Coutadas are former hunting reserves established in Mozambique between 1956 and 1962 (French, 2010). During this time, they were mainly run by private concessionaires and used for tourists hunting safaris. They were a crucial part of the Park system, as funds from taxes, hunting licenses, and the selling meat and ivory allowed the further development of tourist infrastructure in the Park (French, 2010).

Landscape and *space* are key concepts at the heart of the confluence between the earth sciences and the social sciences[2]. A *Landscape* is embedded in *space* and *time. It* reflects a synthesis of physical elements – geophysical-defined landforms, living features of

[2] Even though the difference between the concepts of "space" and "landscape" have been emphasised in *The Perception of the Environment: Essays on Livelihood, Dwelling and SkillI* by Ingold (2000), for the sake of this thesis, both of the words will be used interchangeably. S*pace* will be used to mean the same as surroundings, the term we use to think about how one should describe the world people live in and with when discussing protected areas, so as to not replicate culturally biased terms such as "nature", or "wilderness".

landcover, transitory (lighting and weather conditions) and anthropogenic elements (such as buildings, land-use) – combined with peoples' experiences of those dynamics. It thus represents political, cultural and ecological interactions (French, 2010), out of which actors and institutions construct local environmental discourse (Fairhead & Leach, 1996). *Space* was first formulated based on extension, thought of in terms of coordinates, lines and planes, like Euclidean geometry (Elden, 2007; Janzen, 2002; Neumann, 1998; Smith, 1990), and is produced through social practices, science, planning, and technology (Lefebvre, 1992; Smith, 1990; P. West et al., 2008). For the purpose of this study, *space* is not a given passive reality but rather a collective product reflecting the history, values and representations of those who have shaped, continued to, and will shape it.

Moore (1998, as cited in West et al., 2008) demonstrates how landscapes come into being, how they are profoundly social, and how the spur for conservation changes the social nature of people's surroundings. His study shows the complexity of social productions of space (P. West et al., 2008). Similarly, in his thesis, French (2010) describes struggles over restoring livelihoods and landscapes in the aftermath of episodes of social-ecological disruption in the GNP. He emphasises how different local, regional, and global actors have produced a variety of competing visions of restoration of Gorongosa's livelihoods and demonstrates that such contests are structured by social memories of past livelihoods embodied in ritual, emplaced on landscapes, and constructed in narrative.

Lefebvre (2000) considers *space* as the ultimate kernel and medium of struggle and, therefore, a crucial political issue. Similarly, the interpretation of the landscape of the GNP is political as it is imbued with power relations and contested knowledge over the causes and directions of ecological change (Walker, 2015). GNP's landscapes are a synthesis of material changes in the environment and imaginative understandings of these ecological processes that generate and are generated by contrasting discourses (Beinart & Mcgregor, 2003; Walker, 2015).

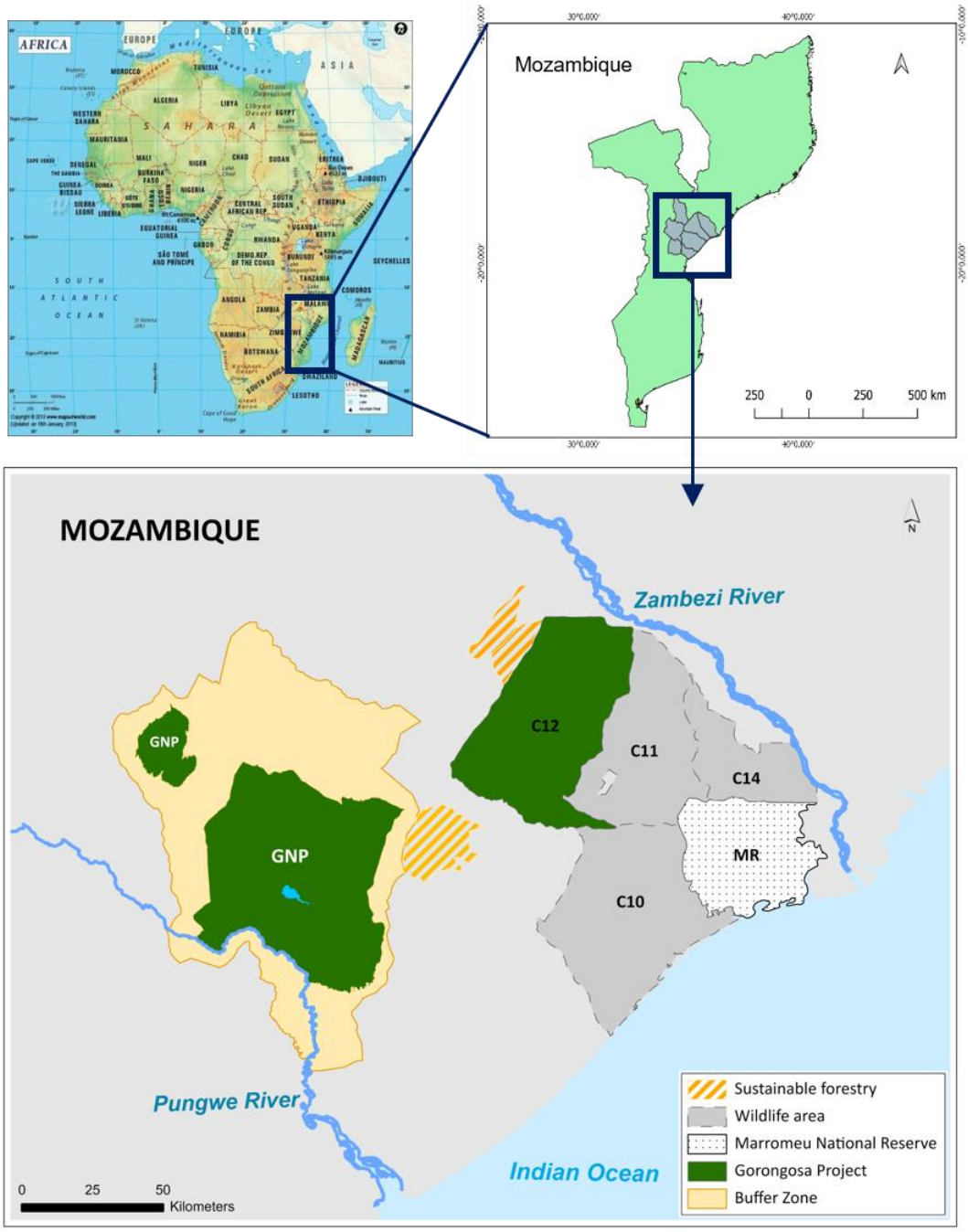

Figure 2 - Map of the location of the Gorongosa National Park and its current boundaries in Mozambique, south-eastern Africa.

Discourses are constituted by humans' desires, imaginaries, ideologies, and metaphors that generate textual products, reflecting and shaping power relations (Neumann, 2004). They are "institutionally based, materially constrained, experientially grounded manifestations of social and power relations'' (Harvey, 1997, p. 80), and they emphasise specific concepts at the expense of others (Peet & Watts, 1996). To gain power and be heard and validated, discourses need an audience usually sought through storytelling (Fortmann, 1995). Stories

have the power to frame and create understanding, create and maintain moral communities, validate current actions, and encourage, empower, and relieve their tellers (Fortmann, 1995). In places where conservation, restoration, or development projects generate conflicts over land, narratives emerge as discursive strategies to define and claim land and resources (Fortmann, 1995; Hutton et al., 2005; Peters, 1994; Schuetze, 2015). The narratives constructed around Gorongosa's lands and resources illustrate how different visions have shaped the landscape and boundaries of this space and present opposite visions of what should be taken as the reference state for restoring the landscape. The GNP is a prism through which profound divergences of interest are observed between the transnational level, where the legitimacy of the preservationist watchword is elaborated, and the local level, where this watchword impacts the traditional uses of the environment and its resource (Blanc, 2020; Higgs, 2003).

The need to determine to which past conditions the landscape should be restored remains; from whom does it needs to be protected, with whose help? Also, a definition of which and whose perceptions of the past landscape is necessary to become a model for present ecosystem management. In the aftermath of the civil war, while Gorongosans recalled memories of colonial evictions in their struggle to rebuild their livelihoods, international conservationists, NGOs, and the Mozambican government referenced histories of land invasion and poaching by locals as they imagined different possibilities for restoration (French, 2010; Muala, 2015).

3. Resurgences of contrasting perceptions upon the Park's landscape

3.1 At the origin of the Park: a colonialist and fantasised perception of the landscape

3.1.1 Building the Eden…

To understand what discourses are currently at play in the restoration of the Park, it is necessary to unveil which historical precedents, institutional structures, and power dynamics were behind the establishment and delimitation of Gorongosa as a national park.

Africa's Lost Eden (Byrne et al., 2010) and *Last Wild Places* (National Geographic Societies, 2019), National Geographic documentaries, illustrate the dominant and most widespread narrative around the Park's landscape. This quest of a lost past evoked in both documentaries represents the fantasy of the environmentalist discourse of national and global conservationists upon the African landscape (French, 2010). They authenticate shared

memories of the landscape as a *wilderness* and omit the landscape's past human occupation. French (2010, p. 327) refers to this narrative as the "memories of a lost wilderness" that contrasts with the "memories of ancestral past" carried out by MaGorongosi[3]. The most dominant narrative displayed in popular media (Pringle, 2020; Quammen, 2018, 2019; Rooks, 2017; UNDP, 2019), illustrated by the National geographic vision of Gorongosa as a memory of a lost paradise, raises the question of the origin of Gorongosa and national parks.

Gorongosa was first a game reserve created in 1920 by the Mozambique Company to entertain guests and managers of the company (Matusse, 2019). When the company ceased its contract, the ownership of the area returned to Portugal, and in 1960, Gorongosa was the first national park to be established in Mozambique. Hunting was banned during the following years, and the area turned into a tourist attraction (Matusse, 2019). In 1966, an article published in *Connaissance du Monde* (Huibregste, 1966) felicitates the implementation of the Park as a people-less space to regulate hunting and prevent more "mass slaughters" that decimate the local wildlife. For the landscape of Gorongosa, similarly to most of the sub-Saharan African landscapes, regional discursive formations are inseparable from the past experience of colonialism and the relations of power that sustained it (Neumann, 2004).

Most of the national parks in Africa results from the belief that biodiversity protection is achieved upon the establishment of protected areas where ecosystems are separate from anthropogenic disturbance (W. Adams & Mulligan, 2003; Domínguez & Luoma, 2020; Plumwood, 2012). The prevailing model of conservation known as "fortress conservation" assumes that environmental degradation and biodiversity loss are caused by local peoples' irrational and destructive use of natural resources (Buscher & Whande, 2007; Domínguez & Luoma, 2020; Hummel et al., 2019). Consequently, conservation strategies in Africa were first implemented and operated on the belief that Africa's resources and landscapes are a "paradise" to be protected (Adams & McShane, 1996, p. 18), even against the people who have been an integral part of the landscape for over 2 million years. The African landscapes are presented as sanctuaries unviolated since time immemorial, as African peoples preserved them over the millennia, but that would now be at risk of imminent extinction (Adams & McShane, 1996; Blanc, 2020; Domínguez & Luoma, 2020). Nowhere this paradoxical representation of African landscapes is more apparent than in Africa's nature parks, as the

[3] *MaGorongosi* is the term used by the individuals who identify themselves as indigenous to Gorongosa for themselves (French, 2010). The term *Gorongosans* refers to non-indigenous immigrants living in Gorongosa District.

preservation and restoration of *natural* and *wild* landscapes have been at the heart of their creation throughout the 20th century (Blanc, 2020; Nelson, 2003).

This paradoxical myth is the root and locus of conservation strategies in Africa that started under colonialism (J. S. Adams & McShane, 1996; Blanc, 2020; Domínguez & Luoma, 2020; Jeanrenaud, 2002), and the ideas of *wilderness* and *Eden* seem interchangeable to describe the landscape and sometimes even collide into "wild Eden" (Adams & McShane, 1996). However, this oxymoron refers to two opposite romanticised visions of what a landscape could be: while *wilderness* evokes a place beyond human control, where order breaks down, *Eden* invokes the image of a paradise where humans prevail and live harmoniously with the Earth's creatures. Understanding how could any space embody both of those visions at the same time is a challenge. Yet, they both meet to describe the European perceptions of the African continent as a wildlife paradise and ignore the role being played by African peoples in shaping the landscape (Adams & McShane, 1996; Larrère & Larrère, 2009). For Adams and McShane (1996), the invention of a mythical Africa arose from Europeans' need to create a refuge from the industrial and despoiled "old Continent" as the march of civilisation has tamed and destroyed the wilderness of Europe. During the 19th century, tales of explorers and travellers created a place of spectacular but savage beauty, coveted with quality of solitude, mystery, chaos, and sublime that embody both paradise and wilderness and that was sold to an eager audience steeped in romanticism (Berque, 2016; Larrère & Larrère, 2009).

Colonialism is premised on the acquisition of new territories and natural resources (Domínguez & Luoma, 2020), which necessarily led to the exclusion of the local population (Brockington & Duffy, 2010; Brockington & Igoe, 2006; Diallo, 2015; Walker, 2015). This might not be related to conservation laws in the colonial period but a consequence of imperialism, neoliberal and modernist conservation approaches (Matusse, 2019). Under Portuguese colonisation until 1974, the landscape of Gorongosa was no exception. As with most African parks, Portuguese settlers' perception of the Gorongosa landscapes lacked a general appreciation of the extent to which those *pristine* landscapes were the results of long-term land-use interventions by local populations (Adams & McShane, 1996; Adams & Mulligan, 2003; Dahlberg et al., 2010). Paradoxically, as their narrative displays a perception of a past human-free *natural* and *wild* Gorongosa landscape, they simultaneously claimed that Indigenous activities were a threat to this *pristine* and high-valued environment (Muala, 2015; Tinley, 1977). In 1947, the Game Commission of Beira recommended more effective hunting regulations to avoid poaching and called for an appraisal of the Gorongosa Reserve (French, 2010). It led to the eviction of hundreds of Gorongosan households, corresponding to several

thousand natives (French, 2010; Muala, 2015). This exclusionary ideology led to what Tinley (1977, p. 153) referred to as “perhaps the most ironic affair in the chequered history of changing park boundary limits” and involved high human costs (Schuetze, 2015).In GNP, the colonial agents carried out evictions in the name of conservation (Domínguez & Luoma, 2020), established high taxations and drafted locals to build infrastructures for tourism (Schuetze, 2015). Not only did the evictions of MaGorongosi change ecosystem dynamics on the floodplain (Tinley, 1977), but they also affected their perception of customary life. Along with space, the evictees lost spiritual connections as their traditional culture and believes are deeply embodied and intricated within the landscape. Their perception of nature reflected Indigenous knowledge, supported their self-determination, and promoted a balance between them and the ecosystem (Muala, 2015).

3.1.2 … based on the Western dichotomy between nature and culture

For the most part, sub-Saharan African national parks are based on the duality of two major concepts that accompany conservation as a science of human interactions with their environments: *nature* and *culture*. The *nature* to be conserved is largely understood and imagined as a fantasised version of a “wild Eden”, without any trace of human appropriation of space. The general vision of *fortress conservation* in Africa which imposed conservation through exclusion and violence, posits a particular relationship between society, environment, and history, emphasising native’s role in environmental degradation processes while downplaying histories of long-term African occupation of conserved areas (Igoe & Brockington, 2002). In addition, some authors suggest an inextricable link between the perception of the protected area as non-lived in space and the Euro-American conceptualisations of wilderness as uninhabited space (Cronon, 1996). Contemporary conservation strategies in sub-Saharan Africa reflect the values and assumptions embedded in western conceptualisations of *nature* (Walker, 2015).

As highlighted by anthropologists (Descola, 2005; Viveiros de Castro, 2014), or geographers (Berque, 2016), until now, the predominant scientific postulate in the Western world and widespread throughout the Earth is based on a deterministic and Cartesian understanding of the environment, where “Man” wants to make himself “as master and possessor of nature” (Descartes, 1637). This perception and way of being in the world are referred to as the *naturalist cosmology* by Philippe Descola (2005). Western scientists, institutions, and power brokers established the need to separate nature from culture to preserve this idealised vision of African landscapes. The ecological effects of human activities are presented as *cultural,* thus in conflict with *nature* (Brockington & Igoe, 2006). Yet, in this view, *culture* lies mainly in the use of landscapes and resources by Indigenous people, whom

these same all-powerful institutions accuse of destroying the environment in which they live. However, paradoxically, more than tolerated, scientists and tourists are even encouraged to come and enjoy these landscapes and the experiences they offer.

Nevertheless, whether Indigenous people are imagined or project themselves as inside or outside *nature*, the nature/culture dichotomy induces effects at the material and sociological levels (West, 2008). Indeed, not only have Indigenous people have been excluded from their land (Brockington & Duffy, 2010; Brockington & Igoe, 2006; Diallo, 2015; Walker, 2015), but they have also been held to politics that limit their traditional way of living (Brockington et al., 2006; P. West et al., 2008). To simplify and relieve policy-making and management and make people's socio-ecological practices fit into new spatial productions of conservation, the social component has to be simplified to appear less complex (Brockington, 2002). However, one should be aware of the propensity and potential of conservation strategies to follow a path similar to colonialism, as it can solidify particular identities and ethnicities and incarcerate them in places, space and time (Blanc, 2020; P. West et al., 2008).

Now, since it has been demonstrated that the Eden does not exist and can therefore not be preserved, the question remains on which visions of the past are to be held, especially in Gorobgosa's post-war landscapes.

3.2 Memories of an ancestral past that "dwell in the landscape"

3.2.1 Healing from war-induced traumatisms…

After the civil war in Mozambique ended in 1992 (fig.1), reconstruction followed countrywide. The Mozambican State abandoned many features of its state-centred economy, favouring a free-market, capitalist economy (Lunstrum, 2008) and marketised its environmental goods. In 1995, in this post-war liberalisation and reconstruction context, the Mozambican government decided to rehabilitate the Park, and Frelimo handed over land concessions to the African Development Bank (AFD), the International Union for Conservation of Nature (IUCN), and the European Union. The GNP did a survey that showed a population of roughly 15000 natives living within the GNP boundaries, subsisting on rotation farming and hunting/fishing (French, 2010). Gorongosans were either displaced by the war, using fertile lands within the Park or were returning to ancestral lands lost after their eviction in 1948. The Park's cultural space preserved what had disappeared during the war: the way MaGorongosi used to interact with their surroundings' physical and spiritual aspects during the time of their ancestors (French, 2010). The GNP became a landscape of memories where their ancestral spirits still reside and thus is associated with an ancient and better way of life. Memories of an ancestral past refer to social memories Gorongosans have constructed of past relationships

with the land, and they use these projections to reconstruct and restore society and landscapes.

By ejecting the local populations and appropriating the most arable lands of Gorongosa, the floodplain, the Portuguese settlers made the first steps towards the obliteration of the Gorongosan identity, as it is deeply embedded in their relationship to their surroundings. During the war for independence, Gorongosans allied with Frelimo freedom fighters. Yet, once independence was achieved in 1975 and until 1987, the focus of the new Marxist government was on rural development through industrialisation and collective farming "based on 'science'" (Matusse, 2019). Frelimo implemented the policy of villagisation that forced local people to live in community villages and, once again, leave behind their rural lands, sacred places, independent huts, family farms, and ancestral graves (Muala, 2015). The expected return to ancestral lands and freedom after the withdrawal of Portuguese colonists was prevented by the constant patrolling of the Park's borders. Therefore, the Frelimo post-independence government was in total opposition with what local peoples were expecting (Saad-Filho, 1997), as the relationship Gorongosans have with lands, fauna, and flora through spirits, kinships, and totems were considered as a superstition (Izidine et al., 2008; Matusse, 2019Virtanen, 2002).

During the civil strife and its aftermaths, pain, misery, and hardship affected the population of Gorongosa, which was accentuated by outbreaks of cholera, diarrhoea, and malaria as healthcare services were destroyed by the war (Igreja, 2003b). In addition, most people lived alongside soldiers from one of the parties, leaving most of the local population traumatised by the end of the war. Therefore, Gorongosans have constructed responses to cope with traumatisms engendered by the war-time and post-war context (Igreja, 2003b; Igreja et al., 2008). Igreja (2012) argues that indigenous understandings and practices of justice and healing are constituted by multiple contingent temporalities, blending present, past, and future. This vision of healing differs from common mainstream linear temporalities that assume that peace agreements or military defeats are the starting point of transitions. Indeed, local peoples had to reinvent and rebuild their traditional and deeply-rooted beliefs among themselves (Muala, 2015) and with infrastructures and organisations of power (from the Portuguese colonial state to the GNP nowadays) within the landscape. In this dynamic, reappropriating the environment through culture and landscape building around the Park allowed Gorongosans to recreate new codes of life (Muala, 2015).

For Gorongosans, the landscapes lost during those hard times were a wilderness that their ancestors had humanised. The way the war has affected people in Gorongosa and their

relation to the landscape varied in space and time. The ambition here is not to give a full overview of the evolution of the relationships between local people and the landscapes as they are multiple, diverse, and complex; neither is it about reducing centuries of local cultures, traditions, and people's socio-ecological practices. The processes of healing, reconciliation, and justice in the aftermath of the Mozambican civil war within the Gorongosa district, including the role of post-colonial politics on processes of religious transformation in this area and spiritual strategies to convey experiences of post-colonial pain, with an emphasis on the suffering of women were already addressed by some authors (Igreja, 2003a; 2003b; 2015a; 2008; Igreja & Lambranca, 2009). However, while popular media has been celebrated the win-win conservation success story of the Park (Pringle, 2020; Quammen, 2018, 2019; Rooks, 2017; UNDP, 2019), it was mostly at the expense of the discourse of local Indigenous people (Brockington et al., 2008; Peet & Watts, 1996; Schuetze, 2015). The objective is to introduce different stories upon the same landscape and provide other possibilities to consider the interactions between humans and other living and non-living components of their surroundings. As the study area is broad and its inhabitants numerous, it is not an exhaustive vision but rather some avenues elaborated in this part.

