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The impact of participating in the biodiversity economy on household food security: a Gonarezhou National Park Communities' case study

By

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DECLARATION

I, **Mwansa Mwansa**, declare that the dissertation, which I hereby submit for the degree Master of Science in Agriculture (Agricultural Economics) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

Signature:  .

Date: 21st October 2024

DEDICATION

I dedicate this dissertation to my late father, Cletus Mwansa, a spirited Agricultural Economist who inspired my career path.

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ABSTRACT

Biodiversity conservation initiatives are often hailed as essential for safeguarding natural resources, yet they frequently come at the expense of communities reliant on these ecosystems for sustenance. Literature extensively documents the displacement of local populations to make way for protected areas, perpetuating poverty and social discord among the affected communities. Responding to these concerns, policymakers have increasingly turned to community-based natural resource management programmes, epitomised by initiatives like transfrontier conservation areas. Among these, the Great Limpopo Transfrontier Conservation Area (GLTFCA) stands as a prime example, spanning South Africa, Zimbabwe, and Mozambique since its establishment in 2002. Despite its inception, scant attention has been given to examining the impact of the TFCA on household-level food security.

This study delved into the impact of the biodiversity economy within the Gonarezhou National Park (GNP) on local household food security. The study used descriptive statistics to characterise the households in the study communities, calculated five food security indicators to gain an understanding of the food security situation and employed the propensity score matching technique to conduct an impact analysis.

The key findings of the study indicate that the communities are a patriarchial society with an average household head age of 50 years old. Their main livelihoods include agriculture, cross-border trade and casual labour including work in the biodiversity economy. The food security situation is poor, most households face food shortages during the agricultural lean season, lack productive assets, consume less than five of twelve food groups and engage at least three harmful coping strategies to cope with insufficient food supply. Moreover, it is not surprising that the study found no direct impact of the park's existence on local communities' food security, as evidenced by statistically insignificant Average Treatment Effects on the Treated (ATT). This suggests that the park has fallen short of its intended goal of promoting local development. Possible explanations for this shortfall range from the park's limited success in attracting tourists and generating local economic opportunities to external shocks such as the COVID-19 pandemic.

To bolster the park's performance and enhance its socioeconomic impact, policymakers must adopt a multifaceted approach. This could entail bolstering social protection policies, supporting

agricultural livelihoods, and fostering tourism-based economic opportunities within the park's vicinity. By addressing these underlying challenges, policymakers can strive towards achieving the dual objectives of biodiversity conservation and sustainable local development within protected areas like the GNP.

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ACRONYMS

CBNRM	Community Based Natural Resource Management programmes
CPR	Common Pool Resources
FAO	Food and Agriculture Organisation of the United Nations
GNP	Gonarezhou National Park
GLTFCA	Great Limpopo Trans Frontier Conservation Area
KNP	Kruger National Park
LNP	Limpopo National Park
PA	Protected Areas
SADC	Southern African Development Community
SOFI	State of Food Insecurity in the World
TFCA	Transfrontier Conservation Areas
TFCP	Transfrontier Conservation Park
UN	United Nations
WFP	World Food Porgramme

CHAPTER 1: INTRODUCTION

1.1 Background

Natural resources are integral to the livelihoods of rural communities, serving as vital sources of raw materials and sustenance. Across Africa, these communities have traditionally depended on the continent's rich array of resources, encompassing land, marshes, forests, lakes, and rivers, for their sustenance and economic activities. Typically, these resources are managed as common pool resources (CPRs), shared equally among community members for various purposes such as grazing, resource extraction, and agriculture.

However, variations exist in how these resources are treated. Some are legally protected, prohibiting community extraction, while others are accessed both legally and illegally for subsistence and commercial activities, both within and outside protected areas. This utilisation significantly contributes to food security and nutritional outcomes at the household and community levels (Dalu et al., 2021).

Despite their critical role in enhancing food security and nutrition, the management of CPRs through joint usage arrangements presents considerable challenges. These challenges stem from inherent characteristics of CPRs, notably their non-excludability and rivalrous consumption. Such characteristics not only affect the sustainability of the resource system but also have long-term implications for household food security and nutrition.

A growing challenge in CPR management and conservation in general is largely attributed to the expanding rural population, due to a combination of high birth rate and inward migration, which translates into increased demand for arable land for agricultural purposes (Zhou et al., 2019). Increased human activities are fast encroaching wildlife corridors and its habitat thereby putting pressure on the limited natural resources that are already showing signs of fragility and gradually running out (Maja & Ayano, 2021). To this end, there is a substantial amount of evidence demonstrating that rapid population growth results in environmental degradation due to increased dependence on fragile ecosystems (Sinding, 2009). Regrettably, the growing detrimental effects of climate change are reducing agricultural potential in arid and semi-arid regions leading to increased dependence on the natural capital base. Reducing agricultural potential has led to

increased demand for alternative sources of income to supplement those from agriculture which often conflicts with the need to mitigate the effects of climate change and save the environment.

As a result, national governments, regional bodies such as SADC and international development agencies have adopted the idea of integrated conservation and development projects (ICDP) to balance both conservation and development goals (Alpert, 1996). One of the conservation strategies that have emerged out of the ICDP initiatives involves turning several national parks that are located adjacent to each other in two or more countries into Trans-frontier Conservation Parks (TFCP), to protect fugitive and transboundary natural resources. However good the idea of transfrontier conservation parks was, it was realised that most shared wildlife corridors were passing through communities which made it difficult to relocate thousands of affected households to create a way for the parks. Trans-frontier Conservation Areas (TFCA) were the next best alternative to TFCPs because they encompass multiple natural resource uses that can benefit the communities too (SADC, 2017). The expectation was that in addition to preventing the total depletion of the natural resource bases upon which poor rural communities depend, these strategies would also encourage coordinated efforts to increase shared economic benefits and foster regional integration (SADC, 2017). According to Ntuli et al. (2021), the creation of TFCAs is not only seen as an efficient method of managing transboundary natural resources by permitting species to roam freely when seasonal variations affect them but also welfare generation in poor rural communities living within its confines and adjacent to protected areas. Whether these objectives of TFCAs have been achieved is a question that remains unanswered, especially with regard to their contribution to food security.

Although the history and contribution of TFCA towards species conservation are well documented across the globe, there are still important gaps on the African continent in terms of their impacts on the welfare outcomes of adjacent communities. The success and failure of TFCAs in various spheres of conservation and contribution to welfare outcomes depend on political, social and economic contexts in different countries and regions. For instance, the first TFCP was established in 1926 as part of the transboundary nature reserve between the United States and Canadian border with a huge success in conservation and economic outcomes (Kelso, 2019). Since then, many other parks have been established all around the world to follow suit.

The creation of most protected areas which now form parts of TFCA in Africa resulted in historical imbalances in the form of land dispossession, restricted access to natural resources and economic marginalisation of poor communities (Kelso, 2019; Salerno et al., 2020; Sinthumule, 2018). The burden of losing means of subsistence, however, falls on park-adjacent communities and households living within the confines of TFCAs, with little thought given to their wellbeing or the potential harm to their collective food security. Due to the establishment of protected areas, there has been a change in the livelihoods of indigenous people who were once traditionally hunters and gatherers through restricted access to natural resources in the conservation areas, which once belonged to the communities through ancestral lineages (Domínguez & Luoma, 2020; Sunderlin et al., 2005). Under most circumstances, the formation of the conservation areas on the African continent led to the forceful removal of local people from their ancestral land to make way for the conservation areas, disrupting their livelihoods and cultural way of life (Domínguez & Luoma, 2020; Kelso, 2019; Ntuli et al., 2021; Turner, 2004). However, this situation is not unique to developing regions such as Africa. History demonstrates that the establishment of Yellowstone in America was also characterised by the eviction of natives from their land by the army (Reid, 2001). This was detrimental to their livelihoods and increased their exposure to food insecurity vulnerabilities, livelihood collapse, and reliance on subsistence agriculture, non-agricultural livelihood options and food aid (Neelakantan et al., 2021).

Most protected areas have severely restricted access for local communities in the form of institutions, policies, laws, bylaws, rules, and regulations designed to protect wildlife both inside and outside protected areas (Becken & Job, 2014). These regulations start at the local level and work their way up to higher levels of the governance structure. The social and economic well-being of communities that depend heavily on the extraction of natural resources for sustenance uses are negatively impacted by these limitations (Becken & Job, 2014). Restrictions on natural resource extraction have also promoted illicit behaviour among community members, such as subsistence wildlife poaching and illegal fishing (Ntuli et al., 2021; Wei et al., 2018). Certain illegal activities, such as poaching, can be carried out as retaliation for harm that wildlife has caused to the community, for the disruption of customary livelihood activities brought about by conservation, or as a form of protest if the locals believe that conservation laws are unjust (Wei et al., 2018). This phenomenon is known in the literature as "contested illegality." (Hübschle, 2017; Ntuli et al., 2021). According to (Gandiwa, 2011b), illegal wildlife hunting in GNP was associated

with young unemployed youth looking to sustain their livelihoods through commercial bushmeat trade and for home consumption, among other reasons.

An excellent illustration of an ICDP in Southern Africa is the Great Limpopo Transfrontier Conservation Area (GLTCA), which is marked by both success stories in areas such as economic performance and failures in others related to socio-ecological factors (Zanamwe et al., 2018). The initiative is an ambitious merger of three national parks (see Figure 3.1) in Southern Africa, namely the Limpopo National Park (LNP) in Mozambique, Kruger National Park (KNP) in South Africa, Gonarezhou National Park (GNP) in Zimbabwe, private game areas and two communally managed conservation areas; Makuleke area and Sengwe communal lands (Kelso, 2019; SADC, 2017). It was established in 2002 to jointly conserve natural resources, strengthen regional cooperation and foster socioeconomic development through shared tourism among the three countries (Kelso, 2019). The communities adjacent to the GLTFCA share a common language, Shangani (Gandiwa, 2011b; Ntuli et al., 2019). At the same time, the communities derive different benefits from the park, which include employment, environmental income and food like wild fruits and vegetables, roots and bush meat, among other products (Gandiwa, 2011b; Kelso, 2019; Zanamwe et al., 2018). However, environmental resource extraction, like meat, timber or minerals, both inside and around protected areas is often labelled as illegal for the most part according to conservation laws and depending on the nature of the resource being harvested (Mudzengi et al., 2022; Ntuli et al., 2021).

Just like other TFCAs in the region, the GLTFCA is also an interesting case study due to the conflict of interest between policy and community interests. Governments in the GLTFCA face a dilemma in trying to protect both threatened and endangered species as well as wildlife habitats without compromising what may be the primary source of food and income for both rural and peri-urban communities. Earlier research has identified several sources of income for these communities, including the trade in bushmeat, medicinal plants, wild insects, beekeeping, wild vegetables, fruits, the processing of palm oil and wine, artisanry, dance and tourism entertainment, seasonal and year-round jobs in parks, and a variety of farming activities such as crop cultivation and livestock rearing (Makhado et al., 2014; Salerno et al., 2020; Wicander & Coad, 2018). The majority of these employment opportunities are seasonal and irregular, low-paying, and unstable (Simelane et al., 2006). In order to lessen the negative effects of livelihood failure, people typically combine various livelihood activities (Salerno et al., 2020). It is important to note that while the

bulk of these alternate livelihood options are still centred on agriculture and the exploitation of natural resources, some of them are directly related to conservation.

Conflict is usually observed in communities if there are fewer economic opportunities to meet their needs (Ntuli et al., 2019). It is believed that local populations will only support conservation if the benefits outweigh the costs and are more interested in protecting natural resources if the benefits are tied to their livelihoods through extraction Ntuli et al. (2019) . The vulnerability of agricultural livelihood activities in the GLTFCA is inflated by low yields and seasonal failure due to the semi-aridness of the environment and wildlife damages (Murungweni et al., 2014; Salerno et al., 2020). For instance, the Zimbabwean side of the GLTFC is in agroecological zone 5, characterised by short rainfall seasons, high average temperatures and suitable for livestock rearing, fruit trees and wildlife tourism (Benson, 1998; Desmond Manasta et al., 2020). Similarly, the South African GLTFCA constituency, which lies in the northern part of the Limpopo province, is highly arid, has very high atmospheric temperatures and receives annual rainfall as low as 200mm (Kephe et al., 2020). Therefore, agricultural-based livelihoods (especially rain-fed crop production systems) are observably mainly on a subsistence scale; most of the community members own small numbers of livestock and have backyard gardens and small farms. Climatic conditions are not the only hindrance to agricultural activities, human-wildlife conflict also has devastating consequences on the welfare of local communities in the region (Mabibibi et al., 2021). Subsistence farmers in the study area suffer human-wildlife conflict in the form of crop damages and livestock predation in addition to human injuries or even death in some cases (Mabibibi et al., 2021; Ntuli et al., 2019). Hence, Community-Based Natural Resource Management (CBNRM) programmes are being implemented to increase community engagement and ownership in managing natural resources to remedy conflicts, incentivise environmental stewardship and increase benefit flows from state (private) actors to communities (Fabricius, 2013).

The recent development of CBNRM programmes followed the realisation that excluding community members from the natural resources management processes fuelled the ill relationship between park authorities and communities. Hence it is important to engage the community in the management process to ensure not only the success of conservation goals but also welfare outcomes through equitable and sustainable use of natural resources (Fabricius, 2013; Twyman,

2000). Otherwise, communities that do not view conservation legislation as fair are bound to frustrate conservation efforts (Hübschle, 2017; Ntuli et al., 2021).

This research aimed to examine the connection between conservation and the food security of households using primary data collected in local communities around GNP in Zimbabwe. It investigated the influence of livelihood activities undertaken by communities residing within the confines of the GLTFP on household food security. The findings of this study are intended to shape policy changes within the core of conservation initiatives and developmental agendas.