3.2.2 …by dwelling in the landscapes

For Gorongosans, the world and space in which they evolve are continually coming into being, and its numerous and diverse constituents take on significance through their incorporation into a regular pattern of life activity, such as rituals. Such immersions of people into an environment have been referred to as "dwelling into" the landscape (French, 2010; Ingold, 2000).

To heal and recreate war-torn communities, families, landscapes, and economies, Gorongosans dwelled into memories of past livelihoods and moral communities (French, 2010). They do so through rituals and spatial practices linked to imagined potentialities embedded into the landscape of Gorongosa. During the war, Renamo and Frelimo perpetrated severe spiritual offences against the land. Both troops ignored local taboos by defiling sacred forests, killing lions, and disrupting several ceremonies (French, 2010). And, because of these spiritual transgressions, connections with the *mizimu*, the ancestral spirits of the land, were broken, resulting in environmental retributions such as drought, infertility, floods, and attacks by spiritual animals mentioned by French (2010).

> *"The Spirits are like the wind…*
> *They are with you*
> *wherever you go.*

Can you see the wind?
Can you hold it in your hand?
Your spirits walk with you.
You are part of their family."

Through those words, Jorge Francisco Afonso Tambarara, chief of Tambarara, in an interview given in 2009 to Muala (2015, p. 62), claims spiritual ancestors' omnipresence. This quotation highlights the cosmology of Gorongosans as it shows how blurry is their line between the *natural* and *cultural* realm. For example, French explains that cemeteries are traditionally located in the bush because, like their ancestors, dead peoples enjoy the fresh shadow offered by the forests. In addition, when transforming the landscape (to start new crops or gather resources) or practising any activities that would be associated with past transformations of their ancestors, Gorongosans reach to them. The highest cultural expression of local people is performed through *Mbhamba* rituals, through which they communicate and make offerings to the ancestral spirits (French, 2010; Muala, 2015). Moreover, most of the ancestors take the form of wild animals. When founders of totemic groups pass away, they take the shape of the totemic animal, and chiefs become spiritual lions, called *mhondoro* (French, 2010; Schuetze, 2015).

Local people traditionally intertwined lions and humans in a socio-ecological dynamic that regulates the attitude between humans and their surroundings (French, 2010; Muala, 2015). The *mhondoro* spirits are the owners of the land that care for the well-being and prosperity of their descendants (Schuetze, 2015). Nonetheless, when these spirits do not receive their due respect, they can show discontent by provoking misfortunes, and for lions to prey on local people is meaningful as it reveals conflicts with the ecosystem code established by the ancestors (Muala, 2015).

Today, the allegation that Gorongosa's landscapes would belong only to Gorongosans because they were its first inhabitants seems too simplified (Muala, 2015). As mentioned above, Gorongosans fled their homeland repeatedly: not only because they were ejected or to escape violence during wars, but also because of floods and droughts that occurred in the early 1980s and 1990s. Displaced individuals were often separated from their communities, altering social interactions, leading to a breakdown in social-environmental relationships (French, 2010), as social relations, group membership, and dynamics can be critically disturbed by high levels of population movements (Cernea & Guggenheim, 1993).

Therefore, the GNP results from a long history of environmental conflicts over access to land and resources between global conservationists, environmental managers and local populations, which is continually evolving. To reconstruct and rebuild the landscapes of the Gorongosa and what Gorongosans have lost during those last decades, one needs to unveil the role the GNP might have to help within this contrasting narrative.

4. Gorongosa Restoration Project: reuniting *nature* and *culture*?

Along with the neoliberal economic context mentioned previously, the early 1990s saw the expansion of the policy commitment to sustainable development arising from the Brundtland Report (1987) and the UN Conference on Environment and Development, held in Rio in 1992 (Hutton et al., 2005), that paved the way for community conservation narrative within international policy. In this regard, the GRP is linked to sustainable development growth by turning the safeguard of biodiversity into economic growth by promoting tourism (King, 2010). Therefore, the park policies and projects aimed at covering the three main pillars of sustainable development: environment, people and economy, to incentivise local communities by linking economic development and livelihoods with the protection of natural resources (Wagner et al., 2019). Now, questions arise on the means the Park uses to achieve these goals and how the landscape, wildlife, and livelihoods of local people have evolved since the GRP was implemented.

4.1 Building a park for wildlife and the people

4.1.1 A successful ecological restoration process undergoing

In 2004, when the Carr Foundation signed a 20-year co-management agreement with the Mozambican government and started the Gorongosa Restoration Project, the objective was to rehabilitate the Park through ecological restoration. The project aims to enhance and provide for conservation, science, and socio-economic activities (Stalmans et al., 2019) to alleviate and mitigate the catastrophic consequences of the civil war. By fostering scientific studies about Gorongosa's complex web of life, the GNP seeks to use science to inform adaptative management of the GNP's wildlife and ecosystems while considering the several hundred thousand local people currently living in the buffer zone (Stalmans et al., 2019). The park restoration efforts concentrate mainly on enhancing the natural recovery of remnant populations by protecting resources (including wildlife, by translocating and relocating some species from elsewhere in southern Africa, and by reducing illegal hunting) and engaging local communities.

The Society for Ecological Restoration (2002) defines ecological restoration as “the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed”. An increasing number of studies have been carried out on the success of the ecological restoration of the Park (Atkins et al., 2019; Bouley et al., 2021; Correia et al., 2017; Gaynor et al., 2021; Stalmans et al., 2020). For example, after the disappearance of leopards and African wild dogs from the GNP, forest-dwelling antelopes called bushbuck (*Tragelaphus sylvaticus*) expanded into treeless floodplains, consumed novel diets and suppressed a common food plant, waterwort (*Bergia mossambicensis*). By experimentally simulating predation risk, Atkins e*t al.* (2019) demonstrate that even though anthropogenic predator extinction disrupted a trophic cascade by enabling rapid differentiation of prey behaviour, carnivore restoration may just as rapidly re-establish that cascade. More recently, Bouley (2021) has assessed the successful reintroduction of African wild dogs (*Lycaon pictus*) to the Park. Likewise, Correia et al. (2017) demonstrated that conservation efforts aiming at recovering populations of large mammals are helping to re-establish target mammal species and their functional roles as seed dispersers in the ecosystem. Gaynor et al. (2021) examine occupancy patterns and their environmental and anthropogenic correlations for different functional groups and species, using camera traps and a multi-species occupancy modelling approach. These surveys provide strong evidence that wildlife in Gorongosa is recovering.

However, the process of ecological restoration of these landscapes has evolved and is not just about biodiversity and wildlife anymore. Throughout the last decades, the restoration process has embraced a social dimension that is essential to the success of ecosystem restoration; solving problems for impoverished rural populations that live daily with wild fauna appeared to be crucial (Adams & McShane, 1996). It can be done through *focal restoration* strategies that engage with the community and local cultures and requires the support of local citizens, local organisations, and all levels of government (Higgs, 2003). In this process, the means – or restoration goals – cannot be detached from the ends, which represent conditions of the resulting ecosystem (Martin, 2017), i.e., restoration of ecosystems regenerates “old ways” and creates new ones that bring people closer to natural processes and one another.

Understanding how does the Park intend to improve both livelihood of Gorongosans and the landscape and the roles played by local peoples and leaders in the GRP is of utmost importance.

4.1.2 Working with local peoples and community conservation strategies

The ecological restoration of GNP is underway and flourishing and is occurring through struggles, debates, and compromises between different visions of a lost landscape. Bearing this in mind, it remains mandatory that animals and humans thrive parallelly, as wildlife knows

no boundaries, which is what the Carr Foundation aimed for – turning GNP into a *human rights park* (Quammen, 2018). Since 2004 and even more so since the establishment of the buffer zone as an inherent part of the Park's restoration project in 2010, the Park has focused on the inclusion of local people in conservation, as they are an intrinsic part of the landscape (Carr, 2019, Gorongosa National Park, 2019).

The Park's evolution and efforts represent well the change of focus, from perceiving the people as a "threat" to seeing them as a "resource" (Jeanrenaud, 2002) or as allies for nature management. The multi-oriented approach of the Park based not only on conservation and science but also on the inclusion of local people is emphasised through two main departments of the Park - human development and sustainable development, and the implementation of Community-based Natural Resource Management. CBNRM builds on the collective management of ecosystems to improve human well-being. It aims to delegate authority for ecosystem management to the local level, thus empowering communities to thrive through sustainable use of available resources, and relies on strong investments in capacity development and the creation of local institutions and governance structures (Fabricius & Collins, 2007). Bearing this in mind, the GNP aims to implement both anthropological and sustainable strategies in collaboration with local communities and their leaders to provide management of the park/buffer area landscapes (GNP website).

An essential part of this process is providing basic – and fundamental – commodities for the communities. So, the GNP also aims to provide healthcare and education programmes. In 2006, a new primary school and a new health clinic were built in Vinho community to provide better access to health care and education for local people. Since then, the GNP implemented dozens of mobile brigades to reach vulnerable households in the remotest areas of the buffer zone and a Community Health Workers programme that provides treatment and health education to the local people. The Park, along with district authorities and community members, also launched the WaSH program that focuses on borehole rehabilitation and construction to allow access to clean drinking water and improve community sanitation and hygiene practices. Regarding education, the Park supports programs from primary level to postgraduate. More than schools, it also wants to encourage the creation of after-school youth and teachers clubs in order to teach communities environmental conservation's principles and values so that local peoples have the tools needed to help protect the Park in the future. In order to understand how the empowerment of local population through education is perceived by the park, it could be useful to further analyse who the teachers are and which values are being taught.

Women's rights and inclusion in all levels of society are also at the core of the GNP values, and a wide range of projects are undertaken in this perspective. According to UNESCO, in 2015 in Mozambique, for 90% of girls enrolled in primary school, only 24% continue to secondary school (MacDonald et al., 2015; UNESCO Institute of Statistics, 2015). Moreover, in rural areas, since some girls are kept out of school to fulfil their traditional roles of household maintenance and care, most of the 40% of children that cannot access education are girls (MacDonald et al., 2015; Roby et al., 2009). To address this problem, the Park established 50 Girls Clubs that served 2000 girls in 2019 (GNP website). Moreover, the Men for Equality Program works with adolescent girls and boys, women and men, "to achieve sustainable change in attitudes and practices related to the empowerment of girls and women" (GNP website). The goal of having 50% of women employees is almost accomplished (Carr, 2019), and it has been noted that more than half of the scientists working in the Park are women[4].

During the two recent natural and human disasters, cyclone Idai in 2019 and the ongoing global pandemic of Covid-19, rangers and healthcare workers from the Park were among the first to intervene (Camões Instituto, Ministério dos Negócios Estrangeiros, 2020) by supporting support and cholera vaccinations to communities in Nhamatanda and Gorongosa after the cyclone.

Besides being fundamentally linked to wildlife and landscape restoration, the GNP's social counterpart in conservation is also intrinsically linked to economic development. Therefore, Carr (2019) explains that the aim is to create "a green economy and a greater landscape in which the park is the centre".

4.1.3 The ambivalence of a green economy

Linking poverty alleviation with conservation strategies is achieved by providing business-oriented approaches for local communities in the buffer zone (Diallo, 2015). This dynamic echoes with the developing synergy between conservation, sustainability and economic growth.

The GNP aims at developing larger farms with some mechanisation and access to the value-chain and stimulates more non-farm employment in the service industry, factories, and others. The Park also employs local people for its infrastructure (for example, rangers or tourist

[4] While doing researches for this chapter, it has been noted that most of the post-2010 scientific and anthropological articles about Gorongosa referenced are written by women.

staff in Chitengo, the main tourist camp) and developed natural resources-based businesses such as sustainable forestry management or coffee, cashew and honey projects[5]. The aim is to allow every family in the buffer zone to have some type of income.

The Honey Project, for example, began in 2016 and is built on a local ancestral tradition, to which it adds a business approach. Beekeeping using bark hives has been part of the subsidence economy of Gorongosans for a long time (Guy, 1971; Tinley, 1977) and has recently been increasingly promoted as an alternative model to supplement rural income while bolstering farming activities in rural sub-Saharan African regions (Amulen et al., 2019; Bigsten & Tengstam, 2011; Carroll & Kinsella, 2013; Wagner et al., 2019). Not only are bees' by-products an additional food source and provide nutritional and medicinal products (Crane, 1999; Crittenden, 2011; Mesele, 2021; Zumla & Lulat, 1989), but they also offer a secondary source of income (Amulen et al., 2019; Girma & Gardebroek, 2015). Indeed, there is a global and domestic growing demand for honey, beeswax, propolis, and pollen (Galli, 2020), with the potential to increase financial returns through adding values and marketing (Wilson, 2006). In addition, beekeeping activities directly contribute to strengthening food security since it supplements farming activities by providing pollination services essential for increased crop yields (Amulen et al., 2017, 2019; Hung et al., 2018; A. Klein et al., 2007).

Nowadays, the Honey Project encompasses seventeen technicians supporting and providing material and technical assistance to more than three hundred and fifty beekeepers throughout the buffer zone (Rodrigues, 2020). It aims at building an inclusive and sustainable business model that promotes environmentally sustainable beekeeping practices with high incomes for small farm owners, allowing beekeepers to thrive financially while expanding conservation practices (including an increase of ecosystem services – pollination – in this landscape).

Another way to link conservation and sustainable development are to present tourism as a driver for sustainability (Brockington et al., 2008, p. 175; Diallo, 2015; Saarinen, 2016). However, this practice raises ethical issues and environmental justice concerns (Brockington et al., 2008; Brockington & Igoe, 2006; Cock & Fig, 2000; Dahlberg et al., 2010). Indeed, while wealthy foreign leisure tourists are encouraged and invited to discover the wild sub-Saharan Africa, poor local peoples who were evicted from this landscape are still kept behind park boundaries. African national parks are closely delimited based on the belief that biodiversity can only be conserved in areas free of any human influence, yet accept the ones who can afford to stay in tourist lodges (Frontani, 2005; Hutton et al., 2005; B. King, 2010), all on behalf

[5] The same project that is assessed in the following chapter of the thesis.

of the benefits that ecotourism generates, such as population empowerment and economic growth (Brockington et al., 2008).

In the GNP, as in other parks, the approach of empowering people and protecting wildlife by emphasising green economy dynamics has been praised by the press but has also been subject to multiple critics, especially for exposing local peoples to current capitalist-driven economical practices (Diallo 2015). In this context, there is a risk to consider native peoples as commodities, notably through the exposition of their day-to-day way of life as a “cultural show” (West 2005; 2008), which can be interpreted as a colonial legacy (Gilbert, 2007). It can be linked to the separations of people and surroundings and a neoliberal conservation agenda that needs biodiversity to become commodities and natives to become labour (Frontani, 2005). Moreover, even though the green economy implemented in the Park is working locally to improve livelihoods conditions of local peoples and restore wildlife, it seems to lead to a dead-end in terms of global biodiversity protection, and climate mitigation as the financing of the Park relies heavily on capitalist investors and revenue from tourists coming to the other side of the world. The way the economy of the Park is currently working seems to rely on the same capitalist industry that is causing the climate and biodiversity crisis to which national parks were first offering a solution.

If currently the GRP is working towards building a park that protects biodiversity and wildlife species while empowering the local communities, different discourse and conflicts with the local people are still present. Indeed, an ancient, yet still ongoing conflict over the landscape of Mount Gorongosa highlights the current differences in perceptions over the landscape.

4.2 The puzzling case of Mount Gorongosa

If there are multiple very developed theories behind the concept of community conservation (Adams & Hulme, 2001; Andre & Reilly, 2009), practical implementations are more complex (Fabricius & Collins, 2007; Magome & Fabricius, 2004; P. Virtanen, 2005), as what “community” refers to is at the core of the concept and yet, very vague, evolving depending on time and place. However, promoting community conservation strategies means that conservation cannot and should not be pursued against the interests and wishes of local people (Adams & Hulme, 2001). In this regard, Mount Gorongosa’s case undermines the vision of the GNP as a park “for the people” and its willingness to include local peoples and their perception of the landscape in conservation strategies, as it brings out two contrasting discourses on the same landscape once again.

The GRP has recently ignited debates and revealed competing perspectives on sub-Saharan African land use, biodiversity conservation, human settlement, and rural development in Mozambique (Walker, 2015). As an example, in 2010, the Government of Mozambique expanded the boundaries of the Park, completing the long-held "mountain to mangroves" vision of the Park (Tinley, 1977) carried by Carr Foundation (Beilfuss, 2006; Schuetze, 2015). It increased its overall size by roughly 10% to 4,067 sq. km and established a buffer zone of 3,300 sq. km around the Park. These new delimitations incorporated all land parcels above 700 m of Mount Gorongosa as a satellite-protected area of the Park. In his study on the spatial production of the greater Gorongosa ecosystem, Walker (2015) links the production of space with scientific discourses on environmental degradation. The Park's main argument for expanding its boundaries is its concern about the local people's livelihood activities on the mountain, which are believed to have damaging effects on the mountain's hydrology that supplies water to GNP (Walker, 2015).

As the Carr Foundation's desire to incorporate Mount Gorongosa into the Park's boundaries and development plan was met with significant opposition, two crises emerged: describes the conflict between the narrative of the mountain residents that picture the park officials as people that are greedy for more land; and the other discourses that figure the mountain locals as people that might threaten biodiversity (Diallo, 2015; Schuetze, 2015; Walker, 2015). Both narratives encompass inherent moral perceptions of what has been the past and should be the future of the same space (French, 2010; Neumann, 2004; Schuetze, 2015). It raises again the issue of separating people emotionally, spiritually, and physically attached to their land to protect this land from them.

4.3 A new cosmology of the natural

As far as conservation strategies are concerned, going beyond the naturalist cosmology – the western and most widespread way for humans to perceive and be in the world based on the nature/culture dichotomy (Descola, 2005) – is necessary on two levels.

The first level has been illustrated by the propensity of the GNP to emphasise community conservation (i.e., that nature cannot be protected without society playing a role). This shift in conservation agenda goes hand in hand with the emergence of a new essential scientific paradigm. It represents the first and necessary steps towards the reunification between *nature-culture* dualist categories, between the *wild* and *socialised* realms, or between ecosystems and humans-beings, when studying the production of a landscape – either through the lens of social or natural sciences. For a long time, how sciences understand and explore the world

has resulted in a naturalist perception, which postulates the uniqueness of nature on which unfolds the diversity of cultures and where only humans have subjectivity (Descola, 2005). In both his ethnographic studies of the Jivaro Achuar people (1996) and his book *Beyond Nature and Culture* (2005), Philippe Descola criticises the *naturalist cosmology* by demonstrating that *nature* is a social construct and that conceptualisations of the environment are the products of everchanging historical contexts and cultural specificities). The rejection of this dualist cosmology is already happening in specific sectors of contemporary sciences and might not only set the stage for a new kind of way to undertake conservation strategies, creating a cornerstone to enhance multidisciplinary studies, bringing together biology, ecological anthropology, environmental history, geography, and ecology, among other (West et al., 2008). But it would also imply a redefinition of traditional western cosmological and ontological categories (Berque, 2016; Descola & Palsson, 1996; Viveiros de Castro, 2014).

This desire to go beyond the *nature*/*culture* dichotomy and propose different approaches to the relationship between nature and society appears to be essential regarding the current social and ecological crisis. It could engender a consciousness of the interdependencies between humans, biotic and abiotic components of the ecosystems, and mitigate anthropologic activities that are destroying biodiversity, ecosystems, and the biosphere. These interactions have allowed history to be a continuous product of diverse modes of human-environmental relationships (Descola & Palsson, 1996).

However, naturalistic cosmology is not the only way to perceive the world around us. Based on the multiplicity of ways to see and be in the world, Descola (2005) constitutes an “ecology of relations”, i.e., a non-dualistic anthropology that does not separate human and non-human into two distinct ontological domains and highlight three other possible fundamental ontological matrices: animism, totemism and analogism. The way Gorongosans perceived and lived within the landscape of Gorongosa used not to be *naturalistic* but rather *totemistic*, where groups of humans and non-humans share interior as well as physical attributes (Descola, 2005). This local calibration creates a major difference between the conflicting narratives around the landscape of Gorongosa. As attentive and careful as it is to the inclusion of local populations in conservation efforts, the GNP should consider the link between local people from Gorongosa Mountain and their land.

5. Conclusions

This chapter gives a brief historical overview of Gorongosa’s landscapes evolution from the reconstruction of its ecosystem in the aftermath of the civil war (1977-1992) to the

community-based National Park in 2021, through the history of perceptions of the landscape during Portuguese colonisation. The blooming resurgence of the GNP's environment and communities is often quoted as a powerful example of self-reliance in rural sub-Saharan Africa. However, if the ecological restoration of Gorongosa's landscapes is underway and flourishing, it is occurring through struggles, debates, and compromises between different visions of a lost landscape – a lost fantasised wild Eden originating from a colonialist perception of nature in Africa, and a landscape representing spirits of an ancestral past. The reconstruction of livelihoods and landscapes destroyed by the war occurs at the intersection of these competing visions of the landscape's potentialities and the practices they generate (French, 2010) that are currently illustrated via the resurgences of conflicts around Mount Gorongosa landscapes.

Those conflicting visions arise from the difference between the cosmology of Gorongosans and the naturalistic cosmology through which scientists analyse the world. Conservation efforts undertaken in a naturalist understanding of humans and their environment operates as an economic sector that markets biodiversity, ecosystems, and nature as natural capital, service provider, or option value, even though the pursuit of economic gain has sponsored much of our planet's despoliation (Descola & Palsson, 1996). For conservation practices to break away from this capitalist vision and ally poverty alleviation, environmental justice with biodiversity conservation in rural sub-Saharan Africa, the understanding of nature and people as two different realms as the basis of social and natural sciences must change.

To understand both humanity and the rest of the world, a fundamentally revised division of academic labour and the disciplinary boundaries between natural and social sciences should be blurred (Descola & Palsson, 1996). There is a necessity for competencies to come together to question the scope and status of traditional knowledge and techniques of nature management, the ideological foundations of conservationist movements, and the commodification of many components of the biosphere.

Finding ways to link humans and other beings of their surroundings for them to thrive together is what the GNP Honey Project is trying to achieve.