Due to time and resource constraints, the study only focused on communities surrounding the Gonarezhou National Park (GNP) in Zimbabwe's Masvingo province. Masvingo province is located in agro ecological zones III, IV and V. These agroecological zones are characterised by low rainfall patterns as low as 450mm annually (Chingarande et al., 2020). The area is arid and generally not suitable for agricultural activities

1.2 Problem statement

Being initially established as one of the first Trans-frontier Park in Southern Africa, the GLTFCA transitioned from being a TFCP linking LNP in Mozambique, KNP in South Africa and GNP in Zimbabwe to a fully flagged TFCA with local communities included in the conservation and development discourse. While the transformation was intended to enhance cultural heritage, foster collaborative management of transboundary natural resources, and sustainable use of natural resources to drive community development, it inadvertently failed to address some of the historical imbalances which resulted in the loss of indigenous livelihoods and a crucial food source for the affected communities. The creation of protected areas in the region as independent national parks led to the displacement of local communities whose livelihoods depended heavily on natural resources for sustenance with significant implications on food security and nutritional outcomes. Therefore, this study aims to address critical issues arising from the evolution of the biodiversity economy of the GLTFCA, looking at communities living adjacent to the GNP in Zimbabwe - a protected area which shares a similar historical background with its neighbouring constituencies, i.e., LNP in Mozambique and KNP in South Africa, as well as many parks in the region.

In response to these challenges, conservation authorities and the governments of the GLTFCA formulated policies aimed at involving communities in natural resource management and ensuring equitable shared benefits from ecotourism in the context of the wider "biodiversity economy" which entails sustainable use of wildlife and plant species. However, the practical impact of these initiatives falls short of adequately supporting the day-to-day needs of communities facing the dual challenges of land loss to conservation parks and human-wildlife conflict, exacerbating issues of poverty and limited economic opportunities. The onset of the COVID-19 pandemic further intensified these problems by causing economic closures and reducing tourist visits, adversely affecting employment and economic prospects for households already grappling with the hardships of living near protected areas.

The study found that there exists a significant literature gap regarding how the GLTFCA has influenced the household-level food security of local communities. The existent literature takes a broader focus on the livelihood outcomes of local communities, however, food security has not been studied. Moreover, studies done in this area are purely qualitative in nature and their claims need to be tested. specifically, the relationship between participating in the biodiversity economy and HH food security in GLTFCA has not been investigated using econometric techniques to provide evidence to policymakers. As a result, policies are fervently endorsed based on weak empirical evidence.

Therefore, the study seeks to discern whether the impact has been positive or negative, shedding light on the effectiveness of current conservation strategies and contributing valuable insights for future policy development.

1.3 Research questions

1. What are the social, demographic, economic and cultural characteristics of households living adjacent to the study area?
2. How has the Gonarezhou National Park (GNP) impacted the household food security of surrounding communities?

1.4 Aims and objectives

While a cross-country assessment of all three countries in the GLTFCA would have been more meaningful, time and resource constraints limited this study to focus on one country.

Consequently, the primary aim of this study is to evaluate the impact of the Gonarezhou National Park (GNP) on the household-level food security situation of the neighbouring communities within GNP, Zimbabwe. The study addressed the following specific objectives:

i) To characterise the social, demographic, economic and cultural characteristics of households living adjacent to the GNP.
ii) To evaluate the impact of participating in the biodiversity economy of the GNP on the food security of pack adjacent households.

The results of this research will offer valuable understanding for developing policies that address community welfare requirements while maintaining harmony with environmental preservation initiatives. The perception and involvement of the surrounding community in the preservation of natural resources will also be enhanced by these regulations, as will their relationship with park authorities.

1.5 Outline of the dissertation

The rest of the thesis is organised as follows. Chapter two provides an overview of the related literature review. The related literature search, organised into subtopics, presents the intricate relationship between food security and biodiversity conservation on a broad global spectrum and down to the situation in Zimbabwe, the country under study.

Chapter three gives a detailed description of the study area and methodologies used to address the research questions presented in chapter one. The study employed a mix of methodologies, beginning with descriptives to characterise the study community, food security formulas to calculate the five food security indicators, and propensity score matching to determine the impact of the park on household-level food security.

Chapters four and five present the study findings and offer a brief discussion on the same. In chapter six, the study concludes by providing policy recommendations useful for policymakers championing biodiversity conservation coupled with community development. Chapter six also provides recommendations for future research into the study.

CHAPTER 2: REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter gives a detailed discussion of the comprehensive findings of the literature reviewed. With a particular focus on Zimbabwe specifically, the chapter explores the intricate dynamics surrounding transfrontier conservation areas (TFCAs) in Africa and their consequences for food security and biodiversity conservation. Across national boundaries, TFCAs work to preserve natural ecosystems while promoting economic integration across areas. However, they have varying effects on the lives of nearby populations, with mixed results. Through resource use limitations and displacement, TFCAs threaten traditional food sources and livelihoods even if they can also create jobs and bring about economic opportunities.

Furthermore, the chapter draws attention to the complex issues surrounding food security in Africa, which are made worse by things like violence, climate change, and economic downturns. Despite Africa's potential for agriculture, food insecurity still exists because of the continent's reliance on food imports, the high cost of nutritious meals, and interruptions to food production brought on by climate change. Particularly in Zimbabwe, there is a serious problem with food insecurity, which

is made worse by frequent droughts and economic shocks, particularly for rural communities that depend primarily on agriculture.

The study's conceptual foundations highlight the significance of inclusive conservation strategies that prioritise community engagement and benefit-sharing programmes. The knowledge of how biodiversity conservation affects household food security is shaped by theoretical frameworks, which emphasise the need for equitable outcomes that give community welfare and conservation objectives equal priority.

In summary, the chapter emphasises the intricate balance between conservation efforts, livelihoods, and food security in African contexts, advocating for holistic approaches that address the needs of both ecosystems and local communities.

2.2 Transfrontier Conservation Areas (TFCA) in Africa and their implications for the livelihoods of neighbouring communities.

Transfrontier Conservation Areas (TFCA) are conservation areas spanning national borders to foster regional integration and socioeconomic development (Munthali, 2007a; Ntuli et al., 2021; SADC, 2017). TFCAs have gained prominence as a vital conservation strategy in Africa. Nevertheless, the adoption of Transfrontier Conservation Areas has elicited varied sentiments among communities residing on their borders regarding the purported benefits for livelihood improvement (Sinthumule, 2020). This literature review seeks to analyse the repercussions of TFCAs on the food security of communities neighbouring the GNP, an integral park that is part of the Great Limpopo Transfrontier Conservation Area. The establishment of TFCAs has had mixed impacts on the livelihoods and food security of adjacent communities (Cumming & Dzingirai, 2017). A study by (Senyolo et al., 2015) found that the biodiversity economy is more profitable than agrarian livelihoods over the long run, and community members' realisation of this phenomenon has made agriculture less appealing. TFCAs have the potential to bring in money for the community and create jobs (Kachena & Spiegel, 2019). Regardless, the establishment of TFCAs poses a threat to food security to local communities' traditional food and livelihood security. Most studies have shown that the implementation of most TFCAs resulted in the displacement of local people from their homeland, loss of grazing land and restrictions on the use

of natural resources such as water, timber and land, which affects local food production (Sinthumule, 2018; Slater, 2002).

Consequently, most studies are in support of a community-based approach to the management of TFCAs (Munthali, 2007a; Ntuli et al., 2021; Turner, 2004). These studies claim that involving communities in the decision-making process increases communities' support of conservation efforts and enhances their participation in conservation. On the contrary, Nsikwini Sakhile & Urmilla Bob, (2019) found that the cost to communities is greater than the benefit owing to a lack of an efficient benefit-sharing mechanism.

Despite the challenges associated with TFCAs, there are also potential benefits for local communities in terms of livelihoods and food security. Slater (2002) documented that conservation areas, in general, have created various livelihoods, including increased demand for crafts and various forms of short or long-term employment. Another notable illustration can be found in the communities surrounding KNP, a significant park within the Great Limpopo Transfrontier Conservation Area (GLTFCA) (Mabibibi et al., 2021). The KNP actively supports its communities through Community-Based Natural Resource Management (CBNRM) initiatives, offering substantial direct and indirect employment opportunities. Additionally, there is community stake ownership in select projects, a public works programme generating short-term employment for locals, and capacity-building business incubation projects. KNP also permits controlled natural resource extraction, exemplified by the collection of highly nutritious protein-dense mopane worms. The park distributes game meat to households and school feeding programmes, allowing for sustainable utilisation. Furthermore, KNP accommodates traditional healers by permitting the extraction of medicinal plants from the buffer zone. Lastly, through the Skukuza Indigenous Tree Nursery, the park contributes to environmental conservation by distributing trees for various purposes. We see that the benefits of the conservation areas are multisectoral in health care and education, both of which are crucial to enhancing food security and community welfare.

In sum, the literature suggests that TFCAs have both positive and negative impacts on the livelihoods and food security of neighbouring communities. The outcome largely depends on the policies adopted, whether they exclude community engagement or embrace CBNRM philosophy and to what extent. Nevertheless, the implementation of protected areas evidently leads to reduced

access to natural resources critical for food security and the displacement of communities. Thus, involving communities in TFCA management is crucial to mitigate its negative impacts and distribute its benefits equitably. The success of TFCAs depends on implementing careful and well-thought-out policies that strike a balance between conservation goals and the needs of adjacent communities.

2.3 Definition of and the dimensions of food security

According to recent research, the past three years have seen a marked rise in the strain on global food systems, with the compounding effects of COVID-19, armed conflict and climate change exacerbating the situation (FAO et al., 2022; Rahaman et al., 2021). This "triple burden" has shone a light on the vulnerabilities of food systems worldwide and the urgent need for action to build resilient and sustainable food systems.

There are only seven years left to achieve the United Nations' global sustainable development goals (SDG), and the world is backtracking in efforts to achieve SDG 2, "zero hunger". It is expected to continue this trend by 2030, the deadline by which the SDGs must be achieved. FAO et al. (2022) State of Food Insecurity in the World report reveals that the world has regressed in its progress towards ending hunger and malnutrition, naming climate change, conflict, economic downturns, increasing cost of nutritious foods and widening inequalities as the contributing factors to this regression. The report reveals that about 828 million people faced hunger (278 million in Africa) in 2021, and the prevalence of undernourishment increased by 1.8 per cent between 2019 and 2021.

Although food security was not initially prioritised in government policy agendas, it has become a topical issue (Hendriks, 2015). The term was coined in the 1970s but was first given attention in the 1940s. Since then, it has gained momentum as a critical global issue. Due to its multifaceted nature, there is still a lack of agreement on the causes of food insecurity (Hendriks, 2014; 2015). But, the definition of food security, which is globally recognised as "*a situation when all people, at all times, have physical and economic access to adequate, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life*" (FAO, 1996; FAO et al., 2022), highlights the four dimensions of food security. This definition serves as a standard for achieving global food security. (Hendriks, 2015), posits that food insecurity starts when a

household becomes concerned about the adequacy of its future food supply. Subsequently, households traverse a food security spectrum ranging from complete food security to starvation. Formerly, the concept was linked to food availability; however, the work of Sen (1981) on poverty and famines prompted a shift in thinking and a greater appreciation of the root causes of food insecurity. Consequently, the four traditional dimensions of food security: food availability, access, utilisation and stability; are now the benchmark against which food insecurity can be assessed.

FAO et al. (2022) provide definitions of these four traditional dimensions of food security. Food availability pertains to the actual physical presence of food in physical terms. Food can be made available through various means, including food markets, farming production, food aid, and wild foods. Food accessibility refers to both physical and economic access to food. Even when food is available, it must be accessible to people in terms of their location and purchasing power. Inaccessibility can result from food being too far away in distant markets or too expensive, rendering it inaccessible to poor households. Food utilisation refers to the proper consumption of food that is both available and accessible. Food security is multisectoral, and other sectors can cause food insecurity even when food is both available and accessible. The utilisation aspect of food security focuses on the body's ability to utilise the nutritional value of food in a clean and safe environment. To achieve this, safe water and hygiene must be available to prevent diseases that can reduce the ability of the human body to use food effectively. Food stability is a cross-cutting dimension that spans all three dimensions. The stability of the three food security dimensions ensures that people do not worry about adequate future food supply. Thus, all three dimensions must be stable for everyone to be food secure at all times. For instance, shocks induced by climate change, political instability and other factors can disrupt food security stability, resulting in acute or chronic food insecurity.

As suggested by Hendriks (2015), comprehension of food security is an evolving process that expands with the emergence of new knowledge and the evolution of contexts related to food and hunger. The State of Food Insecurity and Nutrition in the World (SOFI) report of FAO et al. (2022) has incorporated two additional dimensions of food security: agency and sustainability, as proposed by the High-Level Panel of Experts (HLPE) (Figure 2.1). These two dimensions further

underscore the significance of community food systems ownership and food dignity while also taking into account the sustainability of food systems to ensure future food production.

The right to access safe and nutritious food is a fundamental human right that was recognised by heads of state at the 1996 World Food Summit (FAO, 2005). Moreover, access to adequate food and freedom from hunger is a human right enshrined in the Universal Declaration of Human Rights. Like all other human rights, governments have an obligation to fulfil their duty in ensuring universal food access for all citizens. This paper addresses a crucial issue: the food security of rural communities residing near conservation areas, who often lack access to basic amenities and infrastructural development. Governments are responsible for safeguarding the food sources of all individuals within their jurisdiction, including those living in the frontiers of conservation areas. Therefore, it is imperative to include these communities in food security policy initiatives to ensure they are not left behind.