CHAPTER 2 - A SUSTAINABLE BEEKEEPING MODEL FOR CHANGE AT GORONGOSA NATIONAL PARK, MOZAMBIQUE

1. Introduction

The increasing day-to-day challenges faced by local people in rural sub-Saharan Africa can have profound consequences for their welfare and livelihood security (Osbahr et al., 2008), as they depend mainly upon natural resources and their food system outcomes to survive (Davies et al., 2009). Over the past forty years, Mozambicans have endured disruption of their socio-political system in the aftermath of the civil war that ended in 1992 (Hatton et al., 2001; Newitt, 2017; Osbahr et al., 2008) with continued violence and a breakdown of government institution (French, 2010). In addition, the Mozambican State has abandoned many features of its state-centred economy in favour of a free-market, capitalist economy (Lunstrum, 2008). Yet, during the four decades after the cessation of hostilities, the United Nations Development Programme (UNDP) and the World Bank have consistently ranked Mozambique as one of the poorest countries in the world (Cunguara, 2012), and external agencies, international institutions, and aids have stimulated a plethora of economic reforms from the International Monetary Fund (IMF) economic adjustment to the Poverty reduction Action Plan (Castel-Branco, 2014; Hanlon, 2010; Harrison, 2000) in attempts to reduce poverty. Those reforms led to an increase in privatisation (Cramer, 2001), notably on land-use investments and natural resources (Lunstrum, 2008; Newitt, 2017), which consequently engendered crucial changes in rural livelihoods (Bleyer et al., 2016).

Furthermore, Mozambique experiences high levels of climate variability and extreme weather events (Arndt et al., 2011), such as droughts (Cunguara et al., 2011; Eriksen & Silva, 2009), wildfires (Hoffmann et al., 2009), or floods (Arnall et al., 2013; Brida et al., 2013) and events like the tropical cyclone Idai that stroke in 2019, which caused massive loss of life and vegetation damage (Charrua et al., 2021). In its Fourth Assessment Report, the Intergovernmental Panel on Climate Change (IPCC, 2007) acknowledged Africa as extremely susceptible to climate change , whose impacts affect the poorest and marginalized populations (Davies et al., 2009; M. B. Hahn et al., 2009), or those who are less likely to have contributed to the acceleration of climate change (Chanza, 2015; N. Klein, 2014; Moore, 2017; Reyes-García et al., 2021). In a country like Mozambique, where almost 70% of the population live below the poverty line, and over 80% of the poor are located in rural areas (P. Virtanen, 2005), socio-political, economic, and ecological shocks have led to a decline of farm yields over time

and left many households without sufficient food or income to meet their basic household amenities (Kimaro et al., 2013).

Therefore, political and economic turbulences, the frequent failure of past development interventions (Cunguara, 2012), the increasing environmental pressures as well as the need for adaptation to secure ecological, economic, and welfare survival have encouraged a focus on Indigenous knowledge and self-reliance community-based strategies for natural-resource dependant people (Binns & Nel, 1999; Burkey, 1993; Nel et al., 2000). Such models stimulate local employment in sectors already present in a given region, using existing human, natural and institutional resources (Gooneratne & Mbilinyi, 1992; Nel et al., 2000) and relying on local cultural values and traditions (Fonchingong & Fonjong, 2002). Whilst many Mozambicans are used to deal with variability and change within the socio-ecological systems in which they live (Arnall et al., 2013; Eriksen & Silva, 2009; Thierfelder et al., 2016), the diversified livelihoods portfolio is considered as a resilient model to face the increased pressures, to mitigate risks and to enhance adaptation and resilience (Amulen et al., 2017; Bigsten & Tengstam, 2011; Cunguara et al., 2011; Headey et al., 2014). The ability for a household to diversify into more resilient income streams and to rely on a network of various activities have been proven to spread the risks (Bryan et al., 2013; Osbahr et al., 2008) and to be contingent upon food security and poverty alleviation through ownership, control and access to key livelihood assets (Amulen et al., 2017; Bigsten & Tengstam, 2011; Kangalawe et al., 2008).

As a traditional activity in rural sub-Saharan Africa and especially in Mozambique (Crane, 1999; Illgner et al., 1998; Nel et al., 2000), beekeeping has been supported and promoted by the Mozambican government, international organisations, and NGOs as an alternative model to supplement rural income while expending farming activities (External Market Task Force, 2004; GEF Small Grants Programme, 2006; WWF, 2018). Beekeeping offers a secondary source of income (Amulen et al., 2019; Girma & Gardebroek, 2015) and an additional food source, providing nutritional and medicinal properties (Crane, 1999; Crittenden, 2011; Mesele, 2021; Zumla & Lulat, 1989). Beekeeping directly contributes to enhancing food security since it supplements farming activities by providing pollination services essential for increased crop yields (Amulen et al., 2017, 2019; Hung et al., 2018; A. Klein et al., 2007). Moreover, not only are there substantial market opportunities for beeswax, propolis, pollen, and other hives products with the potential to increase financial returns through methods of adding values and marketing (Wilson, 2006) but most importantly, there is also a growing global and domestic demand for honey (Galli, 2020) which is the foremost beekeeping primary product in amount and economic benefit (Mesele, 2021). In her market study, Galli (2020)

highlighted that Mozambique only uses roughly 5% of the country´s honey production potential" while, in 2018, the country imported 521 tonnes of honey.

As local honey producers often do not have access to markets, the honey is usually informally produced and sold on plastic bottles on the roadside. According to a market study from the Agency for Local Economic Development of Sofala (ADEL – Sofala), the main barrier for the expansion of the beekeeping industry is the lack of beekeeping groups and organisations, as local producers mainly work individually using traditional methods which yield low and inconsistent production volumes (Bush, 2010). It limits the possibility of proper packaging, labelling, and quality control to ensure that the honey meets the primary hygienic conditions required by international food safety standards. Meeting such prerequisites would make the honey suitable for both export markets and sophisticated or higher-end local markets that value local, high-quality and sustainably produces (Bush, 2010; Rodrigues, 2020).

It is, therefore, with the aim of providing opportunities to overcome these challenges and to foster local livelihoods by promoting environmentally sustainable beekeeping practices with high-income potential for smallholder farmers in an area that faced many crises, that the Honey Project was implemented in the buffer zone of the Gorongosa National Park (henceforth mentioned as GNP or the Park) in 2016. The project aims to encourage professionalisation among beekeepers, develop technical studies for expanding operations, scale-up production and processing capacity, and ensure quality control and increased marketing (Rodrigues, 2020). It provides beekeepers with intensive training and relies on beekeeping as a low-cost practice with a low-environmental impact by facilitating beekeepers' access to locally sourced long-lifespan beehives from a sustainably managed forest and local handmade bee suits (Rodrigues, 2020). The project keeps growing and by June 2021 comprised 357 beekeepers, 82 of whom were women. Beekeeping is also used to endorse gender mainstreaming and revenue for women empowerment (Gawaya, 2008; Illgner et al., 1998; Mburu et al., 2017; Pocol & McDonough, 2015).

For its economic, social, and ecological benefits, beekeeping may be seen as a perfect theoretical model of responsible, sustainable agriculture that would help people around the park cope with day-to-day challenges (Illgner et al., 1998). Yet, the study from ADEL – Sofala underlined that, in the past, many honey-related projects in Mozambique have failed because of a lack of accountability and follow-up, recommending an effective monitoring and evaluation for similar strategies in the future (Bush 2010), which is precisely what the GNP Honey Project is implementing.

The aim of this chapter is to provide such a follow-up for the GNP Honey Project. Having a baseline of where the project is at now will enable later analysis to compare and see what has been achieved or is missing, so that the Honey Project team knows where to direct their efforts. It intends to create space for further studies to compare and follow the role of beekeeping and honey production in the GNP buffer zone. This study uses a questionnaire (Annex I) displayed to 50 beekeepers throughout the buffer zone, and secondary data to analyse if the project enhances a fruitful economic and ecological diversification cycle by increasing household revenues and fostering sustainable beekeeping practices. Examining to what extent the project is participating in restoring the buffer zone's landscapes and how it impacts the different districts will allow to know which locations need to be more targeted and in which way. Through this study, beekeeping practices are assessed to understand how they can be used as a tool in response to economic, cultural, and ecological challenges faced by natural resource-dependent people in rural Mozambique.

1.1 Study area: introducing Gorongosa and its affiliation with beekeeping

Gorongosa National Park, contained within the coordinates -18°45'57.60"S, 34°30'0.00"E, is located in the southernmost portion of the Great Rift Valley, East Africa. It is situated in the geographic centre of Mozambique, in the Sofala Province, between the Zambezi and Pungwe Rivers (fig.3).The study takes place within the boundaries of the buffer zone, an area of 3,300 km² that surrounds the park and was implemented in 2011 (Beilfuss, 2006; Decreto n. 78/2010), limiting human activity near the park (Beilfuss, 2006; Walker, 2015).

1.1.1 Ideal landscapes for the development of apiculture

The diversity of the landscapes, with vast forests and woodlands and GMO-free agriculture fields where pesticides are rarely used, make this area propitious to the development of beekeeping as a subsistence and business activity. Indeed, Guy (1971) and Tinley (1977) recorded early evidence of traditional beekeeping, and recent studies highlighted the potential of the buffer zone to respond to a growing global demand for organically produced honey (External Market Task Force, 2004; Galli, 2020). These landscapes shape a variety of habitats that makes it "one of the finest wildlife ecosystems in Africa" (Hatton et al., 2001) and consist of four regions (Stalmans & Beilfuss, 2008; Tinley, 1977): the Gorongosa Mountain, Midlands, Rift Valley, and Cheringoma Plateau (fig.3). The Midlands region is covered by

mixed woodland and dry and moist miombo landscapes[6], a broad deciduous forest and woodland (Tinley, 1977). The Great Rift Valley has the greatest variety of ecosystems in the region, supported by the mosaic of different types of alluvia and the seasonal flooding of the plains (Tinley, 1977), offering an alluvial fan, the lake Urema as well as floodplain grasslands and woodland, while western miombo woodlands and forests cover the Cheringoma Plateau. In addition, this area encompasses the isolated Gorongosa Mountain, which rises to 1863m, supporting tropical to mountain rainforest, with heath grasslands on its summits (Hatton et al., 2001; Stalmans & Beilfuss, 2008). The humid tropical climate has two seasons: rainy between December and March and dry for much of the remaining time, and the average annual rainfall is around 1,000 mm, while average temperatures range between 24˚C and 26˚C (Trusen et al., 2010).

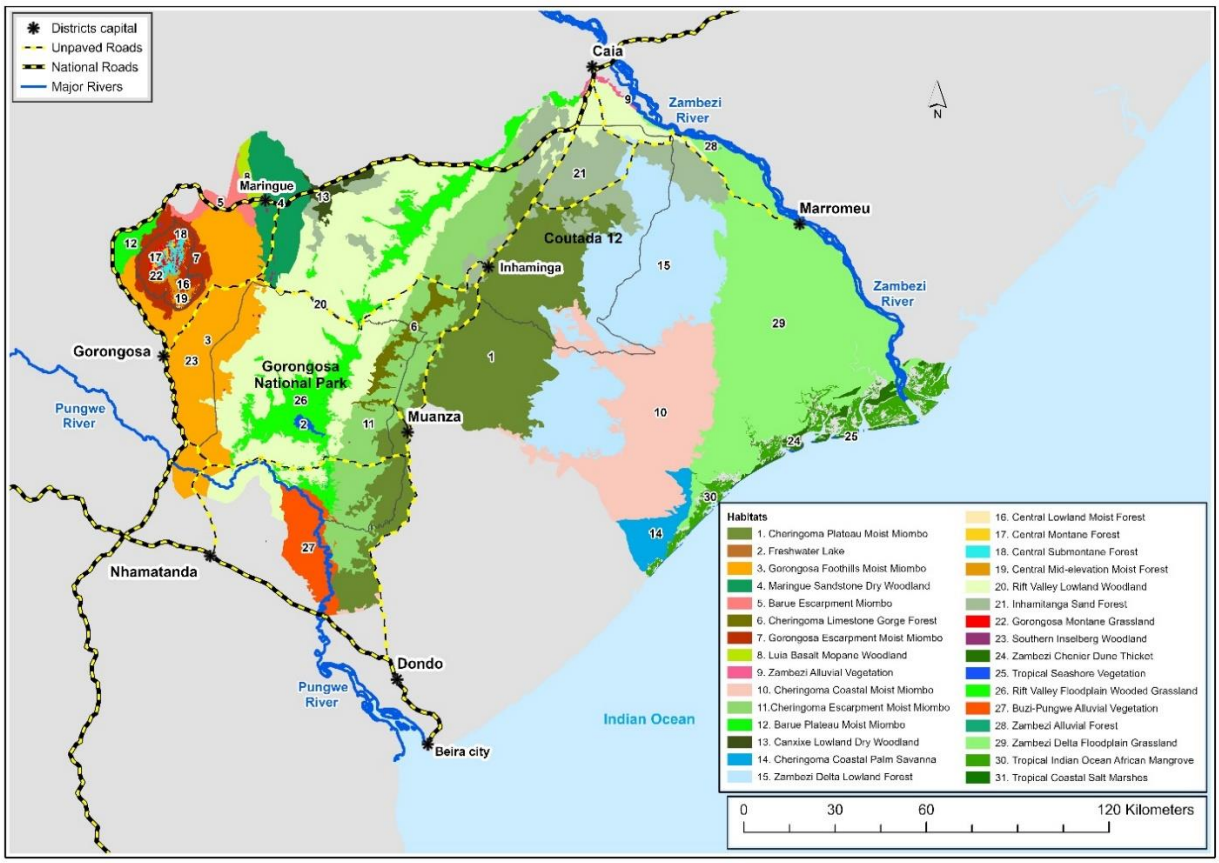

Figure 3 – types of habitat covering the GNP and its Buffer zone. The Rift Valley occupies the central position of the GNP and around. To its west is the Midlands region, from which the Gorongosa Mountain, defined by the 600m elevation contour, rises. The Cheringoma Plateau occupies the eastern part.

[6] Miombo landscapes represent tropical and subtropical grasslands, savannas, and shrublands biome. These dry forests and woodlands form a broad belt across much of southern Africa, spanning an estimated total area of around 2.7 million square kilometres – from Angola, to Tanzania and Mozambique in the east, and down to the northern edge of South Africa. Over 65 million people rely on these ecosystems for their livelihoods, as they provide resources such as fuelwood, timber, charcoal production, fruits, honey, mushrooms, medicinal plants and fodder for livestock (Evans, 2020).

Gorongosa and its inhabitants have faced many challenges. Not only did the civil war killed several thousand inhabitants (French, 2010; Robinson, 2006), destroyed infrastructure and torn apart ecosystems and wildlife (Hatton et al., 2001; Newitt, 2017; Stalmans et al., 2019). But also, its geographic location makes the area particularly vulnerable to various climatic events, such as floods, droughts, cyclones, tropical depressions in the Indian Ocean and cold southern fronts being the most frequent (Matos et al., 2021). This setting makes the area a valuable case of resilience and restoration project that focuses not only on the recovery of biodiversity but also on socio-economic development and the active participation of local communities in biodiversity conservation strategies (Matos et al., 2021).

1.1.2 Beekeeping as a traditional subsistence activity

Most of the 200,000 people living in the buffer zone live below the poverty line (Matos et al., 2021). In 2019, 30% of the households in Sofala Province were in acute food insecurity (INE, 2020) and more than 80% of the population depends on farming as a source of subsistence (Bush, 2010), hence the need to develop alternative strategies to alleviate poverty.

In 1968, a plan to promote self-reliance through beekeeping was already developed (Tinley, 1977). Beekeepers were encouraged to use the miombo system within the park because the one where beehives were usually installed was occupied by the tsetse fly, preventing its use. The aim was to draw a mutualism between people's dependence on protein supply and undamaged miombo, and the need for rural vigilance against commercial poachers that hunted wildlife and damaged forests (Tinley, 1977). It would have allowed local people to be involved in the management and conservation of the park; yet, this attempt was unsuccessful for political reasons (Tinley, 1977).

Beekeeping has been a traditional activity in the miombo savannas across Africa for centuries, and the same goes for the *Brachystegia* (miombo) woodlands around Gorongosa (Tinley, 1977). Eva Crane (1999, p. 267) quoted the African journal of Livingstone who saw hives in Angola and western Zambia in 1855/56 and it can be supposed that beekeeping was already an activity performed in Gorongosa around that time. During the 1970s, Ken Tinley (1977, p. 55) realised a full assessment of the landscapes of Gorongosa and explained that many beekeepers owned between twenty to fifty bark hives which makes this a full-time, specialist occupation. Traditional hives are made of logs and barks, made by ring barking the desired length from a large tree and hung in trees, out of the reach of children, pests, and predators (Illgner et al., 1998).

Nowadays, practices of beekeeping are evolving around the GNP. The ongoing growing demand for low quality honey led beekeepers to cut down trees (Rodrigues, 2020), which is in contradiction with the recommended land uses in the buffer zone area that were implemented to protect its ecosystems (Beilfuss, 2006). In addition, if cultivators and beekeepers used to be two distinct husbandries for they were both full-time specialised activities (Tinley, 1977), this study proves that it is not the case anymore. On the sample of beekeepers interviewed, all of them own a machamba[7], and 66% practice farming as their principal profession (carpenter, mason, motorist, or pastor were quoted among other professions). Local people in Gorongosa rely mainly on small-scale agriculture, cultivating machambas, growing mapira, maize, groundnuts, and beans, among others, even though owning a business or practising small labour jobs is also common (Matos et al., 2021).

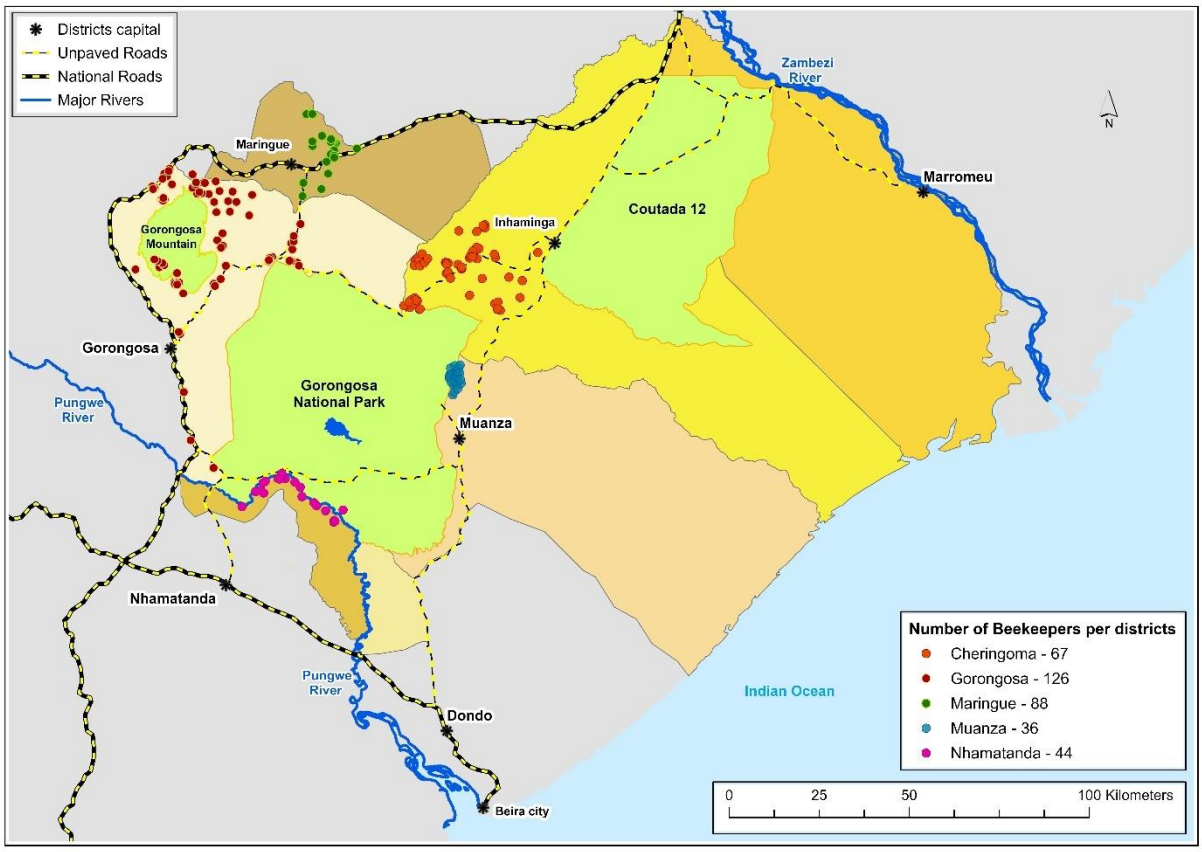

Figure 4 – Districts of the GNP buffer zone and the number of beekeepers involved in the Honey Project per district. In the Nhamantanda district, the purple dots indicate the beehive fence that goes along the Pungwe River.

[7] Machamba is a term used throughout Mozambique to refer to cultivated fields.

The assessment of the Honey Project was carried out in four of the five districts where the Honey Project is taking place: Gorongosa, Cheringoma, Maringue and Muanza (fig.4). Nhamatanda district was voluntarily omitted because of the particular features of beekeeping in this area. Indeed, in this particular district beekeeping has been enhanced by constructing beehive fences along the Pungwe River and around the communities' crops (Branco et al., 2020; Rodrigues, 2020). More than 300 beehives are used as a natural elephant deterrent[8]. They reduce crop-raiding incidents and promote human-elephant coexistence while providing additional benefits derived from the bee colonies pollinating crops and producing honey (L. E. King et al., 2017). For the other districts, the same procedures were applied.

2. Materials and methods

2.2 Data collection and sampling procedure

As a first step, focus group discussions were held with the GNP Honey Team to establish the more appropriate way to gather the following data and interact with the beekeepers. Then, a quantitative and qualitative structured questionnaire (Annex I) has been employed to collect primary data to understand the beekeepers' perception towards honey production and their environment.

The Honey Project team has displayed 50 questionnaires: 20 in Gorongosa, 10 in Maringué, 10 in Cheringoma and 10 in Muanza, which represent 14% of the total beekeepers involved in the project. The beekeepers were randomly selected from the Honey Project database, gathering all the beekeepers of the area, with the only filters being the location and a minimum number set to integrate gender balance. Ten were selected per districts, except for Gorongosa where twenty of them were interviewed as this district accounts for most of the beekeepers involved in the project (fig.4). The distribution of the survey respondents within the districts was random.

Data was collected by local members of the park's honey team who were trained and could translate the questionnaire from Portuguese to Sena, Shona or other African national languages. The beekeepers selected for each district were invited to meet with the interviewers in public places such as schools or village squares. After explaining the questionnaire's and

[8] Elephants are wary of foraging near African honey bees (*Apis mellifera scutellata*) and run away from either the sound of (L. E. King et al., 2007) or a threat of being stung by a swarm of honey bees (L. E. King et al., 2017).

research's aim to the beekeepers' group, the team spent face-to-face time (average 1 hour per questionnaire) with each beekeeper to collect their responses. Before each respondent was interviewed, consent forms were signed, and they were advised that they were free to participate or withdraw at any point during the interview. The survey was conducted over a period of two months between May and June 2021.

Secondary data collected from the parks' books, journals, reports from the *Instituto Nacional de Estatistica* (INE), among others, as well as the access to the Honey Project database complemented the findings obtained from the primary data sources and allowed to triangulate and verify the data collected from the field.

2.3 Questionnaire

The questionnaire (Annex I) is based on previous studies assessing the impacts of beekeeping activities on different populations or with other purposes (Amulen et al., 2017, 2019; Mburu et al., 2015; Wagner et al., 2019) that were redesigned and adapted to answer the specific features of this study. It was divided into four sections:

The first section comprised questions about the personal background of the person interviewed. Then, the cultural and sociological background of beekeeping practices were assessed to understand how beekeepers learned about those practices, for which reasons, and the importance they give to honey production. The objective was to identify perceptions towards women beekeepers and how communities' social structures are affected by the increasing involvement of women in this activity. It verified whether or not the Honey Project is enhancing the comprehension of beekeepers towards their environment and promoting women inclusion. The third section focused on the economic impact of beekeeping and analysed the current honey value chain, processing, marketing and selling processes and the time invested in this activity. It examined the effects of beekeeping on the income of the household. The hypothesis was that the Honey Project was promoting stakeholders' revenue during the seasonal cycle of beekeeping. Lastly, the inquiries analyse the impact of beehives on the environment (crops/landscape) and aim to understand beekeepers' ecological knowledge. It assesses if the Honey Project promotes sustainable beekeeping practices while understanding how and what could be improved.

2.4 Statistical analysis

Data entry, cleaning, and coding were done on Excel. The computation of descriptive statistics and statistical analyses was performed using the statistical software R version 4.1.0. The relationships between variables were analysed to understand what changed and evolved,

according to districts or gender, regarding the adoption or development of beekeeping by individuals. As beekeeping is more endorsed in some places than others, segregating the answer by districts allows one to analyse where the Honey Project has significant impacts, where it could focus and what could be improved in specific places.

To calculate the mean of quantitative variables, the data range of each observation was replaced by the mean value of the range. To study whether a variable varies between genders or regions, two statistical methods were used. First, the Pearson Chi-squared test of independence was performed to verify the existence of a statistical link between two qualitative variables. Then, the Fisher's exact test was applied to confirm the Chi-squared test results and was performed using the same hypothesis tests.

For both tests, the null hypothesis consisted of the non-existence of a relationship between two categorical variables, namely that a variable does not vary by gender or region. A conventional threshold of 0.05 was used. A p-value below the 0.05 threshold is considered statistically significant, and the null hypothesis of independence was rejected.

3 Results and discussion

3.1 Cultural and sociological background of beekeeping practices

This part aims to identify who is the Honey Project reaching and draw a portrait of the people involved in the project. It would allow understanding of whether the project encourages people that were not beekeepers to start this activity and if it supports experienced beekeepers. Knowing the main reasons for people to start beekeeping and the way they learn is of particular interest to developing future training. Those questions help explore and point out which potential indicators are more likely to be concomitant with beekeeping adoption.

3.1.1 Personal background

The common denominator of all the participants is their involvement in the GNP Honey Project; apart from this, they do not necessarily belong to a homogenous group with identical traditions and rules, but different communities (table 1) with specific habits, customs, and norms that vary according to factors – such as gender, social class, residence, or educational levels. Beekeepers devoted to the project are spread throughout the buffer zone; yet, some districts are more involved than others (fig.4). Currently, most beekeepers are located in Gorongosa (n=126), Maringue (n=88) and Cheringoma (n=67), while Nhamantanda (n=44) and Muanza (n=36) accounts for fewer participants. From this total population of beekeepers,

14% (n=50) have been interviewed, and most of them identify themselves as part of Sena (38%) or Duma (22%) ethnic origins; the remaining 20% did not answer the question.

Table 1- Number of all the beekeepers involved in the Honey Project, numbers and sex of individuals interviewed, and their communities by districts.

Districts	Number of participants		Communities
	Honey Project	Interviewed (male; women)	
Gorongosa	126	20 – 13; 7	Mussicadzi 2, Massala, Vunduzi, Dongama, Muera, Nhambita, Nhauriri
Maringué	88	10 – 8; 2	Nhagó, Djodjo, Nkhungué 1, Thoé
Cheringoma	67	10 – 10; 0	Nhamacaringa
Muanza	36	10 – 8; 2	Nhacamuanza, Mueredze, Chiwawa, Matenga, Nhamagaia

The beekeepers involved in the project currently encompass 23% of women (n=82) and 77% of men (n=275). The programme introduced beekeeping to 64% of the women interviewed (n=7) and to 10% of the men (n=5). When analysing the results of the proportion of women who were not beekeepers before being part of the GNP project with the proportion of men in the same situation, both the Chi-squared and Fisher tests showed a significant interaction (respectively p-value = 0.0001603 and p-value = 0.0007681, $p<0.05$), as illustrated in figure 5. This interaction can be explained in two ways: the programme's focus on the inclusion of women and the local culture and norms according to which beekeeping is traditionally a men activity (Crane, 1999; Illgner et al., 1998).

The ages of the participants indicated that beekeeping was mainly between 20 and 60 years old. When verifying the independence between age and district or age and gender, the Pearson Chi-squared test showed no significant interactions between either of them (respectively p-value = 0.8243, p-value = 0.09232; $p>0.05$).

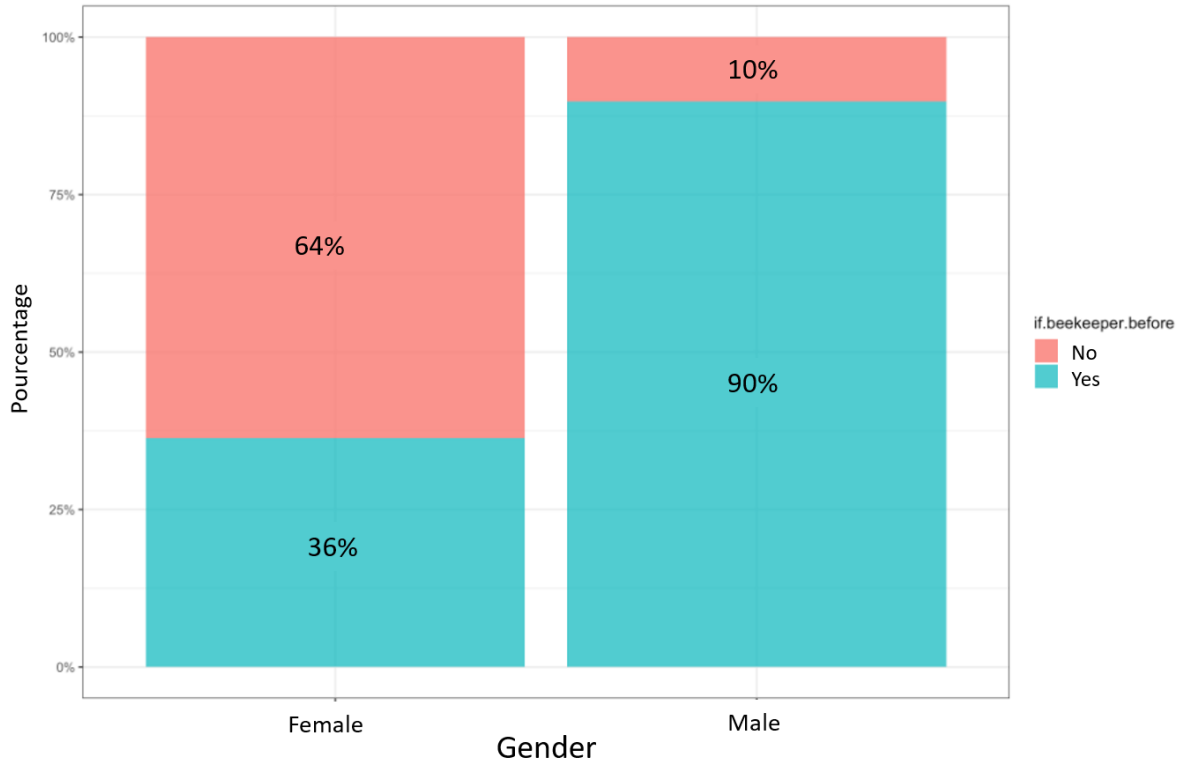

Figure 5 - Proportion of women and men who were (or not) beekeepers before being a part of the Honey Project (in %).

Education-wise, most of the participants have stopped after primary school (66%, n=33), and 28% (n=14) did not complete any educational level, while only 6% (n=3) have completed secondary school. The education level of the participants showed no dependency with the district (p-value=0.555) but was correlated with gender (fig.6), as indicated by the Chi-squared test (p-value=0.01047; $p<0.05$), and confirmed by the Fisher test (p-value=0.01885). Indeed, unequal access to education between women and men have been well documented (Gradín & Tarp, 2019b, 2019a; Roby et al., 2009) and, in rural areas of Mozambique, most of the children (40%) that cannot access education are girls (MacDonald et al., 2015; Roby et al., 2009), and, they are kept out of school to fulfil their traditional roles of household maintenance and care.

In addition, it can be observed that the proportion of women who have completed no academic level is the same as that of women with no previous beekeeping experience (fig.5 and 6). Thus, the relationship between these two variables necessitates further study to understand how they influence each other.

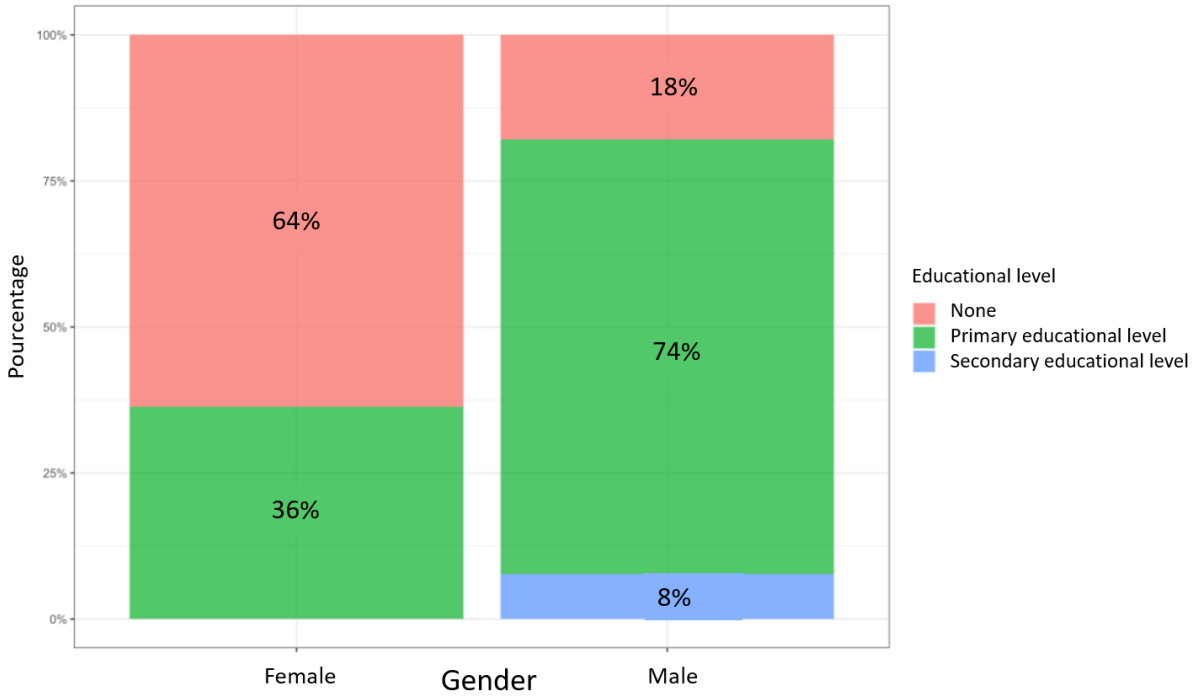

Figure 6 - Proportion of educational level of participants per gender per districts (in%).

All of the beekeepers interviewed (n=50) carry out beekeeping as a secondary activity, which differs from Tiney's observations (1977), who noted that beekeeping was a main specialised activity in this area. This evolution could be interpreted as a consequence of the civil war, which destroyed infrastructures and croplands, forcing households around the park to focus on subsidence farming rather than any types of activities to survive. The economic situation of the country in the aftermaths of the conflict was also a driver for households to reproduce conservative and risk-reducing strategies from the past to cope with resettlement and extreme natural events (droughts, fires) during the years following the General Peace Agreement of 1992 (French, 2010).

3.1.2 Farming activities

Nowadays, the Rift valley's fertile soil make maize the most cultivated crop, as it is grown by 100% of the participants. Then comes sesame with 92% (n=46) and 76% of the beekeepers (n=38) cultivate mapira (fig.7). As 12% also cultivate cashews, they could also be involved in the GNP Cashew programme since the park promotes sustainable agroforestry and distributed approximately 135 000 cashew seedlings to farmers in the buffer zone (GNP website).

These findings are in line with the observations made by French (2010), who studied the post-war cultivation practices in Gorongosa district: around five years after the end of the conflict, farmers began to incorporate more opportunistic and risky production strategies. French (2010) noted that households cautiously revived market-oriented production, principally maize, which grows on fertile pockets of soil (Tinley, 1977). Secondarily comes mapira as it withstands the occurrence of midsummer droughts and the general predominance of poor sandy soils. That is why mapira was the major crop in the 1970s; then came rice, peanuts, beans, onions, tomatoes, garlic, and other horticultural crops (Tinley, 1977).

14% of the men interviewed (n=7) mentioned practising another income-generating activity: carpenter (n=3), agricultural technician, mason, motorist or pastor, yet, all respondents owned a machamba. Indeed, in Mozambique, agriculture remains the main economic activity for most rural populations, and the country's land tenure system follows “the right of land use and benefit of land” *(Direito de Uso e Aproveitamento dos Terras*, DUAT). This law was drafted to support and protect the land rights of communities, women, and smallholder farmers while also encouraging investment by reasserting the state’s ownership of land and providing long-term or perpetual rights to land (Norfolk & Tanner, 2007). However, as they are located within the GNP buffer zone, those machamba are under specific regulation and under the park’s surveillance (Beilfuss, 2006).

In 2010, the average farm size ranged between one and two hectares, and approximately three-quarters of all agricultural holdings were less than two hectares (Ministério da a Planificação e Desenvolvimento, 2010). Those estimations correspond to the mean value of each crop’s size cultivated by the beekeepers (0.5 hectares) which is smaller than what French (2010) reported a few years after the war. He noted that the average size of machambas was two and a half hectares, with men’s machambas measuring one and a half hectares and women’s one hectare. He noticed that the amount of cultivated land varies widely depending on the amount of labour available to each household. The average production level of maize was roughly 1000 kg, half of which was used for household consumption, half available for the market.

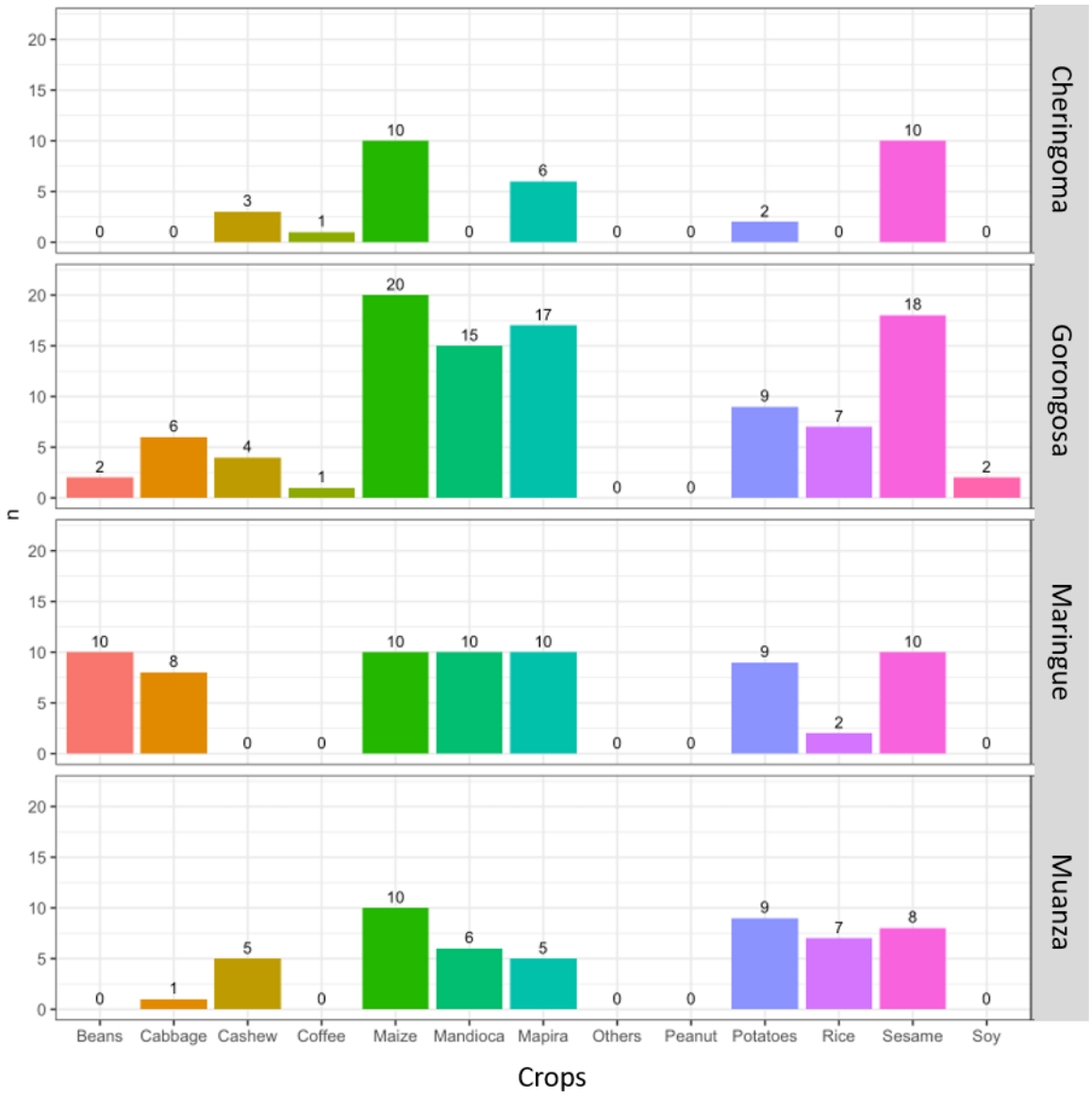

Figure 7- types of crops cultivated by respondents, per district, in number of individuals.

All of the participants own livestock mainly for personal consumption and often to sell. Chickens are reared by 100% of the respondents, and ducks, lambs, pigeons, pigs and turkeys are among the other types of cattle raised (table 2). Since nowadays beekeepers, farmers and livestock owners are not separated professions but are mainly practised together as a complement to each other, it may address some of the frictions pointed out by Tinley (1977). He noted conflicts in the 1970s between beekeepers and cultivators, as one displaced the other in the undisturbed miombo savannas. Cash crop demand was on the rise because of the population increase, which stimulated cultivators to move towards the woodlands, thus forcing the beekeepers to leave. At this time, the prevalence of the tsetse flies prevented livestock from being kept, except for rare goats (Tinley, 1977).

Table 2- types of cattle owned by beekeepers per districts, in number of individuals.

District	Chicken	Duck	Lamb	Pigeon	Porc	Turkey
Cheringoma	10	1	5	3	0	1
Gorongosa	20	4	13	4	8	0
Maringue	10	6	6	3	6	1
Muanza	10	3	1	1	0	0

3.1.3 Beekeeping experiences and learning

For the respondents, the main impetus for starting beekeeping was the source of food it provides (92%; n=46), followed shortly after by the income that the activity generates (86%, n=43), as illustrated in figure 8 –multiple reasons could be chosen. Family tradition accounted for 40% of the Muanza population to start apiculture and 10% in Gorongosa, while pollination and wax production was barely named (respectively n=3 and n=2).