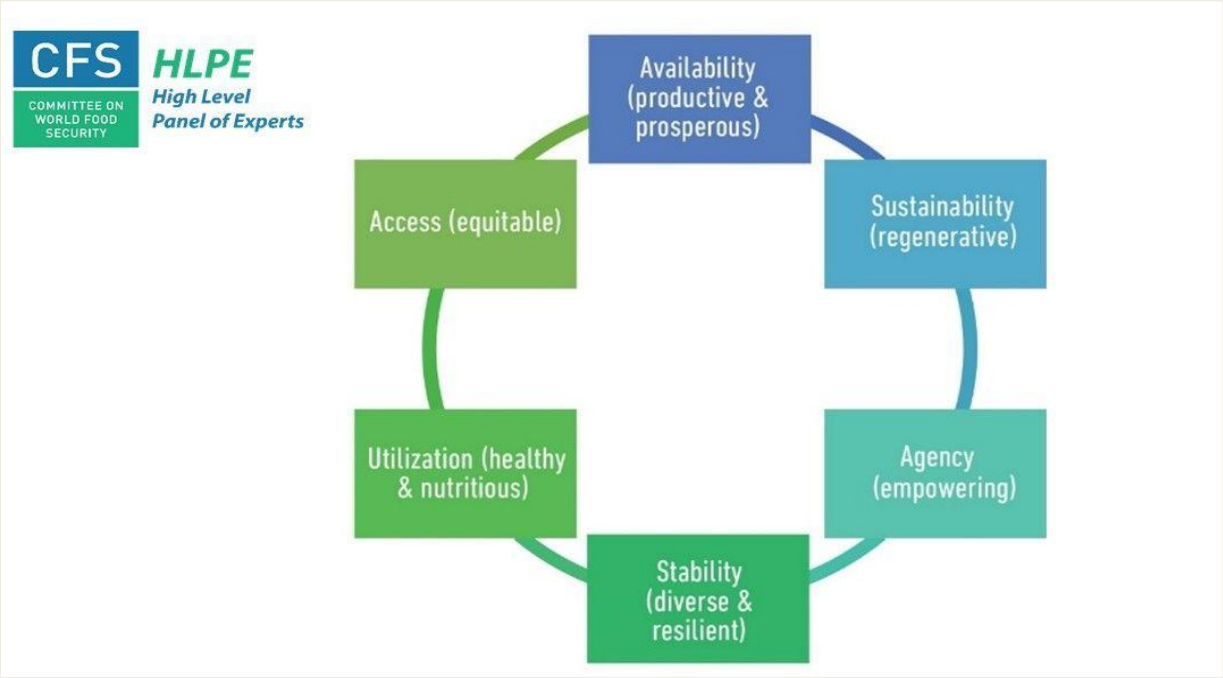

Figure 2.1: Food security dimensions

Source: HLPE 2020

2.4 Food security and nutrition challenges in Africa

Despite abundant natural resources and arable land, Africa is still grappling with food insecurity (Dodo, 2020) Three major drivers of food insecurity are catalysing the ballooning food insecurity

problem on the continent. Firstly, the continent's growing dependence on food imports is a major concern, even though it has the potential to produce its own food. Research indicates that by 2025, Africa's food import bill will surge to a staggering $110 billion (Wudil et al., 2022).

Secondly, the cost of consuming a healthy diet remains unaffordable for most people in Africa (FAO, 2020). According to a report by the FAO (2020) on the affordability of healthy diets, the median cost of a healthy diet is $3.75 per day, which is above the $1.90 poverty line. FAO (2020) has also reported that out of the 1.5 billion people who cannot afford healthy diets, 826 million are in Africa. The cost of a healthy basket is considerably higher for proteins, dairy, fruit and vegetables in relation to carbohydrates, which makeup only 16 per cent of this cost (FAO, 2020). Consequently, households are turning to relatively cheaper high-energy diets to avoid hunger. The result is energy-dense, unbalanced diets that have led to a growing malnutrition problem manifesting as undernourishment or obesity (FAO et al., 2019). Food insecure households have driven up the rate of obesity, in 2018 alone, around 2 billion adults were reported to be obese (FAO 2019).

Thirdly, conflict, climate change, and COVID-19 pandemic all seem to have befallen Africa simultaneously. The triple burden has had dire economic devastation on African economies in three main ways: climate change has reduced the food system's ability to produce enough food for all regions, the Ukrainian war has caused price hikes of important food commodities and fuels and the COVID-19 pandemic disrupted supply chains and economic activities. These impacts are briefly discussed below.

Climatic events cause disruptions in the smooth functioning of food systems. Sirba et al. (2021) also pointed out that the impacts of climate change are far worse in Africa, where temperatures are already warm. Climate change impacts all four dimensions of food security directly and indirectly (Sirba et al., 2021). Food production is reduced as a result of climate change reducing food availability; food accessibility becomes economically challenging due to reduced supply and subsequent price increases; food utilisation is further lowered by compromises made on food quality, with most households resorting to consuming high-energy-dense cheaper foods.

Meanwhile, the war between Russia and Ukraine that started in 2022, at the time when Africa was just coming out of the COVID-19 shock, has resulted in exponential global price increases in major

cereals, seed oils and energy fuels, which many African countries rely heavily on (Abu Hatab, 2022; Ben Hassen & El Bilali, 2022). The price spikes have pushed millions into poverty, as reported by the (FAO et al., 2022), exposing the fragility of global food systems, especially for African countries that are highly dependent on food imports.

Furthermore, agricultural intensification has decreased soil regeneration time, reducing productivity and increasing reliance on fertilisers (Lal, 2023). This is costly for resource-poor farmers, who often resort to exploiting natural resources to meet their food needs. In addition, access to markets plays a crucial role in ensuring food access and facilitating trade, but it remains a challenge for many rural African communities. At the same time, the Comprehensive African Agriculture Development Programme (CAADP)'s third pillar acknowledges that sustainable demand is critical in promoting efficient markets (NEPAD, 2009). The key factor responsible for the underdevelopment of rural markets is the location of many conservation areas in remote and isolated areas with limited market access. While remoteness is critical for wildlife conservation, adequate road networks and transportation systems are essential for reducing the market distance between communities and markets. Without such infrastructure, there is a risk of continued exploitation of natural resources. Consequently, market access remains a major challenge in most Southern African rural communities located around protected areas (Scoones et al., 2010).

To sum up, African food systems are struggling to cope with various shocks, and rural communities are particularly affected. Urgent action is required to transform the continent’s food systems rapidly and make it a global food hub.

2.5 Food security in Zimbabwe

Zimbabwe is a landlocked lower middle-income Southern African country with a population of 16 million people, of which 80 per cent are mainly dependent on the agricultural sector for their livelihoods (Chingarande et al., 2020; FAO, 2020; Profile, 2011). The country has always been an agro-based economy, where over 1.5 million farmers are smallholders (FAO et al., 2022; Mutambisi & Chirisa, 2021). Zimbabwean agroecology is divided into 5 agroecological zones, with Natural Region I being the most rainy region and Natural Region V being the least rainy region (Desmond Manasta et al., 2020; Mutambisi & Chirisa, 2021). The country suffers from a food deficit and hefty climatic and economic shocks (WFP, 2022). These shocks have had an

unprecedented impact on the agricultural sector which is highly dependent on rain-fed agriculture (SADC, 2023; WFP, 2022).

As a landlocked country, Zimbabwe is highly dependent on food imports, with the food import bill averaging $200 million annually (FAO, 2022). Sorghum, Millet and Maize are the main staple foods consumed in Zimbabwe and are usually imported from neighbouring countries (Chisadza et al., 2014; Mutambisi & Chirisa, 2021). The seemingly limited staple diet of the country has resulted in detrimental effects on food security in the face of climate change. With recurrent droughts, serious economic shocks, unemployment and poor performance of the local currency, physical access to food has proven difficult in Zimbabwe (Carmody, 1998; MacNairn, 2014). The country has been facing perpetual food security shocks exacerbated by economic and climatic shocks. According to (SADC, 2020), close to 7.7 million Zimbabweans were estimated to be facing food insecurity, all as a result of a fall in the production of main staple crops. Furthermore, the 2022 State of Food Security (SOFI) report also found that at least 31 per cent of Zimbabwe's population faced severe food insecurity between 2019 and 2021 (FAO et al., 2022). This is why the food security of Zimbabwe's poorest has now become a national priority policy action point (Mutambisi & Chirisa, 2021).

Zimbabwe is a natural resource-rich country with an expanse of biodiversity, natural water bodies and fertile soils (Casper, 2007). Historically, Zimbabwe's indigenous people relied on natural resource extraction for food, medicines and construction material (Mutambisi & Chirisa, 2021). However, during colonial times, white settlers expansively demarcated Zimbabwe into large commercial farms that positioned the country as a food basket in the region (Munzwa & Wellington, 2010). The country was self-sufficient in the main staples consumed and exported agricultural commodities to neighbouring countries for forex (Casper, 2007). At the time, Zimbabwe's climate was suitable for crop and livestock production, however, climate change has over time led to recurrent droughts and flood cyclones like the 1992 droughts and cyclones Idai and Kenneth (Benson, 1998; Chikodzi et al., 2021; Nhundu et al., 2021). Furthermore, economic, and political instability have also contributed to the decline in Zimbabwe's agricultural output (Mhlanga & Ndhlovu, 2021).

Overall, Zimbabwe plummeted from its glorious days as the food basket in southern Africa and a self-sufficient country to a present-day food-insecure country mainly driven by economic upset. In 2023, its Global Hunger Index classification was ranked 13th worst in the world, making its food security situation a grave concern (Von Grebmer et al., 2022). Unfortunately, the poorest are based in rural areas and are engaged in agriculture as their main livelihood coupled with cross-border trade and remittances.

The research site for this study is in Masvingo province which is situated in the southeastern region of the country. The climatic features of these areas consist of hot and arid landscapes. Rain-fed agricultural activities contribute to the local livelihoods, although they are not the predominant livelihood. Due to the challenging climatic conditions, communities in the study area are observed to depend on small-scale poaching, extracting natural resources, the tourism economy, and cross-border trade (Musakwa et al., 2020). Existing literature also indicates a trend of physically fit youth migration in pursuit of economic opportunities in neighbouring countries (Tavuyanago, 2016).

2.6 Conceptual underpinnings

This section introduces the theoretical foundation underpinning the impact of residing near conservation areas and engaging in the biodiversity economy, which serves as the basis for this study. The study centres on assessing the impact of the biodiversity economy on household food security within communities residing on the fringes of Gonarezhou National Park, one of the three national parks within the Great Limpopo Trans-Frontier Conservation Area (GLTFCA).

This conceptual framework illustrated in Figure 2.2 draws its theoretical roots from the three key feedback loop Frameworks by (Wei et al., 2018) and the DFID Livelihoods Framework (Singh, 2017). These frameworks propose that all things being equal, communities living in proximity to conservation areas experience both conservation and non-conservation-related benefits. It is posited that improved livelihoods serve as a proxy for enhanced food security and increased income.

However, it's important to acknowledge that research has indicated that communities do not consistently have the opportunity to fully realise the benefits of the conservation areas in which

they reside (Pimbert & Pretty, 2013). They are often marginalised by influential entities that own and manage these conservation areas, and the rules and regulations tend to prioritise exclusionary policies over their needs (Oliver et al., 2022; Pimbert & Pretty, 2013).

Consequently, this conceptual framework illustrates the potential outcomes if communities were to maximise their benefits from both the park and other sources. For the purpose of this welfare-focused study, only economic benefits from the park are considered, as they directly impact food security.

Additionally, recent efforts by conservationists to promote benefit-sharing with local communities have arisen from the realisation that conservation is more likely to succeed if it garners the acceptance of these local communities (Gandiwa, 2011b; Ntuli et al., 2021; Pimbert & Pretty, 2013). These communities are no longer seen as dangers to biodiversity conservation, but rather as its defenders. Zimbabwe's CAMPFIRE initiative is a notable illustration of conservation that involves the people (Gandiwa et al., 2013).

Building upon this ideal method, the conceptual framework aims to illustrate how the flow of benefits ultimately contributes to improved food security. Households and community members have two sources of economic benefits: those derived from the conservation area and those from non-conservation-related activities. Within the conservation area, households have access to tourism-related income, which can be generated through tourism-based businesses, informal earnings from tourism activities (e.g., artisanal or traditional dancing), and formal employment within the tourism industry. All of these avenues lead to increased income, which improves households' food purchasing power.

Another benefit that arises from the direct extraction of a diverse array of natural resources such as fruits, vegetables, meat, and medicinal plants. These direct resource extractions enhance food access and provide access to medicines that improve health and food utilisation. It is worth noting that increased income also improves access to healthcare, thereby reducing the impact of illness on household food utilisation and economic productivity.

Conversely, households can engage in non-conservation-related economic activities, including farming and off-farm formal or casual employment. These activities generate income and

contribute to improved economic access to food, healthcare, and overall livelihood. With increased income, households can accumulate assets, making them more resilient to future shocks.

Drawing on the DFID Livelihood Framework, which asserts that improved livelihood is a direct proxy for enhanced food security, this study underscores the notion that enhanced livelihood alone is insufficient to guarantee food security. The study recognises the crucial role that policies and robust institutions play in establishing a fair playing field for both conservationists and local communities to achieve equitable benefit sharing.