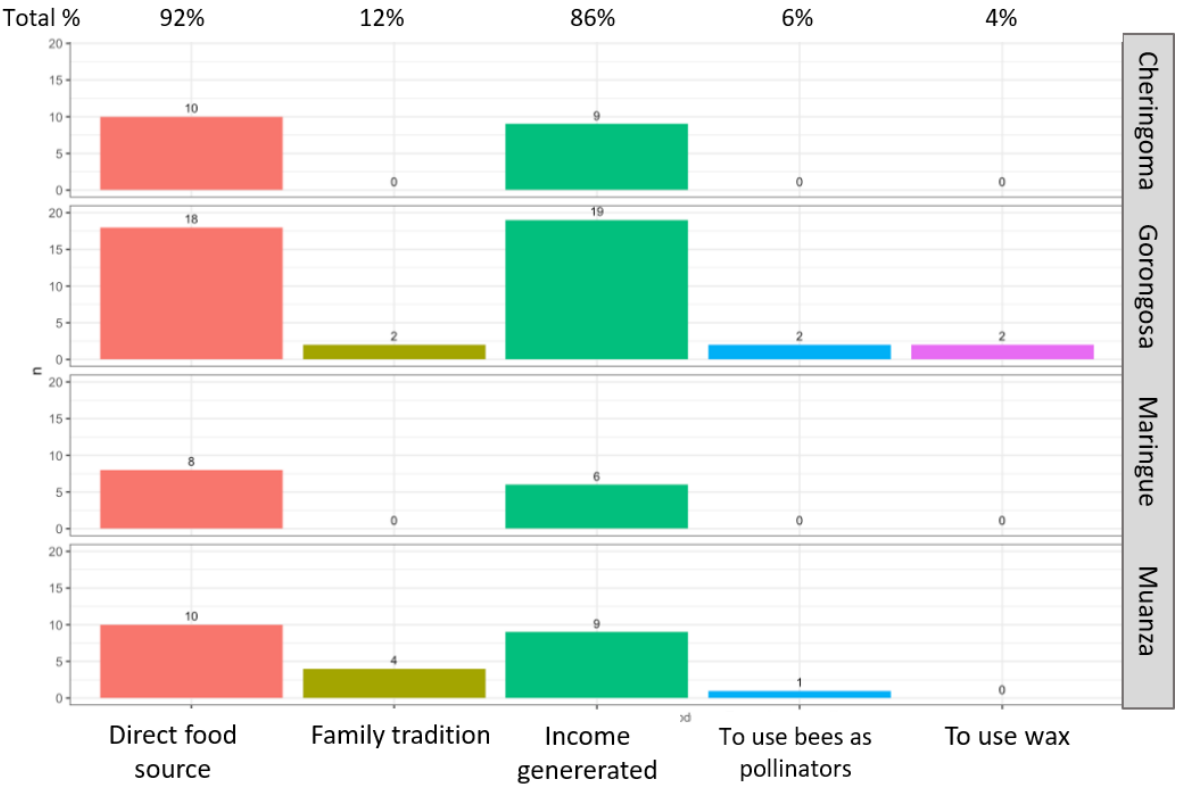

Figure 8 - Main reasons for individuals to start beekeeping activity, number of individuals per district.

From the sample of respondents in Cheringoma and Maringue districts, all were already beekeepers before starting collaborating with the Honey Project, while in Gorongosa and Muanza districts, 45% and 20% respectively started apiculture through the GNP programme. The tests performed revealed a dependence between the locations and the inclusion in the project as a starting point for beekeeping activities (p-value = 0.008 p-value = 0.005; p<0.05).

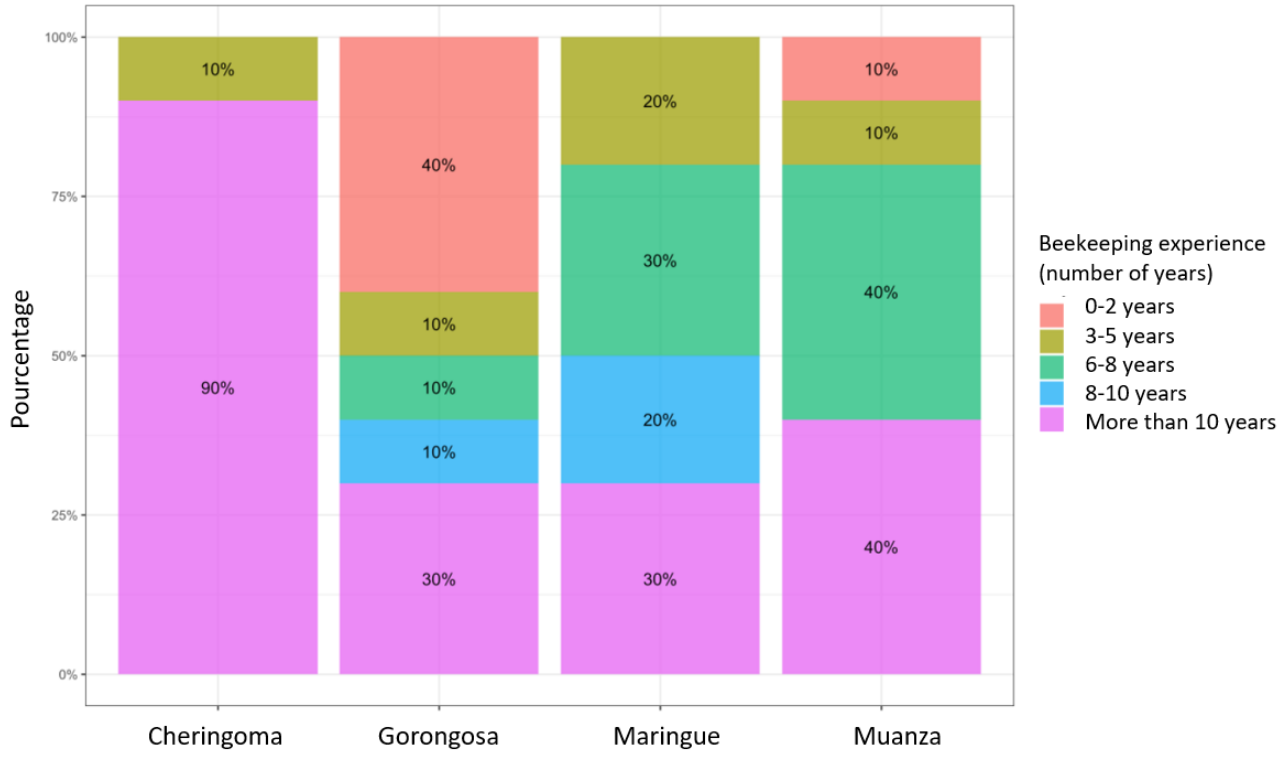

Figure 9 - proportion of respondent's beekeeping experience (in number of years) per district.

Similarly, this is supported by the number of years of beekeeping experience as it appears to be also influenced by the location (fig.9). It underlines significant differences between districts (Chi-squared test: p-value = 0.012; Fisher exact test: p-value = 0.009, p<0.05), and Cheringoma beekeepers stand out with 90% (n=9) having more than ten years of experience. Muanza followed with 40% (n=4) of the respondents with more than ten years of experience, which could be related to apiculture being a family tradition in this region. In other words, this programme shows prominent results in implementing new beekeepers.

The distinction of Cheringoma and Muanza from the two other districts could be linked to the age differences between respondents as it would be reasonable for older beekeepers to have

more experience. Indeed 40% of Cheringoma's and 60% of Meringue's beekeepers were more than 50 years old, compared to 30% or less for Gorongosa and Maringue (Annex II). Likewise, Gorongosa's respondents have the youngest population in proportion (58% are less than 40 years old) and the least experience, 40% have been practising for less than two years. From those findings it could be hypothesised that Cheringoma's beekeeping activities would be more successful than in other districts as beekeepers are more experienced than those in other districts. Yet, this interpretation will prove to be contradictory to following results.

Beekeeping was mainly learnt through people in the same household (42%; n=21) and elder relatives (44%; n=22), emphasising the importance of traditional knowledge within communities (see Annex II). Except for Maringue, where 40% (n=4) of the beekeepers had taken at least one, training course reached only one participant in each district. This could be explained by the fact that the Honey Project is relatively recent and is counting on trained beekeepers to replicate their courses within their community (Rodrigues, 2020). In Maringue and Cheringoma, private companies other than the GNP, such as ADEL – Sofala, TCT Dalmann, GTZ and Fruitimel, have also fostered apiculture by providing learning courses. TCT Dalmann, for example, is a private forest concessionaire located in Northern Cheringoma and works with local people to reforest areas that were degraded in the 1994 fires (Trusen et al., 2010). They promote beekeeping as a sustainable business activity and provide technical training on how to transition from traditional hives to Kenyan Top-Bar hives (KTB) that they manufacture to sell to the local market. Yet, 82% (n=41) of the respondents have indicated that they would like to learn more about the subject and would be willing to participate in beekeeping courses.

3.1.4 Hives

Traditionally, most hives in Mozambique, and thus in the buffer zone, are made of barks and logs. They are made by ring barking the desired length from a large tree, then hung in trees, out of the reach of children, pests, and predators (Illgner et al., 1998). Until the 1970s, clay vessels with holes were used as beehives (Dunne et al., 2021), and in 1988, there were approximately seven hundred modern hives (e.g. Langstroth), two thousand top-bar hives and more than a million traditional hives in Mozambique (Nel et al., 2000).

Within the buffer zone, the type of wood used to make traditional hives has evolved. Guy (1971) and Tinley (1977) indicated that *Brachystegia boehmii* (*Mfuti* or *Mupfuti* in Shona[9],

[9] The Shona names of common fauna and flora species were kindly provided by Marcos Bera Chova, supervisor of the Honey Project, and can be found in Annex III.

and commonly known as Prince of Wales' feathers in English), *B. spiciformis* (*Messassa*/*Msasa* in Shona; zebrawood or bean-pod tree in English), and *Julbernardia globiflora* (*Muimbe* in Shona) were particularly used. *Brachystegia boehmii* was used at any time of year, and *B. spiciformis* and *Julbernardia globifera* were employed mainly at the height of the rainy season around February (Crane, 1999). Whereas at this day, the questionnaire emphasized that if 61% of bark hives are still made of Muimbe and 7% of Messassa, while 32% came from *Sclerocarya birrea* (Mfula).

However, the removal of the bark to build traditional hives have resulted in the cut of an estimated 7000 trees every year in Gorongosa (External Market Task Force, 2004). In addition, these traditional hives are not as efficient as other types in terms of honey yield and cannot be reused (Nel & Illgner, 2004). By promoting sustainable use of environmental resources around the park, the GNP Honey Project aims to reduce the cutting of trees traditionally associated with beekeeping practices in Southern Africa (Crane, 1999; Nel & Illgner, 2004; Rodrigues, 2020). The transition is still ongoing; 48% (n=24) of the respondents reported that they still own traditional hives, including 100% of those who live in Cheringoma.

Therefore, the Honey Project provides beekeepers with other types of hives with a longer lifespan and can be low-cost sustainable products. Bush (2010) assessed that most small-scale beekeepers in Sofala Province use traditional log beehives that produce about 15 kg of honey per year, whereas Langstroth hives – stacked rectangular wooden boxes with removable frames – can produce 40 kg. Known to be really long lasting, Langstroth hives were owned by 20% (n=10) of the beekeeper's sample. Kenyan top-bar (KTB) were utilised by 90% (n=45) of the respondents and consists of a wooden box covered by a series of removable wooden slats on which bees built the honeycombs (Nel & Illgner, 2004). This type of hive is promoted in rural Sub-Saharan Africa to enhance rural development as they allow easy manipulation and are relatively cheaper than Langstroth hives, although they yield considerably lower honey (Bush, 2010; Gupta et al., 2014). Results show that, on average, beekeepers in Cheringoma have 23 hives, 10 in Gorongosa, 8.5 in Meringue and 5.5 in Muanza; beekeepers generally own multiple types of hives.

3.1.5 Perception towards women beekeepers

As highlighted earlier, there are more and more women being involved in beekeeping activities. However, since it is not an activity traditionally undertaken by women in this area of Sub-Saharan Africa (Crane, 1999), it appears necessary to monitor local people's perception of this evolution. It would help understand the room for manoeuvre that the project has and where should be its focus regarding empowering women through beekeeping. In addition, the

project was set up as part of a Community-Based Natural Resource Management (CBNRM) programme, or community conservation strategy, which is based on the idea that changes cannot and should not be pursued against the interests and wishes of local people (Adams & Hulme, 2001). Here, when analysing the relation between the respondent's perception of women inclusion in beekeeping activities and districts, there was a significant correlation (Chi-squared test: p-value = 5.969e-09; Fisher exact test: p-value = 2.202e-08). It revealed that the role of women is perceived fully as a positive change in Gorongosa, Maringue and Muanza (100%, n=40), whereas in Cheringoma, 90% (n=9) of the beekeepers interviewed saw women inclusion as a negative thing. In an open question, the main reasons for not encouraging this evolution were that women were not courageous enough or unable to pursue this activity. Moreover, it was highlighted that women do not have time because they already have a lot of housework and agriculture work to take care of.

The poor perception of Cheringoma's respondents towards women beekeepers could be related to the small number of women who have undertaken this activity in this district. In this case, proximity to women beekeepers in the social circle may influence one's opinion of them. Further studies are needed to investigate this hypothesis and other possible factors that may impact the perception towards women beekeepers.

3.2. Economic impact of beekeeping activities on beekeeper's household

This section is dedicated to the analysis of the economic effects of the project, by examining how beekeeping's revenue affect the household's income. It aims to understand the current place of beekeepers in the honey value chain. Results could help determine which roles they could and would like to take in the future processing, marketing and selling processes and the time invested in this activity. The hypothesis was that the project is promoting stakeholders' income during the seasonal cycle of beekeeping.

3.2.1 Time spent in beekeeping activities

Beekeeping offers a way for small-scale farmers to diversify their income, which is why it has been promoted to enhance rural livelihoods (Amulen et al., 2017; Carroll & Kinsella, 2013). Being an activity that requires a low amount of time besides routine maintenance, honey extraction, and hive construction (Nel & Illgner, 2004), beekeeping is an accessible activity to supplement farming. Unlike Tinley (1977) reported fifty years ago, it does not require any more full-time dedication from the beekeepers.

The honey production is seasonal, and Tinley (1977) noted that around Gorongosa, the harvest is mainly in autumn and early winter. There are commonly two harvests per year in

Sofala, from February to April and October to December (Bush, 2010). The harvesting season varies from district to district and among beekeepers (Table 3). The results highlight that the period of the year with the highest occupation is between September to November, particularly for Cheringoma (n=9) and Gorongosa (n=18). The time and products harvested by hives depend notably on harvesting techniques, which vary among beekeepers based on the type of equipment used and the level of knowledge.

Table 3 - Period of the year with the highest occupation for the beekeepers, in number of individuals per districts.

Districts	Dec - Jan - Feb	June - July - Aug	March - April - May	Sept – Oct - Nov
Cheringoma	0	5	0	9
Gorongosa	9	13	0	18
Maringue	3	1	1	5
Muanza	2	1	5	2
Total	**14**	**20**	**6**	**34**

3.2.2 Material, marketing, and technical *assistance*

The Honey Project offers technical assistance that seems to be gladly accepted as 100% of participants in Gorongosa, Mauanza and Cheringoma ask regularly (more than once a year) for help to the technician in charge of their area. The Chi-squared test and the Fisher exact test revealed a dependence between the demand for technical assistance and the districts (p-value = 0.003; and p-value = 0.004; $p<0.05$). The only districts where beekeepers did not declare the need for any help was Muanza (33% of no). To extract honey from combs, the most frequently employed technique is manual draining; it is used by 90% (n=45) of the sample of beekeepers. Only in Muanza, another method was mentioned (n=3), which is a third-party processing facility.

The majority of beekeepers in Sofala operate individually or in small informal groups (Bush, 2010; Charrua et al., 2021). Indeed, most participants, except for 11% of Gorongosa (see Annex II), usually sell honey alone rather than in a group. The respondents did not sell in groups because it would attract bandits or they already have their families that help with the sale. Yet, more than half would like to be part of a marketing group (fig.10). The main reasons were the will to gain time and facilitate transportation to the market, increasing the value of the products in the eyes of the consumers, thus enhancing financial return. That is what the Honey Project is implementing by buying raw honey in combs directly to beekeepers at a prime price to be processed, bottled and labelled in the GNP facilities in Vila Goronogosa. The park then serves as a central retailer for the sale of honey in domestic markets, ensuring that beekeepers

are not dependent on market fluctuations and provide more earnings than when the honey is sold in bulk in informal markets.

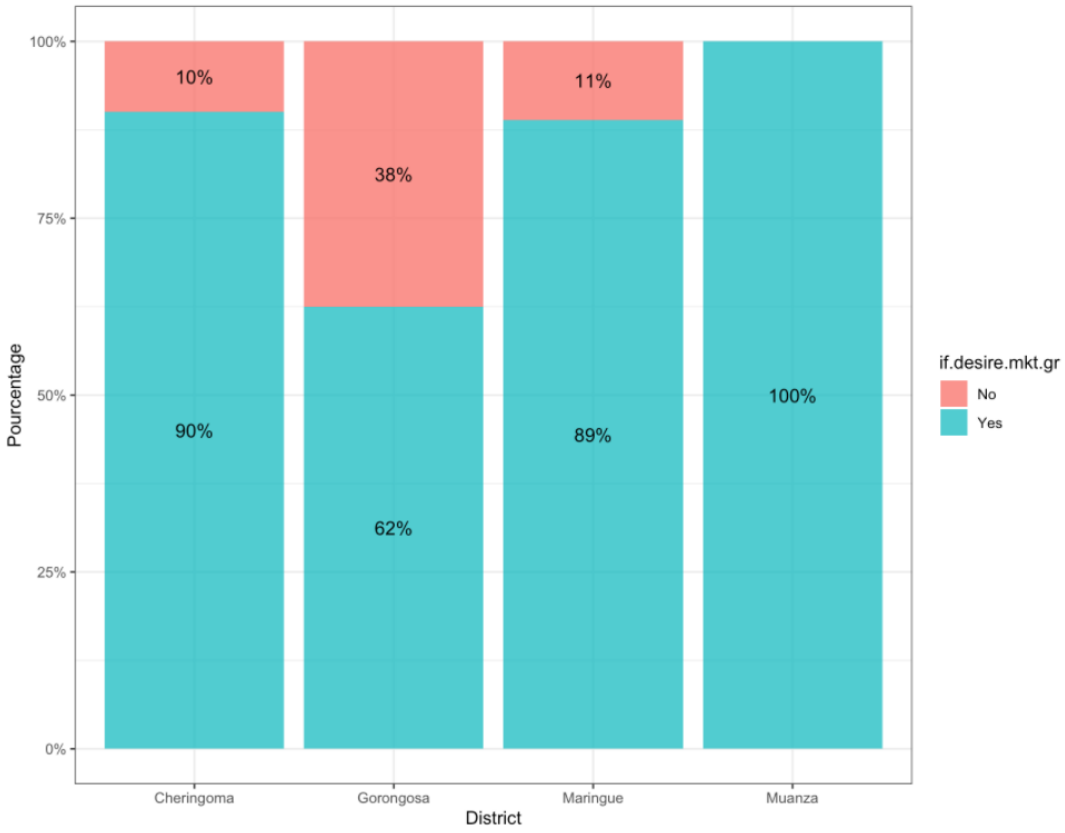

Figure 10 - proportion of respondents' answers (yes/no) regarding their desire to be part of a selling group per districts.

3.2.3 Household revenues from beekeeping activities

More than half of the questions about the quantity of honey, the price, and the total beekeeping-generated revenue were not answered for Muanza and Maringue. Table 4 displays the recorded average values and an increase of the total beekeeping-generated income in Gorongosa, Cheringoma and Maringue, while the quantity of honey sold decreases in Gorongosa and Cheringoma. However, it must be regarded cautiously considering that in Muanza only four individuals addressed the question and three in Maringue. This lack of answers could be explained by the difficulty of communication arising from translation issues while displaying the questionnaires. Another reason could be the informal economy and market that can lead to a less accurate total account of the amount of quantity sold and of money earned.

Table 4 - Average of the quantity of honey sold in 2019 and 2020 (L), average of the price to which honey was sold in 2019 and 2020 (MZN/L), average of the total beekeeping generated income in 2019 and 2020 (MZN).

Districts	Gorongosa	Cheringoma	Muanza	Maringue
Quantity of honey sold in 2019 (L)	33.6	27.7	2.5	31.6
Quantity of honey sold in 2020 (L)	24.5	22	4	60
Price 2019 (MZN/L)	80	60	60	40
Price 2020 (MZN/L)	87.5	60	60	40
Total revenue 2019 (MZN)	1911	1791.6	125	2166.6
Total revenue 2020 (MZN)	1812.5	1820.8	125	3500

Yet, if the numbers gathered are not representative of the reality; statistical tests of independence exposed that the percentage of beekeeping-generated income compared to the overall household income were dependant on the districts (Chi-squared test: p-value = 0.025; Fisher exact test: p-value = 0.007; <0.05). Gorongosa is where the revenue earned from beekeeping activities constituted the smallest portion of the overall household income, with 61% of the respondents for whom it accounted for less than 10% (fig.11). In Cheringoma, 88% acknowledged that it represented less than 30% of their overall income. In Maringue, the answers were different and, whilst 30% mentioned earning less than 10% of their revenue through beekeeping, 10% said it accounted for more than 70% of the overall household revenue.

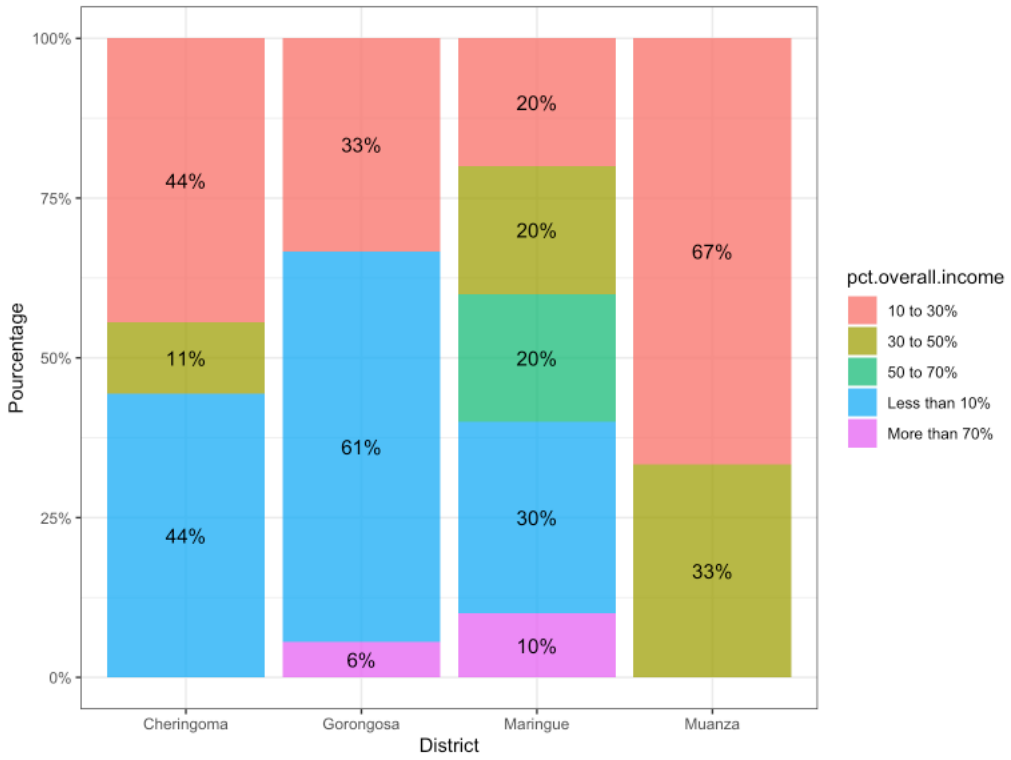

Figure 11 - Percentage of beekeeping-generated income compared to the overall household income per districts.

The beekeepers mentioned three main ways of how the income earned from beekeeping is spent: 74% (n=37) was spent it on expenses for the household, 44% (n=22) went to buy food and 16% mentioned reinvesting in agriculture. Buying clothes could be included in expenses for the family and stands for 16% as well. The percentage of the overall income reinvested in beekeeping is less than 10% for more than half (66.7%) of the beekeepers interviewed. The results of the percentage of the income reinvested in beekeeping showed no dependence with the different districts (p-value = 0.4362; >0.05), or with gender (p-value = 0.3913; >0.05); locations and gender does not influence the investment of beekeepers in this activity.

3.3 Beekeeper's ecological knowledge and environmental effect on the buffer zone's landscapes

Bees and landscapes are interdependent (FAO, 2020b). Analysing how beekeepers perceive their environment and the effects of beekeeping upon it, would allow a better understanding of their practices and their sustainability. It helps to draw up an overview of what beekeepers have implemented and what remains to be done in this regard. By exploring

the ecological knowledge and the socio-ecological of the beekeepers throughout the buffer zone, the interconnection dynamics between them and the ecosystems facing climatic and environmental events can be better understood (Matos et al., 2021), as people's environmental knowledge is reflected in how they understand, utilise, and protect nature (Turner, 2011). Within social systems, knowledge, experience, and practice of managing an ecosystem and its services are stored among a group of people, modified and transmitted over time, thus ensuring information sharing by community members (Barthel et al., 2010). Scientific understanding of the relationship between landscape composition, farming practices, and pollination services is increasing rapidly (IPBES, 2017). However, the perceptions, knowledge base, and the way beekeepers make natural resource management decisions based on traditional practices and the influence of the park need to be further investigate (Breeze et al., 2019).

3.3.1 Landscape alteration

Beekeeping is a discipline that is strongly linked to and impacted by its surroundings, from the presence of pests and/or of melliferous plants availability in the vicinity of the hives, to extreme weather events such as drought, cyclones or fires (Charrua et al., 2021; Chikodzi & Tembani, 2021; Vercelli et al., 2021). In turn, beekeeping also greatly contributes to changes in the environment not only due to bee's pollination activities (Aslan et al., 2016; A. Klein et al., 2007), but also through the activities undertaken by the beekeepers (Decourtye et al., 2010; Tinley, 1977) to harvest the honey, or to maintain adequate nectar and pollen resources.

For example, beekeepers used to be major culprits in setting fires around the park in the autumn (Tinley, 1977). Indeed, in the 1970s, beehive smokers, usually made of a batch of greens and partially dry grass were abandoned after being alighted, setting then fires to the miombo. To prevent improper bee smoking practices to engender fire hazards, the project is providing modern beehive smokers.

According to the sample of beekeepers interviewed, such practice does not happen anymore. Indeed, when asked if they had already altered the landscape to increase the revenue of the household, there were 29 *yes* and 14 *no*. More than 90% of Muanza's and Cheringoma's respondents have undergone alternations. All of those changes in the landscape were reforestation with native trees, and the "other" section comported one type of response: "not cutting trees, no fire" (table 5).

Table 5 - landscape alteration per districts per individuals/

Districts	Setting fire	Cutting trees	Reforesting with native trees	Other
Cheringoma	0	0	10	2
Gorongosa	0	0	6	0
Maringue	0	0	5	0
Muanza	0	0	10	1
Total	**0**	**0**	**31**	**3**

One reason to justify this change would be that, the use of appropriate beekeeping equipment given by the park is contributing to reduce the cutting of trees for bark and log hives construction and from fire hazards initiated by smoking beehives. However, the number of traditional beehives still used mentioned earlier contradicts this statement, thus requiring further investigation. Socio-ecological traditions of the local people would be another reason for the active reforestation by the beekeepers. Indeed, in ethnographic research that examine how traditional knowledge and local beliefs on biodiversity conservation relates to the local ability to be resilient in front of climatic changes in communities around the GNP, Matos *et al.* (2021) reported that those communities carried out practices and believes linked to conservation. They were protecting trees and animal species considered sacred or beneficial to humans, which could explain the high reforestation rate.

In addition, the decision of hives placement was based not only on easy access and the presence of water in the vicinity but also on the proximity to specific flowering wild plants (table 6) and other crops species. Among the crop species, maize, mapira, sunflower, sweet potato, banana, and sesame appeared to be of particular interest. It allows bees to have flower resources nearby while using their pollination service to improve crop yields. Similarly, to ensure feeding when not enough flowers resources are available, 26% of the participants provided plant fodder crops (see Annex II).

Table 6 - scientific and local names of plant species near which the respondents mentioned installing their hives.

Scientific name	Local names
Acacia negrescens	Ncunghu
Acacia robusta	Nsadzi
Adansonia digitata	Mulambe, imbondeiro
Brachystegia spiciformes	Messassa

Cissus integrifolia	N'tamba
Julbernadia globiflora	Muimbe
Kigelia africana	Nvunguti
Pericopsis angolensis	Chiuanga
Philenoptera violacea	Mphacassa
Philenoptera violacea	Npacassa
Ziziphus mauritiana	Nsau
Ziziphus mucronata	Mutchatchane

3.3.2 Perception towards bees' benefits to landscapes and humans

In an open question, the interviewed beekeepers were requested to give their opinion in which way apiculture is beneficial for the environment. Plant pollination and the importance of the relation between bees and trees represented 94% (n=47) of the answers.

The same question was asked to find out what benefits for the community are attributed to bees. Among the answers were the production of honey, wax, and propolis both to consume and sell. Nature conservation, reforestation, plant pollination and better agricultural production were also mentioned. Additionally, they noted the ability of the beehives to scare elephants. Indeed these large mammals are wary of foraging near bees and run away from either the sound of (L. E. King et al., 2007) or a threat of being stung by a swarm of honey bees (L. E. King et al., 2017). As elephants sometimes live the boundary of the park to feed on the nearby farms, they damage crops of small-scale farmers, usually people depending on their crop yields to survive. To prevent such elephant raids, the GNP has settled more than 300 beehives as fences around the ongoing crops (Rodrigues, 2020).

According to the respondents, beekeeping represents opportunities as it offers a source of earning (n=43) and food (n=31), pollinates plants (n=37), and promotes women inclusion (n=10) (table 7). The other answers stipulated that beekeeping is good for the environment.

Table 7- reasons why beekeeping represents opportunities, number of individuals per district

Districts	Source of food	Source of earnings	Plant pollination	Women inclusion	Others
Cheringoma	10	10	10	1	3
Gorongosa	12	17	14	4	0
Maringue	1	7	3	1	1
Muanza	8	9	10	4	0
Total	**31**	**43**	**37**	**10**	**4**

The respondents' perception of the opportunities and benefits provided by apiculture seems to align with values of landscape restoration and conservation and human-wildlife coexistence promoted by the GNP Honey Project. Then, to make beekeeping a viable, accessible and fully sustainable activity, it is necessary to analyse the challenges encountered and what can be developed or implemented to address them.

3.3.3 Challenges and foresight

Gorongosa National Park and its buffer zone are particularly vulnerable to various climatic events, such as floods, droughts, cyclones, tropical depressions in the Indian Ocean and cold southern fronts (Matos et al., 2021). For example, the tropical cyclone Idai that stroke in 2019 generated a massive live loss, vegetation damage (Charrua et al., 2021) and destroyed homes and infrastructures throughout Mozambique. In Manica, the adjacent province west of Sofala, an assessment of the harms caused by the cyclone underlined that the massive winds caused trees to fall and destroyed many hives within their vicinity (Mukomana, 2019). The destruction of means of subsistence, belongings, food storage, along with beekeeping equipment's made the resumption of beekeeping nearly impossible without external imputes in these rural livelihoods (Chikodzi & Tembani, 2021; Mukomana, 2019). As Sofala province was impacted the same way by the cyclone, it can be argued that a similar situation occurred.

Moreover, droughts have stimulated sustained fires, resulting in severe damages to the ecosystems, such as the forest ecosystem of Cheringoma that have been heavily burned during the 1994 drought (Trusen *et al.*, 2010). Fire frequency around the park has increased in the post-war years (Eby et al., 2014; Gaynor et al., 2021), which can be a consequence of both climate change (Midgley & Bond, 2015) and more local anthropogenic actions over the landscape. Not only can fires be set accidentally, as mentioned previously, but it has also long been used as a land management tool by local people in the buffer zone (as in most rural sub-Saharan regions). It is traditionally used to prepare agricultural fields, prevent bush

encroachment, improve quality and quantity of forage, maintain biodiversity, and reduce future fire risk (Archibald, 2016; Gaynor et al., 2021; Zubkova et al., 2019). As in other savanna systems, fire plays also an essential role in maintaining a diverse mammal community in Gorongosa (Gaynor et al., 2021) but can endanger people's livelihoods, livestock and wildlife when uncontrolled and persistent (Muala, 2015).

Almost all of the respondents (91.75%) observed the occurrence of more extreme weather events in the past five years (see Annex II). In Cheringoma, all the beekeepers interviewed have faced consequences of cyclones, heavy rains and uncontrolled fires. In the other districts, fires were mentioned by less than half of the participants. Cyclones and strong rains also affected all of the respondents in Muanza (n=10) and 85% (n=17) of those in Gorongosa. Such weather patterns have resulted in some degree of apiaries degradation. The Chi-squared and the Fisher exact tests demonstrated a dependence between hives caused by weather events and the districts (table 8). Those extreme meteorological phenomena all contributed to some extent of apiaries degradation in every area, except in Maringue, where cyclone did not destroy their hives (even though half of the respondents (n=5) noticed their occurrences).

Table 8- proportion of individuals who responded that extreme weather events (cyclones, strong raining and fires) caused apiaries' deterioration per district, p-values of Chi-squared and Fisher test, all <0.05 showing dependence between districts and the alteration of hives due to those events.

Districts	**Cyclones** (% of yes)	**Strong raining** (% of yes)	**Fires** (% of yes)
Cheringoma	28.6	24.7	57.1
Gorongosa	35.7	34.5	7.1
Maringue	0	10.3	28.6
Muanza	35.7	31	7.1
p-value (Chi-squared, Fisher test)	0.0002; 7.679e-05	0.0397; 0.0336	0.028; 0.033

In addition to those weather hazards, most of the respondents in Muanza, Maringue and Cheringoma faced challenges due to a shortage of beekeeping materials, compared to only three individuals confronted with the same issue in Gorongosa. Muanza and Cheringoma also particularly endure death or reduction of honeybee colonies due to natural events. Beekeepers of Cheringoma stood out because all of them mentioned lacking skills and adequate support, time to take care of the apiaries, inadequate access to finance and

beekeeping inputs, and processing, packaging and marketing problems. The lack of water and the presence of thieves were also mentioned.

In this view, the challenges mentioned above and extreme weather phenomena could discourage carrying on beekeeping activities (Budhathoki et al., 2020; Cunningham et al., 2002; Wagner et al., 2019). Yet, all Gorongosa's and Cheringoma's respondents and most of those in Muanza (78%) expressed that they were not likely to be demotivated by them. The statistical independence tests indicated that the location of the respondent influences a potential future discouragement in pursuing apiculture activities (Chi-squared test: p-value = 2.62e-07; Fisher exact test: p-value = 4.757e-08; $p<0.05$). In Cheringoma, all the participants that addressed this question (n=8) stated that it could. This observation is consistent with the high number of challenges they appeared to be confronted with, compared to the other districts. Similarly, all of them observed more extreme weather events in the last five years. A high proportion indicated that those events have already participated in the destruction of their apiaries; thus, inevitably leading to an abandonment of the activity as they cannot afford reparation.

The respondents' needs to enhance their beekeeping practices consisted mainly of more beekeeping materials, adequate support, and technical assistance (table 9). The other demands regarded especially specific equipment such as beekeeping suits and beehives smokers, and propolis for the colonies Gorongosa and Cheringoma. Cheringoma's respondents also express the need to defend their apiaries, which can be linked to thieves in the area.

Table 9 - Future needs expressed by the respondents, number per individual per districts

Districts	Beekeeping materials	Skills and adequate support	Others
Cheringoma	10	9	7
Gorongosa	5	0	3
Maringue	5	5	0
Muanza	9	1	0

All the respondents of Cheringoma, Maringue and Munza have some specific needs to enhance their beekeeping activities, while 67% of those in Gorongosa stated that they do not, which emphasises a dependence between the location and the need – or not – of help (Chi-

squared test: p-value = 1.67e-05; Fisher test: p-value = 7.701e-06; p<0,05). The fact that Gorongosa stands out could be because the Honey Project initially started in this district, and consequently, it might have already furnished the required materials, support and assistance to ensure resilience and adaptation from beekeepers in this area. If this hypothesis is correct, it would further demonstrate that the Honey Project is establishing self-reliant beekeeping practices; therefore, more studies about the resilience of Gorongosa beekeepers are needed.

4 Conclusions

This chapter offers a follow-up of what has been achieved by the Honey Project since 2016 in the GNP buffer zone. It demonstrates that the programme has successively implement a way towards self-reliance as far as beekeeping activities are concerned; yet, its impact on household's livelihoods will require other studies to be fully explored.

The analysis of the cultural and sociological background of the beekeepers underlined that the project mainly contained men who were already beekeepers and is working on encompassing more women – mostly novice as it is not in the customary traditions for women to practice apiculture. In addition, the inclusion of women in beekeeping activities mainly was well perceived, except in Cheringoma, where none of the respondents were women. Data of economic impacts on the project beneficiaries' households appeared to be too limited and not consistent enough to prove whether or not the project enhances a fruitful economic cycle by increasing household revenues. Further studies need to be carried out in this regard.

However, this assessment demonstrates that the Honey Project enhances ecological diversification by fostering existing sustainable beekeeping practices carried out to supplement small-scale farming. Beekeepers are agents of change within ecosystems and use apiculture activities to increase and complete their farming livelihoods. Significant differences among districts were raised, notably regarding the challenges faced. Cheringoma stood out as a region where the local population's involvement in beekeeping is more precarious and uncertain than other districts, even though they were the most experienced. In contrast, Gorongosa's beekeepers seemed to be more resilient in their beekeeping practice, requiring less help from the GNP, although they have more recently started apiculture activities – notably with the project's impetus. This finding highlights the prominent actions of the Honey Programme in successfully implementing beekeeping techniques and call for closer attention to Cheringoma.

However, this study was limited by the number of people and translations involved. It increased the probability of misunderstanding and misinterpretation and might have led to a

lack of regularity and uniformity in formulating questions and answers of the questionnaires during the interview. In addition, even though this study would not have been possible without the great help of the GNP Honey team to display the questionnaires due to the language barrier, and time and mobility constraints for me to go on the field, this involvement of the team can have led to bias in the answers. Indeed, it is important to notice the relations of power at stake and the Honey team represents the institutional agents of the Park, for and with whom the beekeepers are working. Therefore, such relationships can influence what was told or not told during the interviews, with the beekeepers possibly sharing what they think the interviewers want to hear, which could also explain why certain questions were left without answers.

Then, it would have been better that que questionnaire were displayed by a non-biased agent to better understand the impacts of the Honey Program. Also, more questionnaires should have been displayed, and the survey could have comprised non-beneficiaries' beekeepers or non-beekeepers as a control group to carry out a comparison. This was not possible to implement in this study due to technical reasons and limited time.

Those results can serve as a baseline for further studies to compare and follow beekeeping's and honey production's role in the GNP buffer zone, as well as to monitor the global impact of women inclusion in rural livelihoods.

CHAPTER 3 - AN INCLUSIVE BEEKEEPING MODEL TO ENHANCE WOMEN EMPOWERMENT IN RURAL AREAS IN MOZAMBIQUE

1. Leading the way towards future research

Results from the previous chapter provided an overview of the ongoing beekeeping project undertaken in the Gorongosa National Park (henceforth GNP or "the park") in the centre of Mozambique. These results call for further investigations, particularly on the impacts of the existing model for women's inclusion in the districts under study. In 2016, as part of its efforts to conserve ecosystems while enhancing local livelihoods in the buffer zone area, the GNP launched a Honey Project to build an inclusive and sustainable business model based on the development of beekeeping activities. In all dimensions of its organisation, the park emphasises women's inclusion, and it is a major concern for the Honey team that the programme also reaches women and participates in their empowerment, hence the need for an appraisal of its current impacts.

This conclusive chapter emphasises the need to analyse how beekeeping is used to answer social, economic and ecological challenges women face in rural areas surrounding GNP. As the Honey Project is now five years old, the assessment of its model and its effects in women's lives is necessary. However, inconsistency and unreliability of data gathered about its financial effects prevented demonstrating whether the programme has enhanced a fruitful economic cycle for women beneficiaries. Therefore, it mainly affects gender norms' evolution and women's socio-economic conditions that could be monitored with results from chapter 2.

On the GNP level, it will allow the creation of a baseline for future comparison about the role of beekeeping in women empowerment and develop forecasts for the future of the GNP project. Cross-disciplinary studies on a more global level, combining perspectives of rural financial inclusion, would contribute to analysing the benefits societies acquire through enhancing women inclusion in rural livelihoods.

2. Gender norms in rural sub-Saharan African societies

For every human society that has emerged throughout time and places, unwritten rules that affect and regulate human actions have emerged (Bicchieri, 2005; Cislaghi & Heise, 2020). Shared within a given society or group, social norms refer to the rules that define what is considered normal and acceptable behaviour for the group members (Cislaghi & Heise, 2018, 2020), acting like a defined frame for their actions. Among others, social norms dictate gender roles which apportion power, resources, and functions, such as the allocation of labour across household activities according to whether a person or practice is perceived as male or female, masculine or feminine (Arora, 2015; Cislaghi & Heise, 2020; Ridgeway & Correll, 2004; Sikod, 2007).

Yet, w*omen* do not refer to a homogenous and unified group with identical problems. They come from countries with diverse historical experience and, within each country, issues vary according to other factors – such as social class, ethnicity, residence, tribe, or educational levels; yet, the common denominator of women in most of the societies is their subordinate status (Anunobi, 2002). Most existing gender systems are deeply hierarchical (Cislaghi & Heise, 2020) and privilege what is perceived as masculine over what is seen as feminine (Chollet, 2018; Heise et al., 2019). Those norms have contributed – and still are – to widening inequalities among men and women worldwide. This gender-based classification of practices has socio-economic repercussions in all spheres of the societies and women's daily lives intra- and extra-household and leads to major inequalities. The United Nations Development Programme Gender Social Norms Index (UNDP, 2020), which evaluates how social beliefs obstruct gender equality in politics, work, and education, reports that close to 90% of women and men hold some bias against women.

Women, in some of the diverse sub-Saharan African rural and agrarian societies, particularly experience a disproportionate burden of work as not only do they bear much of the responsibility for production, preservation, and preparation of food, and a disproportionate share of domestic labour obligations, but they also account for an increasing share of wage labour (Anunobi, 2002; Arnfred, 1988; Arora, 2015; Lastarria-Cornhiel et al., 2014; Sender et al., 2006; Sikod, 2007; Wodon & Blackden, 2006). Bearing in mind that gender roles are highly diverse across sub-Saharan African cultures, Arora and Rada (2017) explain that household duties and children and elderly persons' care remain the women's responsibility even though both husband and wife work together on farmlands to produce food and cash crops. Not only do rural African women work long hours, but their work is gruelling. Besides performing most of the backbreaking work of processing grains and carrying heavy loads on their heads to fetch water, firewood, and produces, they also use basic tools, expanding the physical difficulty of

the task by hand (Arora, 2015; Quisumbing & Pandolfelli, 2010). In addition to bearing many responsibilities, undertaking arduous activities, and multitasking, which can have consequences upon one's physical and mental health (Arora & Rada, 2017; Barrett & Browne, 1994; M. Virtanen et al., 2012), Arora (2015) demonstrated that rural women tend to work more intensively than men in Mozambique, in East-southern Africa.

3. Mozambique: a puzzling case

Mozambique appears to be a puzzling case regarding women's status in society's realms (Arora & Rada, 2017). Current gender norms in Mozambique are – in a very simplified manner – the products of the traditions of the Bantu people (Newitt, 2017), with the "influence of Muslim settlers along the coast" (Gradín & Tarp, 2019a, p. 181) and a legacy of the western imperialism through Portuguese colonization (Anunobi, 2002; Gradín & Tarp, 2019a). They were recently reshaped by independence and civil wars, FRELIMO's socialist policies, and economic structural adjustments imposed by international development agencies (Anunobi, 2002; Hanlon, 2010; Tvedten, 2012). Mozambican culture is predominantly male-dominated (Gradín & Tarp, 2019a), and traditionally, local people's cultures in Mozambique and around Gorongosa National Park are founded on a patrilineal system of lineage and polygyny (Igreja, 2003b). The family is the fundamental unity of the society and, in patrilineage kinship, an individual's family membership derives from their father's lineage. In addition, marriages are traditionally arranged by paying a bride price and suppose that a wife belongs to her husband (Igreja, 2001, 2003b). These social norms regulate the inheritance of property, rights, and names related through male kin; thus, affecting women access to land and other productive resources (Gawaya, 2008).