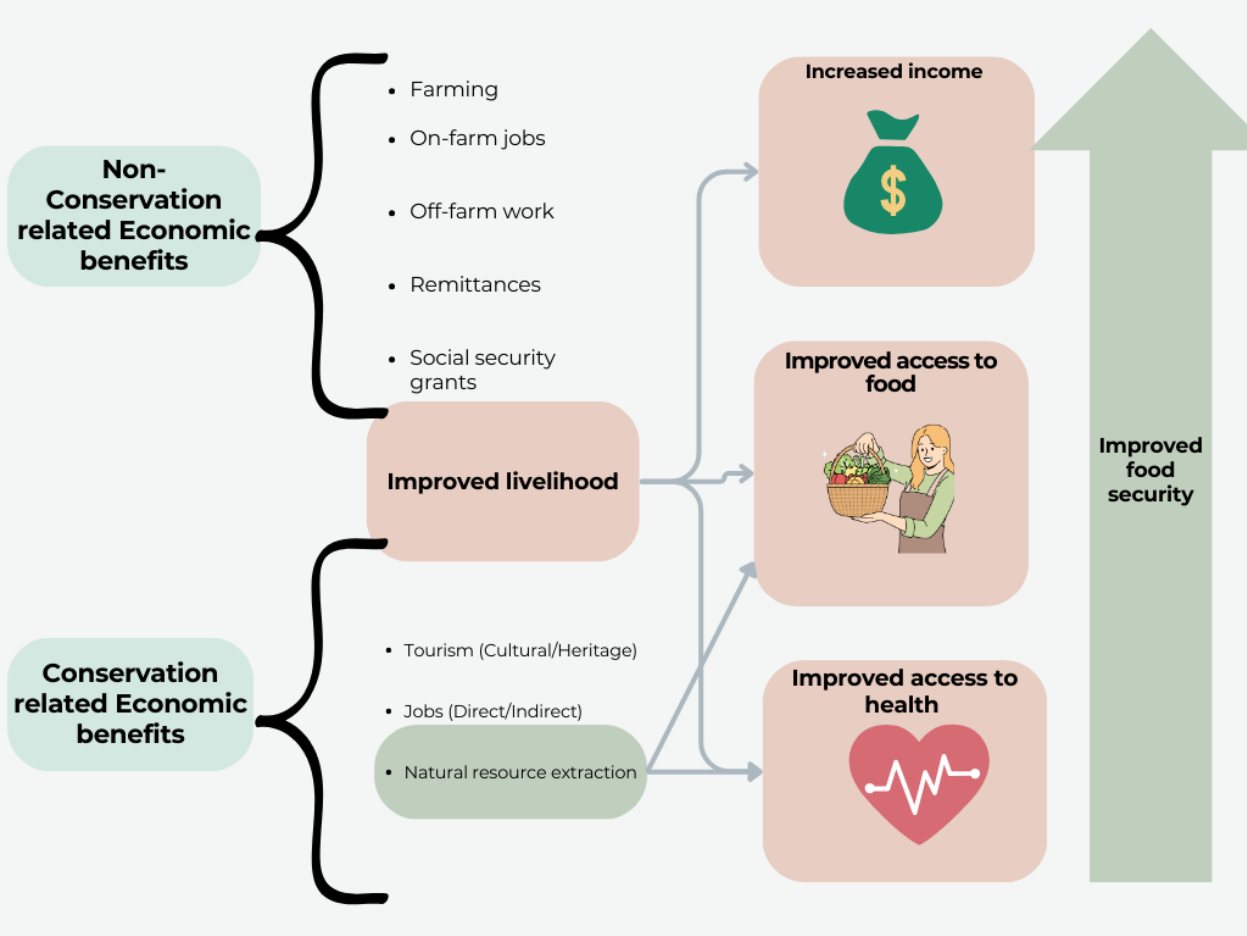

Figure 2.2: Conceptual framework

Source: Author's own analysis of literature reviewed

CHAPTER 3: METHODOLOGY

3.1 Introduction

This section delves into the methodology employed in the research, which is structured into three primary segments: the study area, the methods of data collection, and the processes involved in data analysis. The initial part of this section focuses on the study area, specifically the GLTFCA communities residing in proximity to Gonarezhou National Park in Zimbabwe. Detailed exploration is conducted on the social, environmental, and economic characteristics within this context. Moving on to the second section, the chapter elaborates on the data collection methods. The study encompassed a sample of 320 households, utilising a meticulously designed paper-based questionnaire for administration. The third and final section addresses the data analysis, and consists of three subsections. Firstly, the demographic measurements of households are discussed, addressing the primary objective of the study. Secondly, an in-depth examination of the five food security indicators is presented. This includes a comprehensive exploration of the rationale behind the chosen indicators, the methods employed for collection and measurement, and their interpretation in relation to household food security. The last subsection under this category is dedicated to the Propensity Score Matching (PSM) theory, the chosen econometric method for measuring impact in this study.

3.2 Study area

The study area for this study was based on communities living around the Gonarezhou National Park (GNP) in Zimbabwe. The GNP shown in Figure 3.1, is one of the three national parks that constitute the Great Limpopo Transfrontier Park. It is Zimbabwe's second-largest national park, and it covers an area of roughly 5053 km2 (Musakwa et al., 2020; Ntuli et al., 2019; Ntuli & Muchapondwa, 2018). The park was officially established in 1975, prior to this, it was a game reserve or protected area. The park has had to shift managing authorities, having been managed by the Zimbabwe Parks and Wildlife Authority between 1994 and 2007, the Frankfurt Zoological Society between 2007 and 2017 and finally, the Gonarezhou Trust after 2017 (Gandiwa, 2012;

Pleasant, 2012). The communities surrounding the GNP largely belong to the Shangani ethnic group (Gandiwa, 2012). Their main economic livelihoods include livestock keeping and smallholder crop production (Mpofu et al., 2012). There are very few employment opportunities outside the agricultural sector, except for the few opportunities presented by the biodiversity economy. Through CAMPFIRE, the communities economically benefit from tourism income such as trophy hunting but to a limited extent. The GNP is home to a wide range of wildlife species (flora and fauna), including endangered species such as lions, elephants and leopards (Gandiwa, 2012; Mpofu et al., 2012).

Communities surrounding the GNP have been found to suffer Human Wildlife conflict through wildlife predation and crop damage (Ntuli et al., 2021; Zanamwe et al., 2018). Further, wildlife-livestock diseases are common in the area due to the proximity to wildlife such as the Buffalo, which spreads foot and mouth disease to hoofed livestock (Chaminuka et al., 2014; Tavuyanago, 2016). There is a tense relationship between communities and park authorities as a result of these challenges. There is also a clear challenge to balance wildlife conservation and community developmental needs. Given this history, it is difficult to ascertain the role that the park plays in supporting local food systems and at what expense. This study compared the welfare outcomes, such as food security and nutrition, of households participating in the biodiversity economy and non-participants, using descriptive statistics and the propensity score matching (PSM) method.

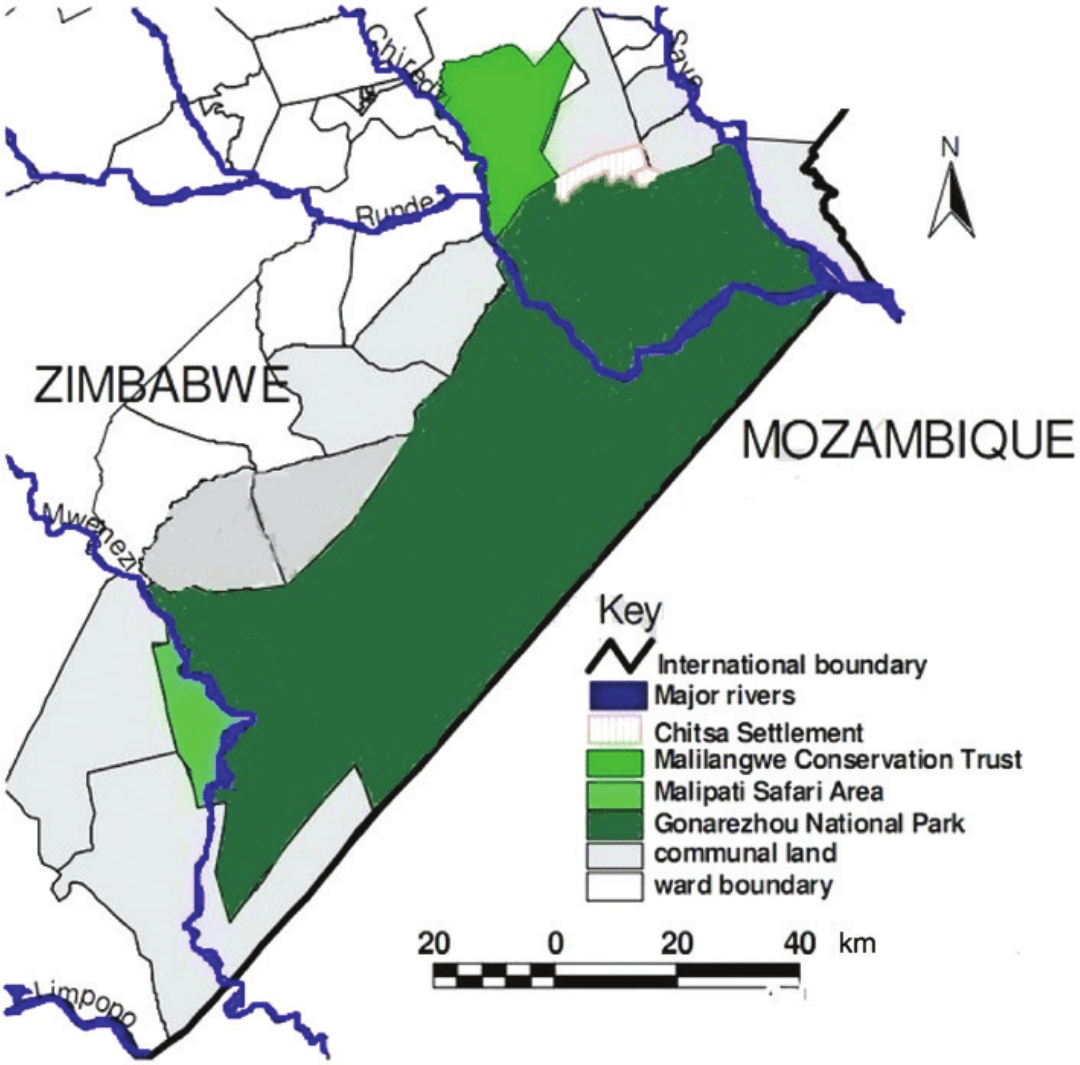

Figure 3.1: Map of the Gonarezhou National Park

Source: Ntuli et al., 2018

3.3 Data collection

The data that was used in this study was collected from a random sample of 320 households in local communities living adjacent to the Gonarezhou National Park in Zimbabwe. Both beneficiaries and non-beneficiaries located within the 45-kilometer radius were randomly recruited into the sample based on a systematic random. Systematic random sampling was used based on a sampling interval computed by dividing the total number of households in a chosen village by the required sample size for that village. First, each enumerator chose an initial household at random upon entering a village by tossing a coin, i.e., head means start while tail means skip. Next the

enumerator chose a direction to follow starting from the chosen household by spinning a metal pointer tied in the middle by a string.

The selection process therefore did not distinguish between the two categories. A distinction is made by the questions asking about household participation in the biodiversity economy. The PSM was then used as a statistical technique used to prepare data for econometric analysis by allocation of participants into treatment and control groups and to reduce selection bias while estimating treatment effects.

Propensity score matching (PSM) is a quasi-experimental method in which the researcher uses statistical techniques to construct an artificial control group by matching each treated unit with a non-treated unit of similar characteristics. Using these matches, the researcher can estimate the impact of an intervention Village names were obtained from village leaders and samples were selected at regular intervals from the list. Selected households that were not available to participate in the interview were replaced accordingly. These households were selected from a total of 13 villages that are located within a 45km radius to the GNP: Mazini, Samu, Chali, Sengwe, Mapolisa, Mathanasa, Mapaipa, Mungwambani, Mayise, Ngwenyeni, Chihlele, Masivamele, and Mpapa. All these villages were located within a 45-kilometre radius of the park. To select the sample size, both the beneficiaries and non-beneficiaries were included, hence the use of PSM to analyze data as it can extract a control group from data that has no baseline. The findings of the study revealed that, on average, households categorised as beneficiaries lived slightly closer to the park, with a difference of approximately 3 kilometres in proximity compared to non-beneficiaries.

The study benefited from data collected under the Welfare Effects and Gender Dimensions of Licit and Illicit Biodiversity Economy: The Case of the GLTFCA, KAZA and SOKNOT Project, in July 2023. The UGOT/UP Project is funded by the University of Gothenburg in Sweden as part of a collaborative research project that was signed between Gothenburg University and the University of Pretoria. Researchers at the University of Pretoria are leading the data collection exercise in the GLTFCA. The UGOT/UP project is an ongoing collaborative research project which was initiated in 2015 by researchers in the Environment for Development (EfD) Initiative or network in South Africa and Sweden.

The data enumerators that aided data collection were taken through an intensive 3-day training by qualified researchers from the University of Pretoria. Thereafter, data collection began under close supervision of the University's researchers. To ensure data quality, the questionnaires were checked on a daily basis for correctness and accuracy. The questions in the questionnaire captured data relevant to the study, including household demographics, socio-economic and livelihood characteristics, natural resource utilisation and household-level food security indicators. The food security indicators included months of adequate food provisioning, household dietary diversity score, coping strategy index, household food expenditure share, and household asset index.

3.4 Data analysis

This study investigated the two objectives outlined in chapter one of this paper. The study used both descriptive and econometric tools to analyse the objectives as outlined in the following subsections. The paper used descriptive statistics to characterise the socio-economic demographics of households living in the study area. Then, the PSM statistical technique was used to tease out the impact that the GNP has had on the food security of the local communities.

3.4.1 Household demographics

The study characterised households using socio-economic and demographic data. This section gives a brief justification for the choice of demographic variables included in the study. The variables have been disaggregated by beneficiary and non-beneficiary to give a distinction between the two groups of interest. The selection of the observed variables was based on literature that points to how these variables are likely to affect participation in the biodiversity economy. This selection criterion is in line with the criteria set out by Rosenbaum & Rubin, (1983) that only variables that meet the requirements shall be included in the estimation method.

Participation in the biodiversity economy is usually limited to communities that live in the confounds of conservation areas. Most rural-based households live in remote areas that are sometimes within or near conservation areas. As such, the distance to the GNP was the main determining factor used to determine the inclusion of households in the study. In this study, only households that live within a 45 km radius of the park were included. Therefore, in addition to distance to the park, for the categorical variables, gender, marital status and native status were included.

According to studies by the International Labour Organisation, gender and marital status have an impact on engagement in the labour force. Women have reduced engagement and men have increased engagement in work (ILOSTAT, 2022). Married males have increased family responsibility and are therefore more likely to seek work than single males meanwhile, women have increased household chores and caregiving responsibilities that take away from their productive time (ILOSTAT, 2022). Similarly, divorced or widowed women are more likely to seek work opportunities to support their families as compared to single or married females. As a matter of fact divorced and widowed women who are heading households are more vulnerable to poverty shocks due to age and reduced ability to work and earn (Converso et al., 2018). Based on this, the marital and gender variable was included in the method. The employment status was included because employment of any nature reduces the need to participate in the biodiversity economy. The native status was included because being a native of a community increases the chances of benefiting from the community as compared to non-natives. Being a native is tied to receiving the social security benefits of a country of citizenship and therefore, it could serve as a selection criterion for selecting who benefits from the park. Further, cross-border work was also included because households engaged in cross-border work/trade are less likely to participate in the biodiversity economy because they are economically well off and are, therefore, not in dire need.

Lastly, the number of years in school was included because education and literacy are a proxy for skill set development. The higher the education level, the more ability the person has to either run a business or get employment in the park.

3.4.2 Food Security Indicators

There is no single food security indicator that captures all the dimensions of food security and at the same time, researchers agree that measuring food security is complex and should involve the use of more than one food security variable (Hendriks et al., 2016; Maxwell et al., 2008). In this study, five food security indicators have been used in an attempt to measure each of the four currently recognised dimensions of food security. The food security indicators used in this study measure various aspects of the four common food security dimensions. These are elaborated on in table 3.1 below.

Table 3.1: Food security indicators and dimensions

Food security indicator	Food security dimension	Reference
Household Dietary Diversity Score (HDDS)	Accessibility	Swindale & Bilinsky, (2006)
Asset index	Stability	Browne et al., (2014)
Coping strategy index	Availability and accessibility	Maxwell et al., (2008)
Food Expenditure share	Accessibility	WFP, (2017)
Month of Adequate Household Food Provisioning	Availability and stability	Bilinsky & Swindale, (2010)

Source: Author's own analysis of reviewed literature

The study compared the food security status of beneficiaries and non-beneficiaries across these five-food security indicators: (i) the Household Dietary Diversity Score (HDDS), (ii) Months of Adequate Food Provisioning (MAHFP), (iii) Food Expenditure Share (FES), (iv) Coping Strategy Index (CSI), and (v) Asset Index. These indicators were calculated and organised into a tabular format. To measure impact, the food security indicators were regressed against the binary variable of participation in the biodiversity economy. The objective is to analyse the relationship between food security and engagement in the biodiversity economy. Here's a brief discussion of each food security indicator used:

a) Household Dietary Diversity Score (HDDS)

As part of the FANTA II Study, the Household Dietary Diversity Score (HDDS) was made public in 2006 as an indicator of household food access. A key indicator of food security, household dietary variety is defined as the number of food groups a household consumes over a certain reference period. A more varied household diet is associated with adequate calorie and protein intake, a higher proportion of animal-sourced protein, and household income (Swindale & Bilinsky, 2006). Based on the last 24 hours, the HDDS indicator gives a peek at a household's socioeconomic situation and capacity to get food (Kennedy et al., 2011).

To compute the HDDS, for each food category, a score of 1 (if consumed) or 0 is assigned (if not consumed). The household score, which ranges from 0 to 12, is determined by how many food groups collectively are consumed by the household. On the other hand, the average HDDS score will be computed as total HDDS divided by the total number of households surveyed. This was done in STATA 18 software. In this study, data on a total of 16 food groups was collected. These

included cereals, white roots and tubers, orange flesh vegetables, dark green leafy vegetables, other vegetables, orange flesh fruits, other fruits, organ meat, meat, eggs, fish, pulses, milk, oils and fats, sweets, and condiments. To come up with 12 food groups, orange flesh vegetables, dark green leafy vegetables and other vegetables were combined, orange flesh fruits and other fruits were combined and lastly, organ meat and meat were combined. This combination gave three food groups, namely, vegetables, fruits and meat. The breakdown of the food groups is only important if the study is trying to calculate the nutrient intake.

b) Months of Adequate Household Food Provisioning (MAHFP)

The Months of Adequate Household Food Provisioning (MAHFP) of households was the second food security indicator that was computed. This indicator is adopted from (Bilinsky & Swindale, 2010) under the USAID FANTA Project. It assesses the number of months in which a household has sufficient access to an acceptable quantity and quality of food. The indicator is computed by simply tallying the number of months each household had food insufficiency. Once tallied, this is subtracted from 12 months to get the months of adequate food provisioning. The average MAHFP is then calculated by summing the household MAHFP of all households in the sample and dividing them by the sample size. The indicator is mathematically presented below;

$$MAHFP = (12) - Sum(A + B + \cdots + L)$$

$$Average\ MAHFP = \frac{Sum\ of\ all\ MAHFP\ in\ the\ sample}{Total\ number\ of\ households}$$

In this study, the number of months that the household obtained enough food over the course of a year was used to determine the MAHFP for each household. For the variable MAHFP broken down by participants and non-participants, a tabulate command was executed. Understanding the distribution of MAHFP among households in these communities was made easier by breaking down the variable by participation. Deitchler et al. (2010) claim that the MAHFP indicator can track changes in a household's capacity to manage vulnerability over time so as to guarantee food availability above a minimal threshold all year long. Understanding the MAHFP is helpful since it records the food calendar for the home and may be utilised to guide policy about enhanced agricultural production, storage, and interventions that raise the purchasing power of the household (Deitchler et al. 2010).

c) Food Expenditure Share (FES)

One measure of a household's economic vulnerability is the Food Expenditure Share (FES). It evaluates economic vulnerability without mentioning a minimum expenditure barrier or poverty line. The degree to which a household is vulnerable to food insecurity depends on the percentage of total consumption expenditure that is spent on food. Over the course of a one-month recall period, data on the cost of consumables and purchases was gathered for this study.

In this study, the FES was calculated using data collected over a one-month recall period. Expenditure on food and non-food items collected over one month to come up with total household monthly expenditure. The expenditure on food was then divided by the total food expenditure and multiplied by 100 percent to come up with a FES percentage share.

Coping Strategy Index (CSI)

The Coping Strategies Index (CSI) keeps tabs on people's actions when they don't have access to enough food. After responding to a series of questions regarding how households deal with a shortage of food for consumption, a straightforward numerical score is produced. The purpose of the variety of questions posed is to learn what happens in households when there is not enough food or the money to purchase it. The questions focus on stress, crisis, and emergency management techniques that are best appropriate for the given situation. It is advised that analysts choose the ten techniques that are most pertinent to their situation.

For this study, the CSI was computed using 12 questions over a 7-day recall period. In a recall period of 7 days, respondents were asked to recall the number of days they used each coping strategy. The value ranged between 0 days and 7 days. The questions were given a score between 1 and 4 depending on the severity of the strategy used. The most severe strategies were scored with 4 and the least severe with 1. The score was multiplied by the number of days that the household used each coping strategy and the outcome value was used to determine the household’s coping strategy index.

d) Asset Index

A household's financial situation can be represented via an asset index (Sahn & Stifel, 2003). It indicates a household's resilience to shocks and provides a relative measure of poverty for each

household. The asset index was created in STATA 18 using a tabulation command. Because they exhibit little variation, it is recommended to exclude assets owned by more than 95% of households or less than 2% of households. Thereafter, the average number of assets that each household owned was determined using a straightforward count command. Next, the households were categorised in order of least resilient (those with fewer than three assets) to most resilient (those with over ten assets). Because data on quality, quantity, and monetary value of assets owned was not available it was difficult to assign a score to the assets, so the simple count variable was used. Strictly speaking, an asset index was not generated, rather a count of assets owned by the household was generated.

3.4.3 Categorisation of the Food Security Indicators

Table 3.2 gives an account of the different categories used to categorise the food security indicators. Each food security indicator is categorised using a metric that indicates how severe the food security situation is. The first food security indicator in the table, Household dietary diversity score (HDDS) was categorised into three categories with households consuming more than 6 food groups are considered to have adequate dietary diversity, those consuming between 4 and 5 food groups are considered to be having moderate dietary diversity and those consuming less than 3 food groups having inadequate dietary diversity (Swindale & Bilinsky, 2006). The second indicator is the consumption based coping strategy index (CSI). The indicator is equally disaggregated into three categories, with low CSI implying that households with a CSI less than 50 percent, medium for households with a CSI between 50 and 65 percent, and high for households with a CSI higher than 65 percent.

The third indicator is the asset index which simply shows that most resilient households are those with more than 10 assets, those with moderate resilience have between six and ten assets and the least resilient households have less than six assets.

The fourth indicator is the food expenditure share, which shows the percentage share of a household's income that is spent on food in comparison to total household expenditure. Households that spend more than 75 percent of their income on food are considered to have very high FES and, therefore, food insecure, those that spend 65 to 75 percent are considered to have

high FES, those spending between 50 to 65 percent are considered to have medium and those spending less than 50 percent are considered to have low FES (WFP, 2017).

The fifth and last indicator is the months of adequate household food provisioning. Households with enough food for more than ten months are considered to be least food insecure, households with enough for six to ten months are moderately food insecure and those with enough food for less than six months in a year are most food insecure (Bilinsky & Swindale, 2010).

Table 3.2: Categorisation of food security indicators

Food security Indicator	Category	Description of category	Literature source
HDDS	Adequate dietary diversity	> 6	Swindale & Bilinsky, (2006)
	Moderate dietary diversity	4-5	
	Inadequate dietary diversity	≤ 3	
CSI	Low CSI	<50%	Maxwell et al., (2008)
	Medium CSI	50% - 65%	
	High CSI	>65%	
Asset Index	Most resilient	≥10	Browne et al., (2014)
	Moderate resilient	6-10	
	Least resilient	<6	
Food Expenditure Share	Low	<50%	WFP, (2017)
	Medium	50% - 65%	
	High	65% - 75%	
	Very high	≥75%	
MAHFP	Least food insecure	≥10	Bilinsky & Swindale, (2010)
	Moderate food insecure	6-10	
	Most food insecure	0-6	

Source: Author's analysis of reviewed literature

3.4.4 Propensity Score Matching (PSM): Theory

Conducting an impact assessment without baseline data for non-experimental observable data can be challenging. Because, unlike randomised research studies where the likelihood of treatment exposure is typically equal between the treatment and control groups, non-randomised data is collected in uncontrolled environments (Winters et al., 2010). As a result, drawing causal inferences from such studies requires the existence of treatment and control groups that possess similar characteristics, like randomised experiments. Fortunately, some techniques can be used to

estimate causal effects, for example, matching methods (Pokropek, 2016). The Propensity Score Matching (PSM) method was employed in this study.

PSM was developed by Rosenbaum & Rubin (1983) and serves as a statistical tool employed to demonstrate the likelihood of receiving a particular treatment based on observed characteristics. It uses propensity scores to match the treated and control groups, ensuring that exposure to the intervention was the only difference between them. The matching process is done so that each participant is matched to a non-participant on a single propensity score rather than multiple propensity scores. By doing so, PSM evades the problem of dimensionality because it matches participants on a single propensity score, rather than trying to match the participants on all characteristics, which is rarely possible to find (World Bank, 2010). Meanwhile, variables that cannot be matched are instantly dropped. Once the comparison group is determined, it is compared to the treated group, and the Average Treatment Effect (ATE) or the Treatment effect on the Treated (TOT) is computed to quantify the difference in outcomes between the two groups. The advantage of using PSM to match participants and non-participants is that it evades the curse of dimensionality.

For PSM to be applied, two conditions need to be satisfied (Rosenbaum & Rubin, 1983):

i) Conditional Independence: This assumption implies that, given the observed characteristics, the assignment to the treatment or comparison group is independent of the potential outcomes. The fulfilment of this assumption evades selection bias, and as a result, the sole difference between the two groups is the treatment assignment, and an objective impact estimate can be generated (Rosenbaum & Rubin, 1983).

ii) Overlap in Propensity Scores: The region commonly referred to as the "region of common support" establishes the range within which the propensity scores of both participants and non-participants exist, with a minimum and maximum boundary. This range must sufficiently overlap to ensure that the observed characteristics in participants are also present in non-participants. This overlapping ensures the existence of comparable individuals in both groups, facilitating meaningful comparisons. Observations with propensity scores outside this common support region are excluded. While removing such observations enhances the quality of matching, it does result in a reduction of the sample size. Therefore, it is crucial to strive for maximum similarity between

the sampled participant and non-participant groups to minimise the risk of diminishing the sample size.

By meeting these two conditions, PSM provides a framework for estimating the causal impact of the treatment by constructing an artificial comparison group. PSM constructs a statistical artificial comparison group based on the method below:

$$P(X) = Pr\ (T = 1|X)$$

Where P is the propensity score, T is the probability of participating in the treatment based on observed characteristics and X are the observed characteristics.

The GLTFCA is made up of three major national parks and a couple of privately owned game reserves. The literature reviewed in this study suggests that one of the objectives of the GLTFCA was to improve the well-being of surrounding communities. This was to be achieved through increased benefit-sharing of tourism benefits. Several developmental projects and activities such artisanry, tour guides and more were implemented by park authorities to enhance community participation in the biodiversity economy yet research suggests mixed outcomes of the economic opportunities presented by the GLTFCA. Some suggest that they have not led to improved livelihood outcomes while others argue otherwise. This study takes a unitary look at communities living around the Gonarezhou National Park in Zimbabwe and uses a propensity score matching to conduct an impact assessment. The study focus is centered on household food security but acknowledges that improved livelihood outcomes are a direct proxy for improving food security.

3.4.3.1 Defining the dependent variable

In this study, the dependent variable is binary "participating in the biodiversity economy". The biodiversity economy is defined as business entities and other economic endeavours that, through their operations, either directly benefit from biodiversity for their primary operations or indirectly support biodiversity conservation (DEA, 2016).

Beneficiaries were defined as households where at least one member received benefits from the park. These benefits encompassed employment, income from tourism, paid work opportunities, access to natural resources, and meat rations. In contrast, non-beneficiaries were defined as households in which no members received any of these benefits from the park.

Considering that this is a food security study, direct access to food from the park was considered a benefit. Therefore, beneficiary households benefiting from meat rations from the park were included. Meanwhile, it was important to define a counterfactual group that the treated group will be compared to. Since baseline data is missing, this counterfactual was extracted from the same study sample. There was no eligibility criteria for households to participate in the biodiversity criteria. all households had an equal chance of participating because of their proximity to the park. However, limited participation opportunities determined who could participate and who could not. Therefore there were two groups, participants and non-participants.

The treated had to take some action, e.g., the treated beneficiaries lived a few kilometers close to the park boundary compared to non-beneficiaries. Furthermore, the treated group members had to have skills to be employed in the park and the untreated did not. Meat rations were distributed based on information flow and those that could reach the slaughter point quickly This was important because to create a good control group for comparison purposes, two comparative groups must be present, and the two groups must be very similar in many ways. The counterfactual represents what would have occurred in the food security status of the communities if the GNP had not been established.

The advantage of using PSM for impact assessment is that it assumes that the influence of unobserved factors is minimal to obtain unbiased estimates. Worth noting that several other researchers have used PSM to conduct impact studies (Gracia et al., 2007; Kuntashula & Mungatana, 2015; Mapanje et al., 2021; Mpande, 2021; Verhofstadt & Maertens, 2015).

Given this background, the dependent variable was constructed by categorising respondents as participants in the biodiversity economy if they answered "yes" to any one of the questions specified below.

i) Does any member of the household benefit from wildlife conservation or tourism activities?
ii) Is any member of the household employed in the park, either temporarily or permanently?
iii) Does the household get any other benefits from the park?

iv) Does any household member receive income from a specified list of biodiversity economic activities e.g., trophy hunting?

v) Does any member of the household harvest environmental resources e.g. mopani worms, meat, wild vegetables?