However, while Mozambican women are particularly well represented in politics, with 41 per cent of the seats in the Parliament in 2019, its Human Development Index and Gender Inequality Index[10], based on health, empowerment, and labour market index, are among the lowest in the world (UNDP, 2021). Despite the crucial role played by rural women in the country's development, their status does not reflect their contribution. Indeed, most of Mozambique's agricultural production is deeply dependent on smallholder farmers, with 95 per cent of this production relying on about 3.2 million smallholders (FAO, 2020a). According to the National Statistics Institute of Mozambique, the agricultural sector is responsible for 90 percent of women's employment, compared with 69 percent for men (INE, 2020). If, during the last two decades, the country has recorded strong economic growth, it is not inclusive since 70 percent of the 28 million inhabitants reside in rural areas (Egger et al., 2020; FAO, 2020a;

[10] Both ranked 181 out of 189 in 2019 (UNDP, 2021)

M. Virtanen et al., 2012), areas which encompass 80 percent of the people living below the poverty line (Baez Ramirez et al., 2018).

Under those circumstances, women empowerment and the enhancement of their life conditions and self-reliance capacities would not only contribute significantly to overcoming society and food production problems (Anunobi, 2002, p. 43), but it would also foster rural development by promoting a more inclusive growth (FAO, 2020a; Gradín & Tarp, 2019a; Wodon & Blackden, 2006). Mozambican women have not passively accepted the inequalities they face, and many grassroots self-help groups have been formed, often by poor and peasant women (Anunobi, 2002; Arnfred, 1988; PLAAS, 2020; UN Women, 2017). Yet, to overcome gender stereotypes and discrimination and to gain greater influence and participation on social, economic, environmental, and political issues, the government, along with development agencies, donors, and NGOs, have actively embraced the implementation of Inclusion Business Models to achieve self-reliance (FAO, 2020a; German et al., 2020; R. Hahn, 2012; Likoko & Kini, 2017; Ménard & Vellema, 2020; Norese et al., 2021).

4. Building sustainable and inclusive business models

To enhance the compatibility between agri-business expansion and rural livelihoods, *Inclusive Businesses* engage vulnerable, small-scale stakeholders to integrate them into agri-business value chains, to whom affordable and accessible services are provided (German et al., 2020; Norese et al., 2021). In the light of the deep interconnection and reciprocal influence between social issues and the ongoing ecological crisis activities (Brockington et al., 2008; Castel-Branco, 2014; Ceballos et al., 2015; N. Klein, 2015; Marques, 2020a; Ripple et al., 2017), beekeeping has emerged as a tool that reunites the environment and societies for them to bloom together. Inclusive Beekeeping Models pave the way towards an inclusive growth path that does not leave women or the environment behind (Devkoda, 2020; Gradín & Tarp, 2019a; Gring-Pemble & Perilla, 2020; Norese et al., 2021; Tutuba et al., 2019).

In 2019, the German Corporation for International Cooperation (GIZ) underlined the huge potential of beekeeping and pollination business models in the Beira Corridor – Manica and Sofala provinces (Galli, 2020). In Mozambique, as a traditional activity (Crane, 1999; Guy, 1971; Tinley, 1977) that requires a low amount of time (Nel & Illgner, 2004), beekeeping is an accessible way for women to acquire social, financial, and nutritional assets, without requiring land ownership or significant capital investment (Mburu et al., 2017; Pocol & McDonough, 2015). Even though beekeeping is not perceived as a female activity by traditional Mozambican gender norms, it can increase women's community participation and agency in the place where it is carried out (Pocol & McDonough, 2015; Shackleton et al., 2011).

Therefore, this activity can be used as a tool to endorse gender mainstreaming and women empowerment (Gawaya, 2008; Kimaro et al., 2013; Mburu et al., 2017; Pocol & McDonough, 2015; Wolff & Gomes, 2015). Therefore, the Mozambican government, international agencies, donors and NGOs have promoted beekeeping as an Ecological-Inclusive Business Model throughout the country (External Market Task Force, 2004; GEF Small Grants Programme, 2006; WWF, 2018).

FINAL CONSIDERATIONS

This thesis demonstrates the potential of inclusive community-based beekeeping models to enhance rural livelihoods and promote women inclusion. Self-reliance in rural livelihoods is crucial to alleviate poverty and answer economic challenges while addressing the ongoing climate crisis and protecting biodiversity. (Brockington & Duffy, 2010; Ceballos et al., 2015; N. Klein, 2014; Massarella et al., 2021).

The Honey Project is recent and an overview of its current impacts was needed to monitor its evolution and to draw baselines for the future. Beekeeping models present potentials to answer economic, social and environmental challenges but further analyses and continuous follow-up will ensure that their potential is fully exploited.

In this case-study, it has been proven that the project implements a way towards self-reliance in beekeeping activities with success – even though answers and challenges were district specific, underlining the need for a closer focus on Cheringoma. However, this study was limited by the low number of questionnaires distributed and the possible misinterpretations of several questions due to language barrier and the implication of the Honey Project team in displaying the questionnaires, which might have biased some of the answers given by the beekeepers.

Lastly, following the first chapter's highlights, the ambivalence of relying on building green growth models to alleviate the global biodiversity and climate crisis – that have been triggered by the growth-driven capitalist economy – needs to be highlighted. Even though sustainable models and programmes implemented in the Park appeared to be working locally to improve livelihoods conditions of peoples, landscapes and wildlife, it seems to lead to a deadlock in terms of global biodiversity protection and climate mitigation. Indeed, the financing of the Park relies heavily on capitalist investors and revenue from tourists coming from the other side of the world. To mitigate the sixth mass extinction event (Ceballos et al., 2015; Newbold et al., 2015; Pimm et al., 2014; UN Environment, 2019) and environmental crisis, more sustainable and inclusive models that does not rely on economic growth need to be studied and implemented worldwide to pave ways for *nature* and societies to bloom together (Gorz, 1994; Marques, 2020b; Meadows & Randers, 2004; Moore, 2017).

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ANNEX I

Questionnaire: GNP's beekeepers' perspectives towards conservation

Sustainable Development Department (SDD)- PNG

INFORMATION FOR INTERVIEWEES In order to guarantee the anonymity of the information, your name will not be registered or used. Personal data or data that can identify you will not be shared. The data provided will be analysed anonymously and the results of the survey will be shared in an aggregated and anonymous way.

Your participation is completely voluntary and you can refuse to participate or withdraw at any time.

Sign (in the case of a questionnaire with interviewer):

_____

1. I was informed about the nature of the study, its purpose, its duration and what is expected of me:

☐ Yes
☐ No

2. I agree to participate in the study:

☐ Yes
☐ No

3. I understand that participation in the study is voluntary and that I can withdraw at any time without giving a reason for this decision and without it having any influence on the form of further treatment.

☐ Yes
☐ No

PERSONAL BACKGROUND

1. District: _____
2. Community: _____

3. Which ethnic group do you identify with? _____

4. Sex:

☐ Male ☐ Female ☐ Third gender/non binary ☐ Other or prefer not to say

5. Age:

☐<20 ☐20-30 ☐31-40 ☐41-50 ☐51-60 ☐ >60

6. Marital status:

☐ Single ☐ Married ☐ Others: specify please_____
If married, how many spouses do you have? _____

7. Number of children:

☐<2 ☐2-5 ☐ 6-10 ☐>10

8. What is your latest and completed educational level?

☐ None
☐ Primary education level
☐ Secondary education level
☐ Higher education level
☐ Other, please specify: _____

9. Do you have a principal profession? ☐ Yes ☐ No

If yes, what is it? _____

10. Are you part of the PNG SSD Honey Project?

☐ Yes ☐ No

11. If yes, in which year have you started to collaborate with the Honey Project? _____
And who is the technician from the project in charge in your area? _____

12. Were you a beekeeper before starting to collaborate with the project? ☐ Yes ☐ No

CULTURAL AND SOCIOLOGICAL BACKGROUND OF BEEKEEPING PRACTICES

1. For how many years have you been working as a beekeeper?

☐ 0-2 years ☐ 3-5 years ☐ 6-8 years ☐ 8-10 years ☐ More than 10 years

2. Besides you, how many people in your household work in beekeeping?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ More than 3

3. If so, who else does? ☐ Wife/Husband ☐ Son ☐ Daughter

Other (specify): _____

4. Why did you start working as a beekeeper? (allow multiple answers)

☐ Family tradition ☐ Direct food source ☐ For the income generated by the products ☐ To use bees as pollinators ☐ to use wax ☐ As defence against elephants ☐ Hobby

☐ Others, please specify _____

5. Where did you learn beekeeping from? (allow multiple answers)

☐ By word of mouth ☐From someone in your household ☐ From other beekeepers
☐ From a training course ☐ From elder relatives

6. If you have taken a training course, who provided it?

_____

7. Do you have the need to learn more by taking training courses? ☐ No ☐ Yes

8. Are you part of a beekeeping association or group?

☐ No ☐ Yes, specify: _____

9. Do you have any other income generating activity besides beekeeping?

☐ Yes ☐ No

10. If yes, which ones? (you can tick multiples answers)

☐ Unemployed ☐ Farmer ☐ Own business ☐ Private Sector ☐ Other Small Labor ☐ Taking care of children ☐ Others: _____

11. Do you own a "machamba"/crop field? ☐ Yes ☐ No

12. If yes, which crops do you grow? (you can tick multiple answers)

☐ Cashew ☐ Mandioca ☐ Maize ☐ Mapira ☐ Coffee ☐ Potatoes ☐ Beans ☐ Rice ☐ Cabbage ☐ Soy ☐ Other fruits ☐ Sesame
☐ Others, please specify:_____

13. And for the crop you are growing, could you indicate the crop field size?

Crop types	Crop field size (area m2/ha)
Cashew	
Mandioca	
Maize	
Mapira	
Coffee	
Potatoes	
Beans	
Rice	

Cabbage	
Soy	
Other fruits	
Sesame	
Other	

14. Regarding cattle, which animals do you own?

☐ Chicken ☐ Duck ☐ Lamb ☐ Turkey ☐ Pigeon ☐ Sheep

15. How many beehives do you have?

☐1-5 ☐6-10 ☐11-20 ☐21-50 ☐>50

16. What type of hives do you usually use?

☐ Langstroth hives ☐ Traditional log hives ☐ Kenyan top bar hives

☐Others: _____

If you use log-hives, how many per year do you set-up?

☐1-5 ☐6-10 ☐11-15 ☐>16

17. What kind of wood you use to make the hives?

☐ Messassa ☐ Umbila ☐ Muimbe ☐ Mfula

18. How is beekeeping important source of livelihood to you?

☐ Elephant deterrent ☐ Income ☐ Food ☐ Preservative ☐ Medicine

☐ Others: _____

19. In your opinion, are there male/female roles in apiculture? ☐ Yes ☐ No

20. If yes, which tasks are more usually done by women (put an 'M')? And which ones are done by men (put an 'H')? If you do not see a difference, you can put both 'M' and 'H'.

Cleaning the apiaries	
Construction of new hives	
Management of apiary	
Repairing hives	
Colony transfer	
Queen breeding	
Harvesting honey	
Packaging the honey in containers	
Selling the honey	

21. Do you think this feminine/masculine division of labour can change in the next ten years?

☐ Yes ☐ No

Why? _____

22. How do you see the role of women in apiculture?

☐ As a positive thing ☐ As a negative thing

23. If you choose negative, why? (you can tick multiple answers)

☐ Women should not do the same work as men.
☐ Women role is in to take care of the family.
☐ Women are not capable of doing beekeeping.
☐ The income should come from men.
☐ Beekeeping can endanger women.
☐ Other: _____

24. Do you know any women in beekeeping? ☐ Yes ☐ No

If yes, who? (allow multiple answers)

☐ Close relative (wife(s), daughter(s))
☐ Relatives (mother/grandmother/cousins)
☐ Neighbours
☐ Others, (specify) _____

ECONOMICAL IMPACT OF BEEKEEPING

25. In your opinion, does beekeeping contribute to the improvement of the following conditions? Yes or no? And could you order them, 1 being the one that seem of greater importance to prioritise to you?

Conditions	Yes/No	Rank
Economic condition	☐ Yes ☐ No	
Social condition	☐ Yes ☐ No	
Sustainability/ecological condition	☐ Yes ☐ No	

26. In which time of the year do you have the highest beehives occupation?

☐ December - January - February ☐ March - April - May ☐ June - July - August ☐ September - October - November

27. How many hours of work a day does it approximatively represent?

☐ Less than 1 hour ☐ 1-2 hours ☐ 2-4 hours ☐ 4-6 hours ☐ 6-8 hours ☐ More than 8 hours

28. In which time of the year do you have the lowest beehives occupation?

☐ December - January - February ☐ March - April - May ☐June - July - August ☐September - October - November

29. How many hours of work a week does it approximatively represent?

☐ Less than 1 hour ☐ 1-2 hours ☐ 2-4 hours ☐ 4-6 hours ☐ 6-8 hours ☐ More than 8 hours

30. In which time of the year do you harvest the honey? (you can tick multiple answer)

☐ January ☐ February ☐ March ☐ April ☐ May ☐ June ☐ July ☐ August ☐ September ☐ October ☐ November ☐ December

31. Are you a member of a beekeeping association? ☐ Yes ☐ No

If yes, could you specify the name?

32. How do you extract honey from the combs?

☐ Manual draining (without extractor)

☐ At group / association / own facility, using extractor

☐ Third-party processing facility, using extractor

☐ At group / association / own facility, using pressure

☐ Third-party processing facility, using pressure

☐ Other, specify: _____

33. How do you store honey after extraction?

☐ Do not store (sell combs to processing facility)

☐ In plastic containers at home/own facility

☐ In aluminium containers at home/own facility

☐ In plastic containers at group facility but separate from other producers' honey

☐ In plastic containers at group facility blended with honey from other producers

☐ In aluminium containers at group facility but separate from other producers' honey

☐ In aluminium containers at group facility blended with honey from other producers

☐Other, specify: _____

34. How do you use the honey you harvest? (multiple answers allowed)

☐ For my own consumption ☐ To create alcoholic drink ☐To sell it ☐To trade it ☐ Others: _____

35. If you trade it, which products would you accept in exchange of honey? (multiple answers allowed)

☐ Types of vegetables ☐ Fruits ☐ Animal products (meat, eggs) ☐ Types of materials ☐ Tools ☐ Alcohol ☐ Others: _____

36. For the products you sell, how many hours do you spend on processing and marketing?

☐ Less than 1 hour ☐ 1-2 hours ☐ 2-4 hours ☐ 4-6 hours ☐ 6-8 hours

☐ More than 8 hours

37. Are you part of a honey marketing group? ☐ No ☐ Yes

If yes, which one? _____

If not, would you like to be? ☐ No ☐Yes

38. Why? _____

39. Which kind of equipment do you use? (multiple answers allowed)

☐ Smoker ☐ Harvesting protective clothing gear ☐ Modern hives ☐ None

40. How did you acquire these materials? (multiple answers allowed)

☐ Bought it ☐ Built it myself ☐ Giving it to me by other beekeepers ☐ Provided by an association, specify which one: _____

41. Do you sometimes ask for technical assistance? ☐ No ☐ Yes

42. If yes, from whom? _____

43. And how often a year?

☐ Less than 3 times ☐ 3 to 5 times ☐ 5 to 10 times ☐ More than 10

44. How much liquid honey did you sell in the last two years and what was the average price?

Year	46.1 Quantity sold (Kg)	46.2 Price (MZN/kg)	46.3 Revenue (MZN)
a. 2020			
b. 2019			

How much comb honey did you sell in the last two years and what was the average price?

Year	4.6.1 Quantity sold (Kg)	4.6.2 Price (MZN/kg)	4.6.3 Revenue (MZN)
a. 2020			
b. 2019			

Do you sell your honey individually or in a group?

☐ Individually ☐ In a group, please specify, _____

45. Who do you sell your honey to?

☐ Consumers at the market

☐ Consumers on the roadway

☐ Producer / beekeeping association

☐ Processing facility

☐ Broker / agent

☐ Trader

☐ Distributor

☐ Other, specify _____

46. Which percentage of the overall income of the household does the beekeeping activity represents?

☐ Less than 10% ☐ 10 to 30% ☐ 30 to 50% ☐ 50 to 70% ☐ More than 70%

47. What do you spend this income for? (multiple answers allowed)

☐ Buying food ☐ Expenses for the family ☐ Investing in agriculture ☐ Investing in beekeeping
☐ Others, specify: _____

48. From the general income of the household, which percentage do you invest in beekeeping activities?

☐ Less than 10% ☐ 10 to 30% ☐ 30 to 50% ☐ 50 to 70% ☐ More than 70%

ECOLOGICAL IMPACT OF BEEKEEPING

49. Could you name the species of bees you work with?

_____
_____

50. Which names do you usually use to refer to these bees?

Common English names	Shona, Sena names
Cape Honey bees	
East African lowland honey bee	
Stingless bee	
Others	

51. In which types of trees do you encounter stingless bees? Could you name the three more common ones?

52. How did you decide of the hives location? (multiple answers allowed)

☐ Easy access
☐ Near to water points
☐ Near specific kinds of flowers, specify which one: _____
☐ Near specific crops, specify which one: _____
☐ To protect from elephants
☐ Randomly
☐ Others: _____

53. In your opinion, in which ways bees benefit nature?

_____
_____

54. In your opinion, which are the benefits that human communities can derive from bees?

_____
_____

55. What do you do to ensure feeding when there are not enough flowers for the bees?

☐ Supplement feeds ☐ Plant fodder crops ☐ Other: _____

56. If some of your hives are located near a farming site, did you notice any difference on the crops before and after the implementation of the hives?

☐ No ☐ Yes

57. If yes, which main differences have you observed? (multiple answers allowed)

☐ More farming production ☐ Less farming production
☐ More wild plants ☐ Less wild plants
☐ Better product quality ☐ Worst product quality
☐ Others: _____

58. Have you observed changes on the wild plant growth around the hives?

☐ No ☐ Yes, which ones: _____

59. Have you ever changed the landscape in order to increase the income of your household?

☐ No ☐ Yes

60. If yes, which kind of alteration have you already proceeded to do? (multiple answers allowed)

☐ Cutting trees ☐ Using fire ☐ Reforesting with native trees ☐ Others, specify _____

61. And, do you think your perception towards these methods have changed since you have been using beekeeping as a source of income?

☐ No ☐ Yes

62. If yes, could you develop in which ways and why?

_____
_____

63. In the last 5 years, do you think you have experienced more extreme natural events than previously?

☐ No ☐ Yes

64. Which types of events? (multiple answers allowed)

☐ Cyclones ☐ Strong raining ☐ Uncontrolled fires ☐ Others: _____

65. Did any of those events affect your apiaries?

Cyclones: ☐ No ☐ Yes
Strong raining: ☐ No ☐ Yes
Uncontrolled fire: ☐ No ☐ Yes
Others: _____

66. Do you feel natural events can demotivate you from continuing beekeeping?

☐ No ☐ Yes

67. Which the main challenges have you been facing to develop your beekeeping activities? (multiple answers allowed)

☐ shortage of beekeeping materials
☐ lack of skill and adequate support
☐ lack of time to take care of the apiaries
☐ inadequate access to finance and beekeeping inputs
☐ honeybee predators and disease
☐ death or reduction of honeybee colonies due to natural events (drought, cyclone, fire, …)
☐ processing, packaging and marketing problem
☐ others: _____

68. For you, in which ways does beekeeping represent opportunities? (multiple answers allowed)

☐ a supplementary source of earnings
☐ a source of food
☐ women inclusion
☐ plant pollination
☐ others: _____

69. Do you have any specific needs that would help you enhance your beekeeping activities?

☐ No ☐ Yes

70. If yes, which one?

☐ beekeeping materials
☐ skills and adequate support
☐ others: _____

ANNEX II

Statistical analysis, in order of appearance in the second chapter.