Based on these questions, a simple participation dummy variable was constructed. This variable assigned a value of one to any observation corresponding to a household answering "yes" to at least one of the questions and zero if the response was "no" to all the questions. Consequently, participants were designated as 1, while non-participants were designated as 0. In principle, participants are denoted as beneficiaries, and non-participants are denoted as non-beneficiaries. Ultimately, a total of 100 households were categorised as beneficiaries and 220 as non-beneficiaries. Based on this, the beneficiaries were matched to non-beneficiaries based on their observed characteristics.

3.4.3.2 General procedure to estimate the propensity scores

Several steps can be followed to conduct a propensity score matching. In this study, four steps were followed to determine the impact of the GNP biodiversity economy on household food security. Firstly, the propensity scores were estimated using a probit method. Secondly, the matching algorithms were selected. Thirdly, the region of support was defined. Lastly, the ATT was calculated. In this section, each of the steps followed to construct the PSM method are discussed.

i) Estimating the propensity scores

Propensity scores were estimated using a probit method, and the criteria for selecting observable variables in the probit method adhered to the principles outlined by Rosenbaum and Rubin (1983). First, the choice of observable variables in the method was guided by those employed in similar previous studies. Second, the selected variables were required to influence both the decision to participate in the treatment (participation in the biodiversity economy) and the outcome variable. Consequently, only variables meeting these criteria were included.

Table 3.3 presents the variables used in this study. Both binary and continuous variables were used in the econometric method with the treatment variable defined as a binary variable indicating participation in the biodiversity economy (yes or no).

Table 3.3: Variables included in the econometric method

Variable	Definition	Type
Gender of the household head	The sex of the head of the household interviewed	Dummy
Household farm plot size (ha)	Hectares of farming land owned	Continuous
Household size	Number of members in the household including infants	Continuous
Household head is married	Variable to indicate if the hh head is married	Dummy
Household income sources	Number of sources that bring income into the household	Continuous
Household went to bed hungry in the last 12 months	If a household went to bed without food due to economic challenges	Dummy
Household is involved in natural resource decision-making	Hh member/s participation in the park's natural resource management	Dummy
Household is aware of the transfrontier conservation area	Hh member/s knowledge of the TFCP	Dummy
Community benefits from wildlife conservation	Hh that receive benefits from the park	Dummy
Distance to park policy office (km)	Distance to nearest policy office in the park in km	Continuous
Household members are native	Hh members born in the GNP	Dummy
Number of schooling years of the Household head	Number of years the hh head spent in school	Dummy
Household head employment status	Formal employment status of hh head	Dummy

Source: Author's own analysis of reviewed literature

ii) Choice of the matching algorithm

The second step involved matching participants to non-participants using four matching algorithms: radius caliper, stratification, kernel and nearest neighbour matching method with replacement. Multiple matching methods were used because using multiple matching techniques, as the World Bank, (2010), suggested enhances the robustness of the programme's impact assessment.

iii) Defining the region of common support

The third step involved defining the region of support. This is the region that shows the overlap between the propensity scores for the beneficiaries and non-beneficiaries. All variables falling outside this area are not used in matching variables. In this study, the region of support was verified using graphical and computational means.

As its main weaknesses, the PSM technique does not use observations that fall outside the common support and does not account for endogeneity issues (Rosenbaum & Rubin, 1983). However, PSM is widely used in social science and other fields such as health economics (Chikodzi et al., 2021; Gracia et al., 2007; World Bank, 2010) if either baseline data was not collected and in cases when an experimental design failed to allocate study participants randomly, suffer from significant bias such as attrition or contamination

iv) Checking the balancing to test the matching quality

PSM serves as a balancing tool that balances covariates between the two groups (beneficiaries and non-beneficiaries). The point of balancing covariates is to ensure that there are no significant differences between the two groups after matching. That way, balancing the two groups becomes very important. Balancing the treatment and comparison groups is crucial for the success of Propensity Score Matching (PSM), as highlighted by (Imbens, 2004).

If there are no significant differences between the groups following matching, balancing was successful. This step is of great importance in preventing misspecification and enhancing the accuracy of treatment effect estimates.

To ascertain the success of balancing in PSM, a critical assessment is performed by comparing the covariate distributions before and after matching. One widely employed method is through the

evaluation of standardised bias, a measure of the degree of imbalance between the treatment and control groups. By calculating the standardised bias for each covariate before and after matching, it is easy to gauge the effectiveness of the balancing procedure.

Beyond standardised bias, various graphical and statistical techniques can be employed to ensure balance. These include visual representations such as kernel density overlays, cumulative distribution plots, love plots, and weight plots. Additionally, conducting covariate balance tests, such as the Kolmogorov-Smirnov test or t-test, contributes to a comprehensive assessment of the matching process. However, researchers commonly use this approach (Imbens, 2004).

v) Calculating the Average Treatment Effect on the Treated

Propensity scores produced by probit regression were used for matching. Regressing a set of observable characteristics that influence outcome variables and participation in the biodiversity economy on the treatment variable "participation in the biodiversity economy" The study's two outcome variables are the share of food expenditure and the household dietary diversity score. The bias in selectivity was largely reduced by matching. It was the matching procedure that produced the ATT.

CHAPTER 4: RESULTS

4.1 Introduction

This study had two main objectives. Firstly, the study aimed to characterise the households in the study areas through their social, economic and demographic characteristics. Secondly, the study aimed to establish the impact of the GNP on the food security situation of the households using pre-identified food security indicators and to identify means through policy interventions of amplifying positive impacts while mitigating negative impacts of the GNP on household food security. This chapter presents the findings of the study. The descriptive statistics are presented first and followed by the findings of the propensity score matching technique.

4.1.1 Descriptive results

This section provides an overview of the social, demographic, economic, and cultural attributes of the communities under examination. These characteristics constitute the focal point of the first objective of this study. Additionally, the descriptive statistics establish a foundation for a deeper comprehension of the context within which these communities function. The study employed a combination of categorical and continuous variables to assess these characteristics, organising them under a unifying thematic framework.

4.1.1.1 Demographic Characteristics

Table 4.1 distinguishes between participants and non-participants in the biodiversity economy, referred to as beneficiaries and non-beneficiaries, respectively. The results indicate that the majority of households are headed by males, comprising 70 percent of the surveyed household heads, with nearly 75 percent being married and 21 percent widowed. Further examination of the marital status variable reveals that 91 percent of widowed households are headed by females, indicating a patriarchal system within the sampled communities. Additionally, there is a higher prevalence of married household heads among non-beneficiaries (77 percent) compared to beneficiary households (69 percent). Regarding native status (i.e. households and their members born in the GNP), nearly all (98 percent) of the households in the sample are native to the community where the study was conducted, and this result is similar between beneficiaries and non-beneficiaries.

Moreover, descriptive findings in Table 4.1 indicate that, on average, household heads are approximately 51 years old.

Both beneficiary and non-beneficiary households have large family sizes averaging eight members per household implying a high dependency ratio in the sampled households. Interestingly, despite the large household sizes, both beneficiaries and non-beneficiaries have small homesteads with fewer than 3 rooms per household. Lastly, illiteracy is prevalent among household heads, with beneficiary heads having an average of 5.83 years in school and non-beneficiary household heads having 5.9 years in school (Table 4.1).

Table 4.1: Household Demographic Characteristics

Variable	categories	Non-beneficiary	Beneficiary	Average
Gender	Female	29.55	29.00	29.38
	Male	70.45	71 .00	70.62
Marital status	Single	2.28	2.00	2.19
	Married	76.71	69.00	74.29
	Divorced	2.28	3.00	2.51
	Widowed	18.72	26.00	21.00
Household head native status	No	1.82	2.00	1.88
	Yes	98.18	98.00	98.12
Age of household head	Mean	51.4	51.2	51.3
	Std. Dev	14.51	14.35	14.43
Number of years hh head spent in school	Mean	5.9	5.83	5.9
	Std. Dev	3.98	4.26	4.12
Number of rooms of the house	Mean	2.39	2.67	2.53
	Std. Dev	1.52	2.5	2.01
Household size	Mean	8.02	7.8	7.91
	Std. Dev	2.94	2.64	2.79

Source: Survey data (2023)

4.1.1.2 Economic Characteristics

Table 4.2 shows that there is a difference in the number of income sources, households tend to have multiple income sources, averaging between 0 to 3 per household with beneficiaries (an

average of 1.36 income sources) displaying more sources and higher average annual income compared to non-beneficiaries (1.28 income sources). It's noteworthy that none of the beneficiary households have zero income sources, unlike the non-beneficiary ones. This disparity underscores two critical points: first, non-beneficiary households confront lower economic opportunities compared to beneficiaries. Second, despite benefiting from the local park, beneficiary households still seek supplementary income sources, implying that the park's benefits alone are insufficient to sustain these households. Furthermore, the results in Table 4.2 show that non-beneficiary households have ZAR 3254 lower total annual household income compared to beneficiary households and spend ZAR 272 less than non-beneficiaries monthly.

Table 4.2: Household Economic Characteristics

Variable		Non-beneficiary	Beneficiary
Number of income sources	Mean	1.28	1.36
	Std. Dev	0.52	0.54
Total annual household income	Mean	21663.42	24976.59
	Std. Dev	25895.64	29149.39
Total monthly expenditure	Mean	1234.53	1506.41
	Std. Dev	1126.44	1455.82

Source: Survey data (2023)

The community in the study area is located on the borderline together with South Africa and Mozambique, therefore it was necessary to examine cross-border work (Table 4.3). The findings illustrate that 20 percent of the parents in non-beneficiary households worked abroad compared to 14 percent of beneficiary households. Conversely, 41 percent of beneficiaries' households have children working abroad compared to 34 percent in non-beneficiary households. This trend might indicate that beneficiary households have fewer incentives to seek work outside the community, whereas non-beneficiaries engage in cross-border work to sustain their households. Moreover, the investigation into household access to electricity highlighted a challenge in rural electrification, with less than 2% of households having access, none of which are from beneficiary households.

Table 4.3: Household economic characteristics for categorical variables

Variable	Categories	Non beneficiary (%)	Beneficiary (%)	Average (%)
Household head in employment	Unemployed	60.45	54.55	57.5
	Self employed	32.27	33.97	33.12
	Employed	7.27	14.00	9.38
Cross border work	Parents working abroad	20.45	14.00	18.44
	Children working abroad	34.09	41.00	36.25
Access to electricity	No	98.18	100	98.75
	Yes	1.82	0.00	1.25

Source: Survey data (2023)

4.1.3 Household agricultural activities and social capital

The analysis of agricultural activities of these households reveals that the communities are mostly pastoralists as livestock ownership was prevalent in the surveyed communities, as shown in Table 4.4. The households are also farming communities with each household owning an average of 1.2 farming plots with an average size of 16.7ha and beneficiaries own more plots and hectares of land than non-beneficiaries.

Table 4.4: Household Agricultural Activities

Variable		Non-beneficiary	Beneficiary
Size of farm (ha)	Mean	10.93	22.50
	Std. Dev.	23.83	92.62
Number of farming plots owned by household	Mean	1.17	1.21
	Std. Dev.	0.49	0.54
Number of livestock owned	Mean	26.26	27.85
	Std. Dev.	21.43	23.4

Source: Survey data (2023)

4.1.1.3 Natural resource extraction

Table 4.5 shows the most extracted natural resources in the park. Beneficiaries seemed to extract more natural resources than non-beneficiaries, likely due to proximity to and high interaction with

the park. Moreover, both groups exhibit a high dependency on the park's resources, notably for food and energy. Firewood and wild vegetables were the most extracted natural resources. The reliance on these resources is evidenced by the significant proportion of households engaged in the extraction of mushrooms (6.9 percent), wild fruits (37.5 percent) and vegetables (20 percent), firewood (93.44 percent), fish (14 percent) and many more. Moreover, there is a notable and perceived underreporting of hunting because it is considered illegal. While only 5 per cent indicated that they are hunters, it is believed that households are fearful of admitting to hunting as it is considered an illegal activity. When asked differently if households are aware of community members that are involved in illegal hunting, households admitted that more community members engage in hunting, especially the unemployed youth.

Table 4.5: Natural resource extraction

Variable	Non beneficiary (%)	Beneficiary (%)	Average (%)
Mushroom	6.82	6.94	6.88
Wild vegetables	32.73	42.22	37.5
Wild fruits	14.55	25.45	20.00
Firewood	94.55	92.33	93.44
Timber poles	19.09	21.53	20.31
Thatch grass	30.45	28.93	29.69
Fish	10.91	17.83	14.37
Other natural resources	16.36	24.00	20.18
Fisherman	23.64	29.48	26.56
Hunter	5.91	4.71	5.31

Source: Survey data (2023)

4.1.1.4 Human Wildlife Conflict (HWC)

Human-wildlife conflict illusttated in Table 4.6 remains a challenge for a considerable proportion of households, predominantly manifesting as crop damage (49 percent) and livestock predation (35 percent). Other forms of HWC were also reported in 54 percent of the households. Notably, beneficiaries experience more human-wildlife conflict (64 percent) compared to non-beneficiaries (50 percent), potentially since they are at least 3km closer to the park and have greater interaction with wildlife.

Table 4.6: Human Wildlife Conflict

Variable	Non beneficiary (%)	Beneficiary (%)	Total (%)
Crop damage	46.82	54	49.06
Livestock predation	35	37	35.62
HWC	49.76	64.21	54.3

Source: Survey data (2023)

4.1.2 Food security indicators by treatment

This section delves into the outcomes of food security indicators, breaking down the results based on whether individuals are beneficiaries or non-beneficiaries. The purpose of this disaggregation is to analyse and compare the food security status of these two groups. Specifically, the Household Dietary Diversity Score and the Food Expenditure Share indicators reveal statistically significant differences between beneficiaries and non-beneficiaries, at the 1 percent and 10 percent significance levels, respectively.

Table 4.7 illustrates that non-beneficiary households exhibit lower levels of dietary diversity, as evidenced by their consumption of fewer food groups compared to beneficiaries, with a difference of 0.37. Additionally, non-beneficiaries allocate a significantly higher portion (4.6 percent more) of their household income to food expenditure compared to beneficiaries, this could suggest a potential food insecurity among non-beneficiary households.

Moreover, the t-test conducted on the remaining food security indicators reveals no statistically significant differences. Nevertheless, the results highlight a prevailing issue of food insecurity among both beneficiaries and non-beneficiaries. For example, households in the study areas employ an average of 3.6 coping strategies to manage food shortages, with non-beneficiary households employing 1.38 more strategies than their beneficiary counterparts. Similarly, households experience an average of two months of insufficient food provisioning, with beneficiaries enduring fewer months of inadequate food provisioning compared to non-

beneficiaries. This implies that, on average, households face approximately two months of food insecurity every year.

In contrast, households exhibit resilience against food insecurity shocks, attributed to their asset base. On average, all households possess a minimum of 10 assets, with beneficiaries owning more assets than non-beneficiaries. The detailed findings of the food security indicators are explained below.

Table 4.7: Mean differences in food security indicators by treatment

Food security indicator	Obs.		Non beneficiary	Beneficiary	p value	t test
HDDS	320	Mean	4.58	4.95	0.008***	-2.66***
CSI	320	Mean	4.34	2.96	0.184	1.33
Assets	320	Mean	12.85	13.4	0.394	-0.85
Food expenditure share	320	Mean	70.14	65.56	0.056*	1.92*
MAHFP	320	Mean	9.95	10.38	0.171	-1.37

Source: Survey data (2023)

4.1.4 Household food security indicator categories

4.1.4.1 Household Dietary Diversity Score

The study used a set of 12 food groups to compute the Household Dietary Diversity Score (HDDS). The outcomes demonstrated that households ranged in consumption from a minimum of two to a maximum of eight food groups. Notably, the majority of households (36 percent) consumed five food groups, while less than 1 percent reached the maximum of 8 food groups, and 2.5 percent consumed the minimum of 2 food groups.

Illustrated in Figure 4.1 below, more than 55 percent of households, including both beneficiaries and non-beneficiaries, exhibited a moderate level of dietary diversity. It's noteworthy that non-beneficiary households faced a higher incidence of inadequate food access by 9 percent compared to beneficiaries. Conversely, 33 percent of beneficiary households achieved adequate diets,

surpassing the 20 percent observed in non-beneficiary households. This implies that beneficiaries enjoy better access to diverse diets.

Almost all households (99.38 percent) consumed cereals, as detailed in the Appendix 1: Household Dietary Diversity Frequency. Following closely were fats and spices, each consumed by over 80 percent of households. Conversely, the least consumed food groups, in ascending order, were organ meat, fish, and eggs. In summary, the overall findings reveal that households exhibit a high caloric intake with a predominant consumption of cereals and fats, while protein intake remains low, constituting less than 20 percent from meat and leguminous foods.

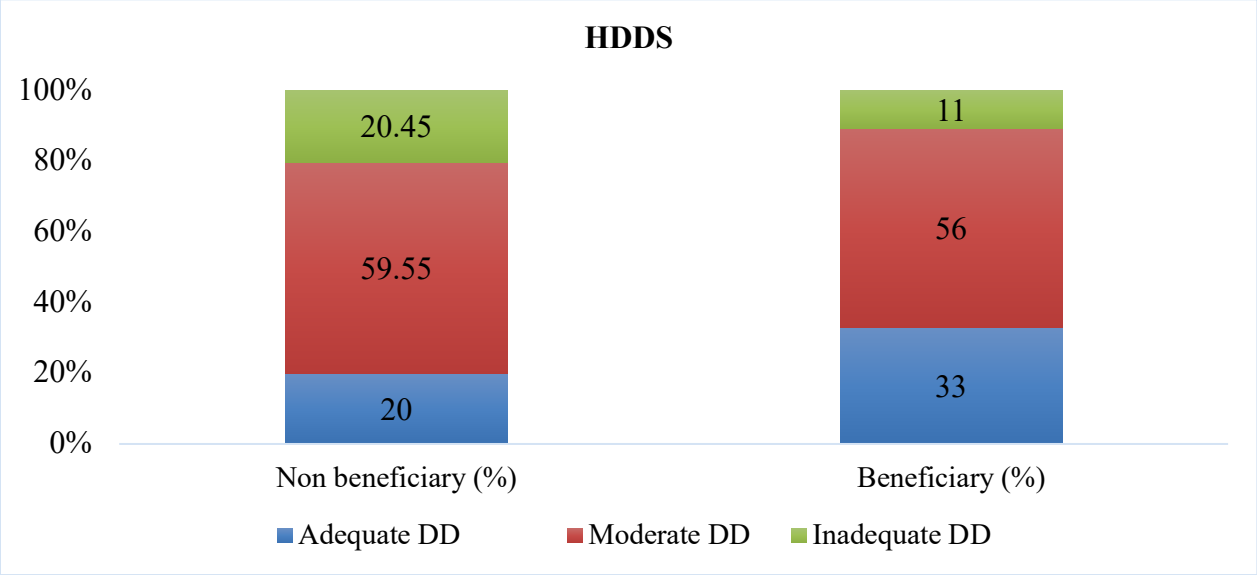

Figure 4.1: Household Dietary Diversity Score categorised by treatment

Source: Survey data (2023)

4.1.4.2 Coping Strategies Index

The Coping Strategies Index serves as a metric for assessing the approaches households employ to overcome food shortages, measured over a 7-day period preceding data collection. These strategies fall into four categories based on their nature: altering diet, temporarily increasing household food availability, reducing household size, or implementing food rationing. Each category encompasses various strategies, each varying in severity, ranked from one (least severe) to four (most severe). The ranking is integral to the index calculation, where the frequency of strategy usage over the 7-day period is multiplied by its assigned rank.

Figure 4.2 illustrates the coping strategies that communities in the study area engage in. In general, both beneficiaries and non-beneficiaries predominantly employed a few coping strategies to address food shortages. Notably, the employment of medium-level coping strategies was scarce among non-beneficiaries, constituting less than 1 percent of this group. Therefore, households are rarely needing to cope with food shortages or have exhausted all the possible coping strategies.

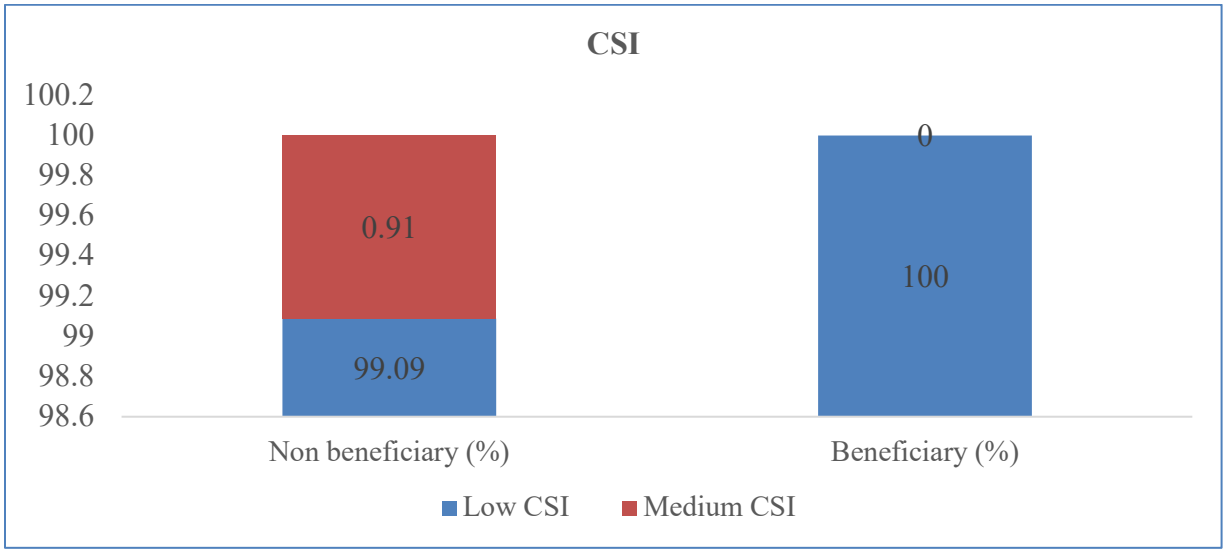

Figure 4.2: Coping Strategy Index by treatment

Source: Survey data (2023)

Table 4.8 gives a detailed overview of the coping strategies that households used in the seven days prior to the survey. The most widely adopted coping strategy among households was the reliance on borrowed food or help from relations, with 20 percent of households resorting to this approach. Interestingly, non-beneficiary households were more inclined to utilise this strategy compared to beneficiaries. Following closely were strategies such as reducing portion sizes (13 percent), limiting the number of meals eaten per day (13 percent), and resorting to less preferred food options (9 percent). Conversely, the least employed coping strategies included sending household members elsewhere to eat (1.25 percent) and prioritising food for working members at the expense of non-working members (1.56 percent).

The limited utilisation of these latter strategies could be attributed to widespread poverty and high unemployment rates within the community, leaving little room for families to support other

households. Additionally, the low employment rate revealed in this study suggests that many households lack working members, further limiting the feasibility of certain coping mechanisms.

Table 4.8: Consumptions-Based Coping Strategies

	Non beneficiary (%)	Beneficiary (%)	Average (%)	P value	Weight/ ranking
Dietary change					
Relied on less preferred and less expensive foods	9.09	9.67	9.38	0.796	1
Increase Short-Term Household Food Availability					
Borrowed food, or rely on help from a friend or relative	22.73	17.27	20	0.07	2
Purchased food on credit	6.36	6.76	6.56	0.831	2
Gathered wild food, hunt or harvest immature crops	5.91	4.71	5.31	0.48	4
Consumed seed held for next season	4.55	3.57	4.06	0.516	3
Decrease the Number of People					
Sent household members to eat elsewhere	1.36	1.14	1.25	0.786	2
Sent households members to beg	2.73	1.65	2.19	0.328	4
Rationing Strategies					
Limited portion size at meal times	11.82	13.00	12.19	0.765	1
Restricted consumption of adults in order for small children to eat	4.55	2.33	3.44	0.107	3
Feed working members of HH at the expense of non-working members	1.82	1.30	1.56	0.584	2
Reduced number of meals eaten in a day	14.55	9.83	12.19	0.056	1
Skip entire days without eating	5.00	1.88	3.44	0.023	4

Source: Survey data (2023)

4.1.4.3 Asset Index

Assets serve as indicators of a household's ability to withstand shocks, as they can be liquidated to generate income in the face of welfare-reducing events. This study incorporates this indicator to assess the stability of household food security over time. Resilience is categorised based on asset

ownership, with households possessing more than 10 assets considered highly resilient, while those with fewer than three assets are regarded as less resilient. Results in Figure 4.3 below indicate that over 60 percent of households fall into the highly resilient category because they own at least 10 assets, while nearly 30 percent exhibit moderate resilience and less than 8 percent are deemed least resilient.

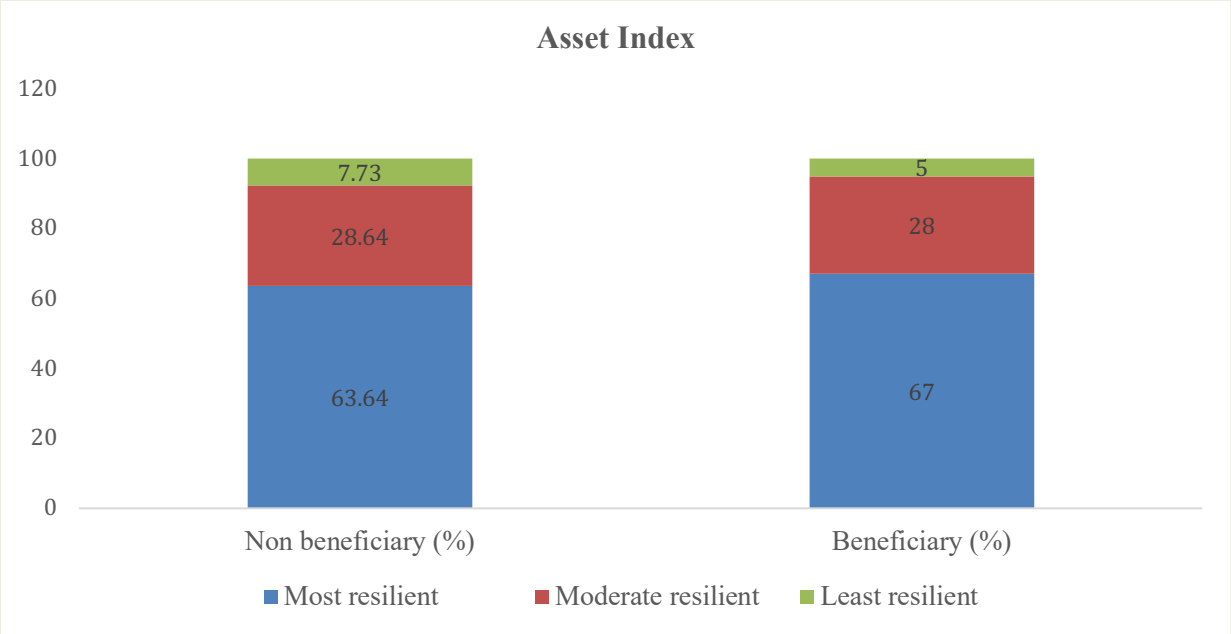

Figure 4.3: Asset index by treatment

Source: Survey data (2023)

4.1.4.4 Food expenditure as a share of total household monthly income

The Food Expenditure Share (FES) is an indicator revealing the proportion of household expenditures allocated to food relative to other non-food expenses. A higher FES, indicating more money spent on food compared to income, suggests greater food insecurity within a household (WFP 2015). In this study, FES was categorised into four levels: low, medium, high, and very high.

Figure 4.4 illustrates that the majority of households, beneficiaries (43 percent) and non-beneficiaries (47 percent), demonstrate very high FES. Notably, a larger proportion of non-beneficiary households allocate a higher percentage of their income to food, as evidenced by 22 percent falling into the high FES category and 16 percent in the medium FES category, in contrast

to beneficiaries with 19 percent in the high FES category and 14 percent in the medium FES category. Conversely, beneficiaries show a higher percentage (23 percent) of households with low FES compared to non-beneficiaries (14 percent). The t-test conducted shows a statistically significant difference at 10 percent significance in FES between beneficiaries and non-beneficiaries.