Chi-squared and Fisher exact tests of the proportion of respondents who were beekeepers before being part of the project, per gender

```
##
##  Pearson's Chi-squared test
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## X-squared = 14.247, df = 1, p-value = 0.0001603
```

```
##
##  Fisher's Exact Test for Count Data
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## p-value = 0.0007681
## alternative hypothesis: true odds ratio is not equal to 1
## 95 percent confidence interval:
##    2.413819 102.981891
## sample estimates:
## odds ratio
##   14.03405
```

Chi-squared and Fisher exact tests of the ages per district

```
##
##  Pearson's Chi-squared test
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## X-squared = 12.43, df = 18, p-value = 0.8243
```

```
##
##  Fisher's Exact Test for Count Data
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## p-value = 0.8596
## alternative hypothesis: two.sided
```

Chi-squared and Fisher exact tests of the ages per gender

```
##
##  Pearson's Chi-squared test
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## X-squared = 10.875, df = 6, p-value = 0.09232
```

```
##
##  Fisher's Exact Test for Count Data
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## p-value = 0.1314
## alternative hypothesis: two.sided
```

Chi-squared and Fisher exact tests of the educational level per districts

```
##
##  Pearson's Chi-squared test
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## X-squared = 4.9134, df = 6, p-value = 0.555
```

```
##
##  Fisher's Exact Test for Count Data
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## p-value = 0.3982
## alternative hypothesis: two.sided
```

Chi-squared and Fisher exact tests of the educational level per gender

---

```
##
##  Pearson's Chi-squared test
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## X-squared = 9.1192, df = 2, p-value = 0.01047
```

```
##
##  Fisher's Exact Test for Count Data
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## p-value = 0.01885
## alternative hypothesis: two.sided
```

Chi-squared and Fisher exact tests of the proportion of respondents who were beekeepers before being part of the project, per gender

```
##
##  Pearson's Chi-squared test
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## X-squared = 11.83, df = 3, p-value = 0.007989
```

```
##
##  Fisher's Exact Test for Count Data
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## p-value = 0.005172
## alternative hypothesis: two.sided
```

Chi-squared and Fisher exact tests of years of experience in beekeeping per district

```
##
##  Pearson's Chi-squared test
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## X-squared = 25.682, df = 12, p-value = 0.0119
```

```
##
##  Fisher's Exact Test for Count Data
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## p-value = 0.009147
## alternative hypothesis: two.sided
```

Size of cultivated cropland per respondents in hectares

ID	Mandioca	Maize	Mapira	Coffee	Potatoes	Beans	Rice	Cabbage	Sesame	Peanut
1	0.25	0.75	0.25						0.75	
2	0.25	0.75		0.25	0.25			0.25		
3		4	0.75					0.25		2.5
4	0.25	0.75	0.75						0.5	
5	0.25	0.5	0.25				0.25	0.25	0.5	0.25
6	0.25	2.5	2.5				0.25	0.25	2.5	
7	0.25	0.25	0.25							
8		0.5	0.5		0.25	0.25	0.25	0.25	0.5	0.25
9	0.25	0.5	0.75		0.25	0.25	0.25	0.25	0.5	0.25
10	0.5	0.5	0.75		0.25	0.25		0.25	0.5	0.25
11		0.5	0.75						0.75	
12		0.5	0.25						0.25	
13		2.5	0.25		0.25				0.75	
14		4							0.5	
15		7	0.25			0.75		0.25	0.5	
16		0.5							0.25	
17		0.75							0.75	
18		0.5	0.25		0.25				0.5	
19		7	0.25						0.5	
20		0.75							0.75	
21	0.75	0.5	0.5			0.25	0.25			0.75
22	0.25	0.75	0.75		0.25	0.25	0.75	0.75	0.75	0.25
23	0.25	0.5	0.75		0.25	0.25		0.75	0.75	0.25
24	0.25	0.5	0.75			0.25			0.75	0.25
25	0.25	0.5	0.5		0.25	0.25		0.25	2.5	0.25
26	0.25	0.5	0.5		0.25	0.75	0.25	0.25	0.5	0.75
27	0.25	0.75	0.75		0.25	0.25		0.25	0.75	0.75
28	0.25	0.5	2.5		0.25	0.25		0.25	0.5	0.25
29	0.25	0.75	0.75		0.25	0.25		0.25	0.5	0.25
30	0.25	0.5	0.75		0.25	0.25		0.25	0.5	0.25
31	0.25	0.5	0.75		0.25	0.25	0.5	0.5	0.75	0.25
32	0.25	0.75	0.75		0.25		0.25		0.25	0.25
33	0.25	0.5	0.75		0.25					0.25
34	0.25	0.75			0.25		0.25			0.25
35	0.25	0.75	0.75		0.25		0.25		0.25	0.25
36		0.75			0.25		0.25		0.75	
37		0.75			0.25				0.75	
38		0.5	0.25		0.25				0.5	
39	0.25	0.75					0.25		0.75	
40		0.5			0.25				0.25	
41		0.75	0.75						0.5	
42		0.75				0.75			0.75	
43	0.25	0.5	0.75		0.25			0.25	0.75	0.25
44	2.5	2.5	0.25						2.5	0.25
45		0.75	0.75						0.75	0.25
46	0.25	2.5	0.75		0.25			0.25	4	0.25
47		0.5	0.75		0.5				0.75	0.75
48	0.25	0.75	0.25			0.25			0.75	
49	0.5	0.5	0.25		0.25		0.25		0.5	0.5
50	0.25	4	0.25		0.25	0.25			2.5	0.25
Total_mean	0.35833333	1.215	0.6474359	0.25	0.25892857	0.33333333	0.30357143	0.31578947	0.83522727	0.41666667

Fig II – 1. Ways throughout which beekeeping practices were taught, per districts

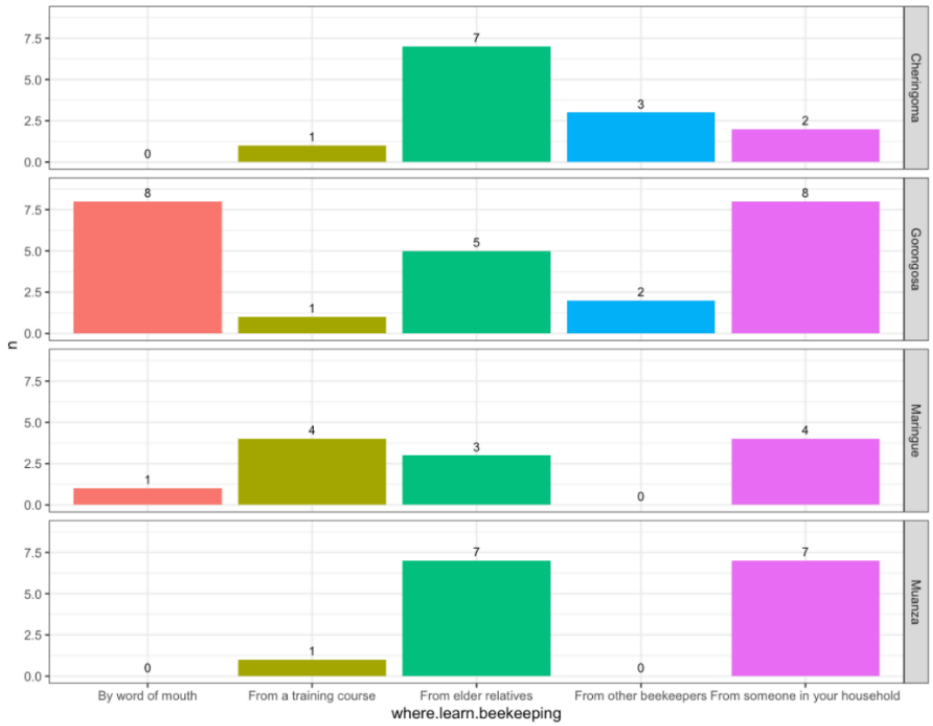
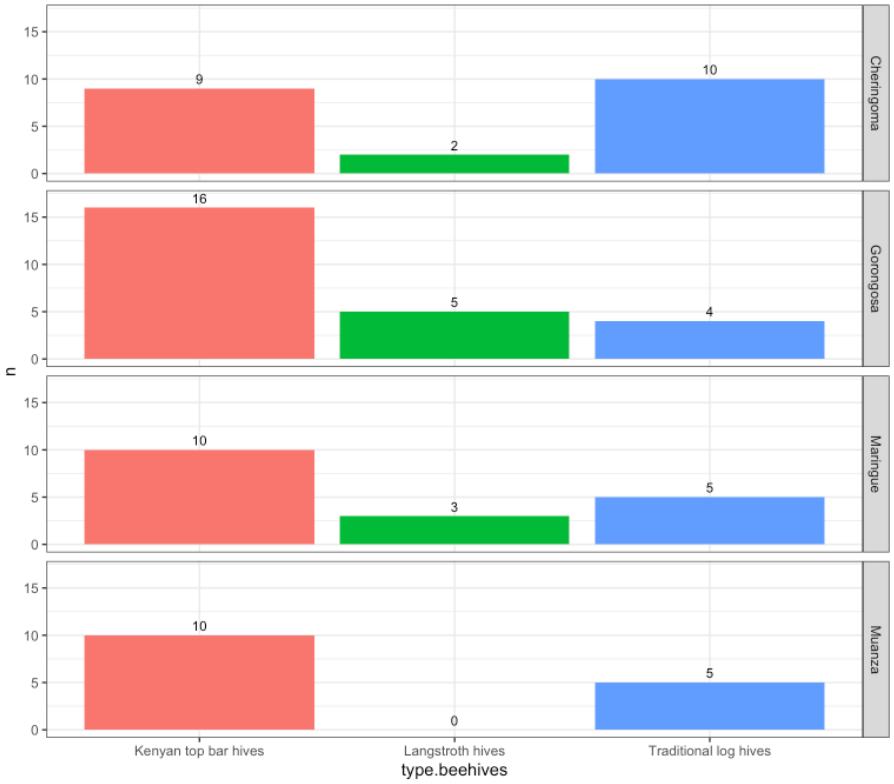
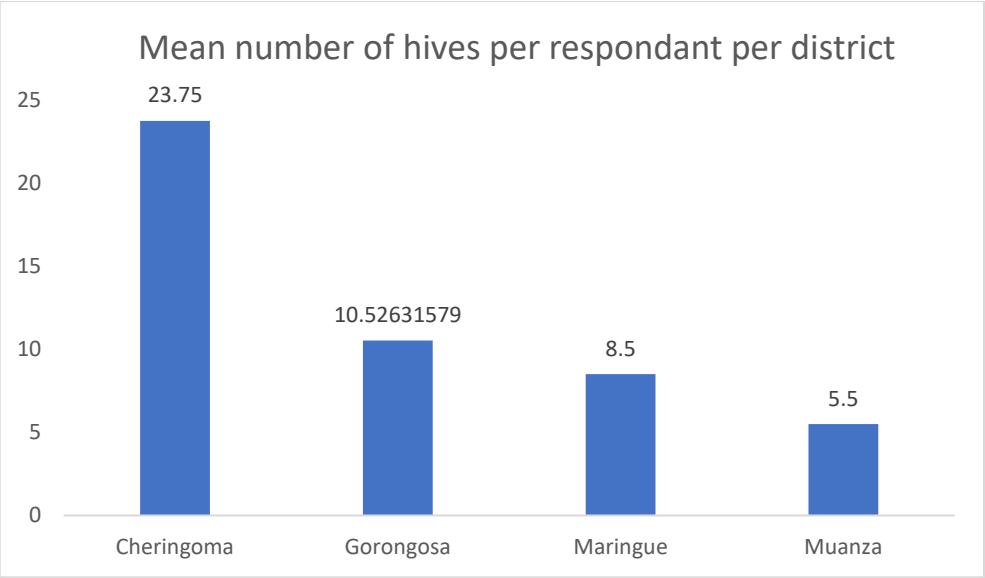


Figure II – 2. Types of hive, number of respondents per districts





Chi-squared and Fisher exact tests of the perceptions of women's role in beekeeping per district

```
##
##  Pearson's Chi-squared test
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## X-squared = 41.187, df = 3, p-value = 5.969e-09
```

```
##
##  Fisher's Exact Test for Count Data
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## p-value = 2.202e-08
## alternative hypothesis: two.sided
```

Chi-squared and Fisher exact tests of the hours spend in beekeeping when the occupation is high.

District	hours.daily.highest.occupation_1-2 hours_n	hours.daily.highest.occupation_2-4 hours_n	hours.daily.highest.occupation_4-6 hours_n	hours.daily.highest.occupation_6-8 hours_n	hours.daily.highest.occupation_Less than 1 hour_n	hours.daily.highest.occupation_More than 8 hours_n
Cheringoma	0	1	0	3	0	6
Gorongosa	1	4	4	10	0	0
Maringue	1	2	1	1	1	4
Muanza	7	1	0	0	2	0

Chi-squared and Fisher exact tests of the proportion of income reinvested in apiculture

```
##
##  Pearson's Chi-squared test
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## X-squared = 9.0119, df = 9, p-value = 0.4362
```

```
##
##  Fisher's Exact Test for Count Data
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## p-value = 0.517
## alternative hypothesis: two.sided
```

Figure II – 3 Use of income from beekeeping activities, number of respondents per districts

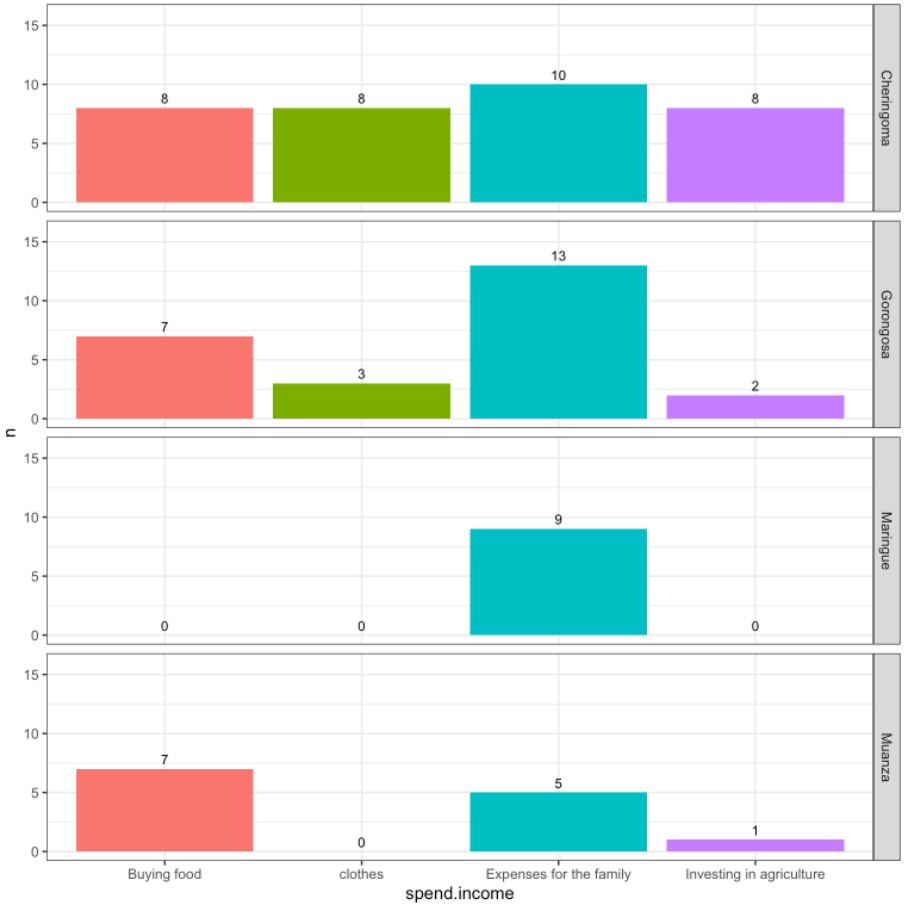


Figure II – 4 Ways through which beekeepers ensure feeding when there are not enough flower resources available, per number of respondents per district

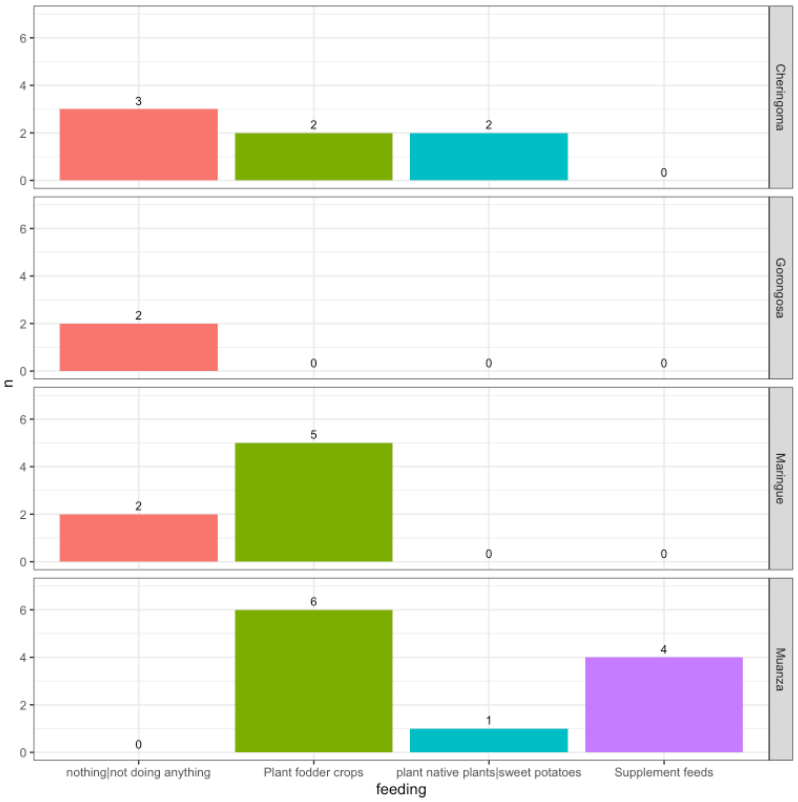
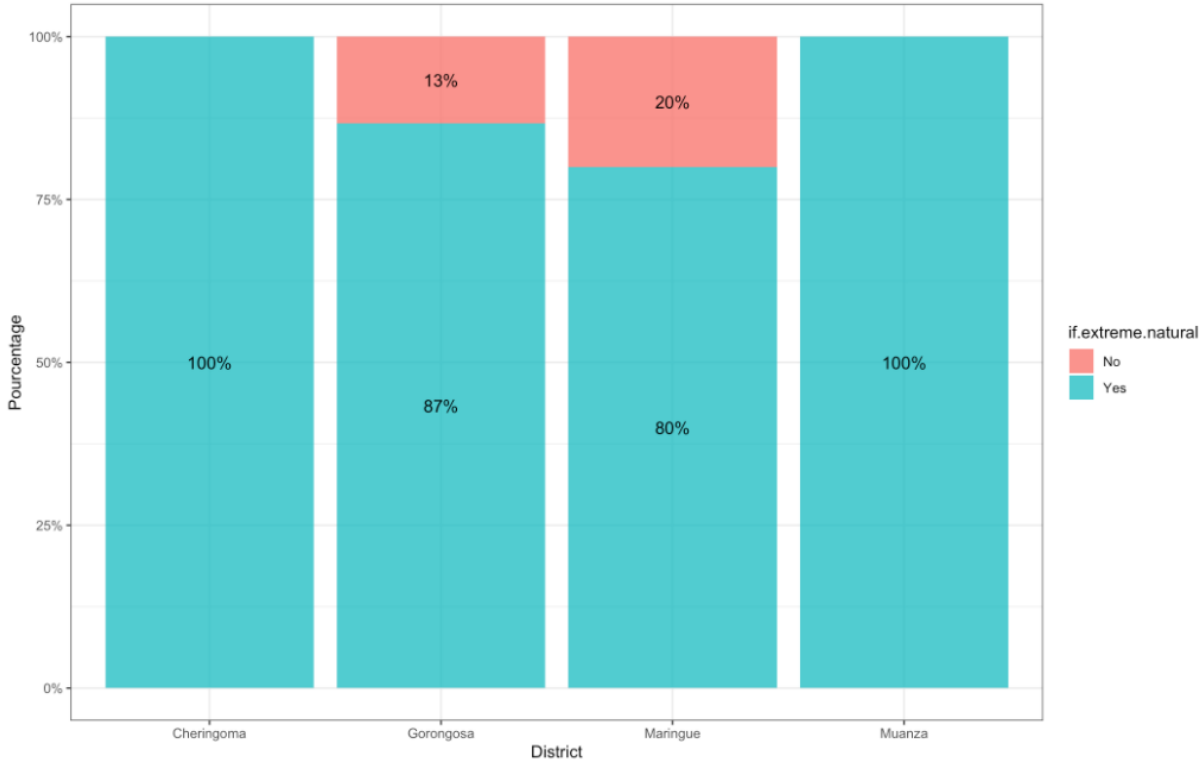


Figure II – 5 Occurrence of extreme natural events in the past 5 years, percentage of yes/no answer per individual, per district.



Chi-squared and Fisher exact tests of potential discouragement in the face of the extreme weather events regarding the pursuit of beekeeping activities, percentage of yes/no answer per district

```
##
##  Pearson's Chi-squared test
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## X-squared = 33.425, df = 3, p-value = 2.62e-07
```

```
##
##  Fisher's Exact Test for Count Data
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## p-value = 4.757e-08
## alternative hypothesis: two.sided
```

Chi-squared and Fisher exact tests of hives alteration if cyclones per districts

```
##
##  Pearson's Chi-squared test
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## X-squared = 19.447, df = 3, p-value = 0.0002209
```

```
##
##  Fisher's Exact Test for Count Data
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## p-value = 7.679e-05
## alternative hypothesis: two.sided
```

Chi-squared and Fisher exact tests of hives alteration if strong raining per districts

```
##
##  Pearson's Chi-squared test
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## X-squared = 8.3273, df = 3, p-value = 0.03971
```

```
##
##  Fisher's Exact Test for Count Data
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## p-value = 0.0336
## alternative hypothesis: two.sided
```

Chi-squared and Fisher exact tests of hives alteration if fires per districts

```
##
##  Pearson's Chi-squared test
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## X-squared = 9.0754, df = 3, p-value = 0.0283
```

```
##
##  Fisher's Exact Test for Count Data
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## p-value = 0.03251
## alternative hypothesis: two.sided
```

Chi-squared and Fisher exact tests of help needed for the future per district

```
##
##  Pearson's Chi-squared test
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## X-squared = 24.837, df = 3, p-value = 1.67e-05
```

```
##
##  Fisher's Exact Test for Count Data
##
## data:  param.tbl[[param.x]] and param.tbl[[param.y]]
## p-value = 7.701e-06
## alternative hypothesis: two.sided
```

ANNEX III

Local and scientific names of fauna and flora species

Realised with the great help of Sónia José Costa Viagem and Marcos Bera Chova.

- **Perto de tipos específicos de flores (especificar quais):**

Julbernadia globiflora	Muimbe
Ziziphus mauritiana	Nsau
Ziziphus mucronata	Mutchatchane
Philenoptera violacea	Npacassa
Acacia robusta	Nsadzi
Kigelia africana	Nvunguti
Acacia negrescens	Ncunghu
Cissus integrifolia	N'tamba

- **Tipo de árvores costuma encontrar as abelhas sem ferrão?**

Nome Cientifico	**Nome local/ Vulgar**
Combretum imberbe	Nangali
Acacia robusta	Nsadzi
Philenoptera violacea	Mphacassa
Sclerocarya birrea	Nfula
Cordyla africana	N' tondo
Kigelia africana	N'vunguti
Cissus integrifolia	N'tamba
Brachystegia spiciformes	Messassa
Khaya anthoteca	Umbaua
Adansonia digitata	Mulambe, imbondeiro
Acacia negrescens	Ncunghu

Ziziphus mucronata	Mutchatchane
Ziziphus mauritiana	Nsau
Julbernadia globiflora	Muimbe
Pericopsis angolensis	Chiuanga

- **Communities :**

Distrito	**Comunidade**
Gorongosa	Mussicadzi 2, Massala, Vunduzi, Dongama, Muera, Nhambita, Nhaurir,
Maringué	Nhagó, Djodjo, Nkhungué 1, Thoé
Cheringoma	Nhamacaringa
Muanza	Nhacamuanza, Mueredze, Chiwawa, Matenga, Nhamagaia

- **Apis mellifera (abelhas do mel)**

Nome de Abelha com Ferão	**Nome local**
Appis melifera	Nyutchi

- **Abelha sem ferrão (indicar várias nomes locais)?**

Nome de abelha sem Ferão	**Nome Local**
Abelhas sem ferao	Pande, Doé, Phasse, Mphumbudza, Cassecha