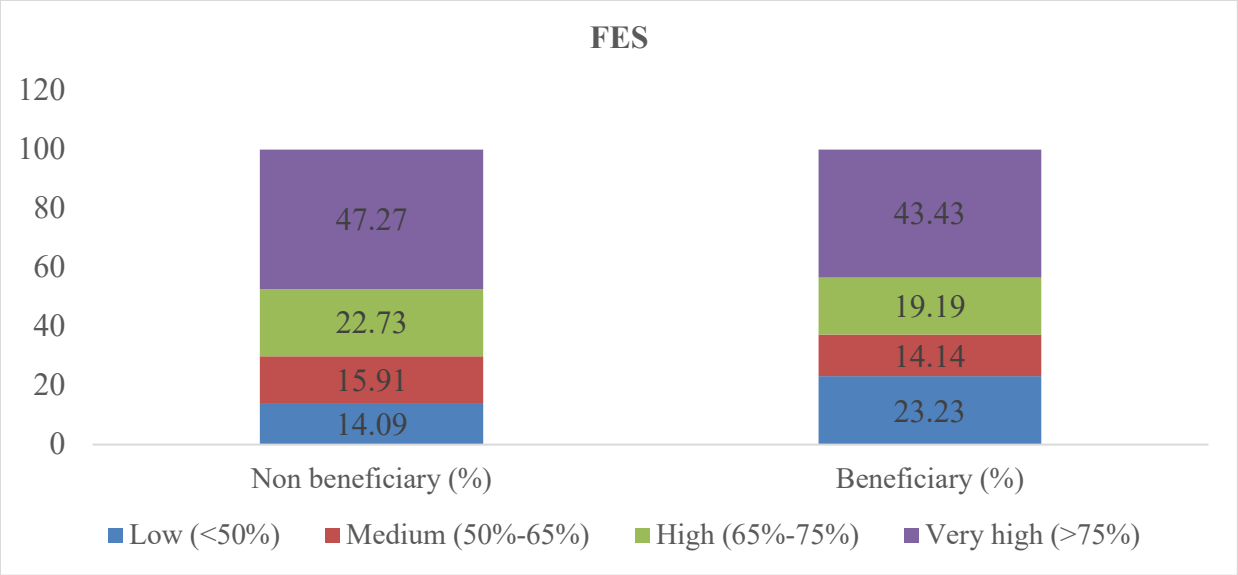

Figure 4.4: Food Expenditure Share by Treatment

Source: Survey data (2023)

4.1.4.5 Number of months of adequate household food provisioning

The result of the Months of Adequate Household Food Provisioning (MAHFP) is illustrated in Figure 4.5 below. The MAHFP serves as a metric to measure the duration within a 12-month calendar period during which a household experiences insufficient food. This study inquired about food provisioning from July 2022 to July 2023, the period when data was collected. The results in Figure 4.5 reveal that 73 percent of beneficiaries and 70 percent of non-beneficiaries experienced adequate food provisioning, averaging 10 months of sufficiency. This suggests that households had sufficient food for a minimum of 10 months throughout the year, with the least-provisioned household having one month and the most-provisioned having 12 months of adequate food. However, at least 27 percent of beneficiaries faced moderate to the least food provisioning, and 30 percent of non-beneficiary households experienced moderate to the least food provisioning. This

highlights a considerably high proportion of food insecurity among both beneficiaries and non-beneficiaries.

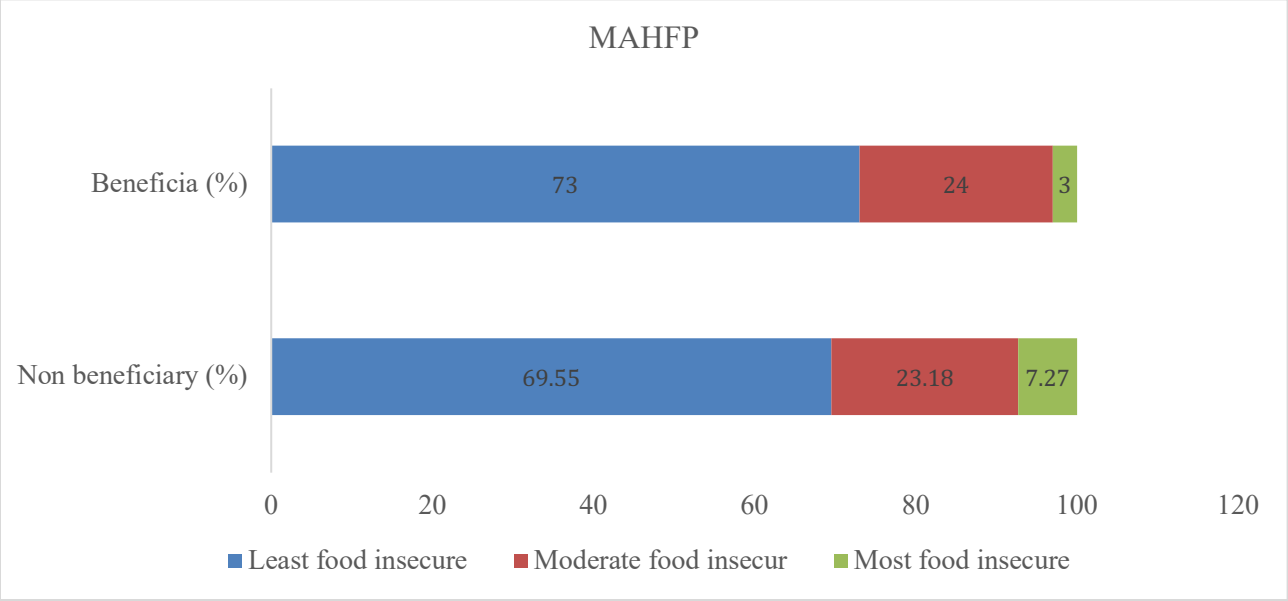

Figure 4.5: Months of Adequate Household Food Provisioning by Treatment

Source: Survey data (2023)

Table 4.9 provides a comprehensive breakdown of the food provisioning throughout the calendar year. The majority of households reporting reduced food provisioning indicated a decline in food adequacy from October to March. In contrast, food provisioning reached its peak between April and September before gradually diminishing.

Table 4.9: Months that the household had enough food

MAHFP	Non beneficiary (%)	Beneficiary (%)	Average (%)
January	74	85	77
February	76	89	80
March	79	92	83
April	91	95	93
May	92	96	93
June	90	94	91
July	89	94	90
August	91	87	90
September	87	82	86
October	78	77	78
November	75	75	75
December	78	81	79

Source: Survey data (2023)

4.1.3 Shocks and vulnerabilities

Table 4.10 presents a descriptive analysis of the shocks and vulnerabilities faced by households over the last 12 months from the time the data was collected. The study conducted a detailed analysis of the shocks and vulnerabilities experienced by households over the past year, shedding light on the economic challenges they were grappling with. The results clearly illustrate the severe economic repercussions of the COVID-19 pandemic on these households. The results reveal that the era of the COVID-19 pandemic disrupted both agricultural production and marketing within these households. More than 85 per cent of the households encountered difficulties accessing agricultural input markets and selling their produce. Additionally, nearly half of the surveyed households had a family member fall ill during the year, indicating the healthcare costs incurred by households to care for their sick loved ones.

Table 4.10: Shocks and stressors experienced in the last 12 months

Shock/vulnerability variable	Non beneficiary (%)	Beneficiary (%)	Average (%)
Household member that lost employment due to Covid 19	3.18	1	2.5
Household member fell sick	40.45	42	40.94
Households with members that suffer with chronic illness	8.18	8	8.12
Household member that died	4.55	4	4.38
Household that lost a breadwinner	1.36	1	1.25
Households forced to sell assets due to covid 19	9.09	8	8.75
Households that were unable to sell produce due to covid 19	90.91	92	91.25
Households that were unable to secure farming inputs due to covid19	87.73	94	89.69

Source: Survey data (2023)

The overarching conclusion is that a higher proportion of beneficiaries faced a greater number of these vulnerabilities and shocks compared to non-beneficiaries. Finally, although the percentage is less than 10 per cent, a notable portion of households experienced severe economic shocks that have the potential to negatively impact their overall well-being. These shocks included the loss of a primary breadwinner or household member, household members suffering from chronic illnesses that rendered them economically unproductive, and a few households being compelled to sell assets in order to mitigate the effects of the COVID-19 pandemic. These findings align with the research conducted by Ngoma et al. (2023), which similarly identified that households in rural settings are susceptible to shocks that reduce their overall welfare.

4.1.4 Decision marking, awareness and cost of living near national conservation areas

The study delved deeper into the costs incurred by local communities due to their proximity to the conservation area. Many households expressed their dissatisfaction with their limited involvement in decision-making processes related to Natural Resource Management. While only 34 per cent of households reported being part of decisions regarding the park, highlighting the tendency of park authorities to make unilateral decisions without consulting the local communities. These decisions often lead to policies and regulations that hinder local development rather than support it.

Notably, it is concerning that a significant proportion, approximately 65 per cent, of households are unaware of the transfrontier conservation area (TFCA). Our findings reveal an intriguing trend, with only 58 per cent of non-beneficiary households being aware of TFCA's existence, compared to a higher awareness rate of 79 per cent among beneficiary households. This discovery underscores why non-beneficiary households may not actively participate in the biodiversity economy to the same extent as beneficiaries. Furthermore, approximately 9 per cent of households felt that their access to natural resources was restricted, with a substantial portion of these being among the beneficiaries (12 per cent) (Table 4.11).

Additionally, human-wildlife conflict is a significant concern, with 35 to 49 percent of beneficiaries reporting incidents such as their animals being attacked by carnivorous wildlife or their crops being consumed by herbivores. Strikingly, despite the prevalence of such conflicts, the majority of households, almost 99 per cent, did not receive compensation for the damage inflicted by wildlife. While human attacks by wildlife are relatively infrequent, they do occur and affect around 1.5 per cent of the population on average.

Table 4.11: Challenges associated with living near the GNP

Challenges	Non beneficiaries (%)	Beneficiaries (%)	Average (%)
Community involvement in NRM decision making	33.64	36.36	34.5
Households aware of TFCA	58.64	79	65
Restriction on accessing natural resources	8.64	12	9.69
Damage to crops by wildlife	46.82	54	49.06
Livestock predation by wildlife	35	37	35.62
Household member injured/killed by wildlife	1.36	2	1.56
Households not compensated for damage caused by wildlife	98.64	99	98.75

Source: Survey data (2023)

4.2 Econometric method findings

4.2.1 Econometric method estimation

The study employed PSM using the kernel, stratification radius caliper and nearest neighbour matching methods. This was done in STATA 18 software using the pscore command. The econometric method findings are presented in the following subsections.

Prior to estimating the propensity scores and running the regression method, a t-test comparison of differences in food security indicators between beneficiaries and non-beneficiaries was performed to understand which food security indicator showed a statistically significant variation in outcome between the two groups. As shown in Table 4.12 two out of the five food security indicators measured showed statistically significant differences. These are the Household Dietary Diversity Score significant at 1 percent significance level and the Food Expenditure Share

significant at 10 percent significance level. Resultingly, the two indicators were selected to be used as the outcome variables in the PSM method. The other food security indicators were not included in the regression method.

Table 4.12: Test comparison of food security indicators by treatment

Food security indicator	Number of observations	Non beneficiary	Beneficiary	p value	t test
HDDS	320	4.58	4.95	0.008***	-2.66***
CSI	320	4.34	2.96	0.184	1.33
Assets	320	12.85	13.4	0.394	-0.85
Food expenditure share	320	70.14	65.56	0.056*	1.92*
MAHFP	320	9.95	10.38	0.171	-1.37

Source: Survey data (2023)

4.2.2 Estimation of propensity scores

Table 4.13 presents the results of the probit method employed to assess the likelihood of households participating in the biodiversity economy. The method incorporates observable variables, as outlined and justified in Chapter 3. The overall statistical significance of the probit method is underscored by various factors. The high log-likelihood ratio of 133 indicates a good method fit, thus establishing statistical significance. Additionally, the Pseudo R2 suggests that the method accounts for at least 16 per cent of the decision-making process regarding participation in the biodiversity economy.

Variables such as the marital status of household heads, communities benefiting from the park, and proximity to the park office exhibit statistical significance. It is rational to infer that married household heads are more inclined to engage in the biodiversity economy due to its economic advantages, given their heightened responsibility for family care compared to unmarried households. Moreover, communities benefiting from the park are more predisposed to participate, possessing a better understanding of the park's benefits in contrast to non-benefiting households. Notably, households in benefiting communities have a positive probability of participating in the biodiversity economy.

Furthermore, the significant outcome of the distance to the park variable entails that households' probability distance to the park increases the probability of participating in the biodiversity

economy. This suggests that closer households receive information and opportunities earlier, coupled with enhanced access to the park and its tourism activities. In conclusion, the propensity score estimation reveals a probit method where only a few variables attain statistical significance, implying the success of the PSM matching process.

Table 4.13: Probit regression results

Participation in the biodiversity economy (Treatment)	Coefficient	z	P>z
Sex of the household head	0.38 (0.29)	1.32	0.19
Household head education level	-0.01 (0.09)	-0.12	0.91
Household head married (yes or no)	0.86 (0.33)	2.56	0.01***
Household size	-0.02 (0.03)	-0.72	0.47
Household members native	0.14 (0.26)	0.55	0.58
Household's farm plot size	0.00 (0.00)	-1.09	0.28
Number of household's income sources	0.14 (0.18)	0.80	0.43
Household slept hungry in 12 months	-0.30 (0.20)	-1.50	0.13
Household involved NR decision making	-0.25 (0.19)	-1.30	0.19
Household aware of TFCA	0.33 (0.23)	1.45	0.15
Community receives benefits from the park	1.21 (0.25)	4.83	0.00***
Distance to the park office	0.01 (0.00)	1.70	0.09*
Constant	-2.07 (0.55)	-3.77	0.00***
Number of obs	245.00		
LR chi2(12)	52.09		
Prob > chi2	0.00		
Pseudo R2	0.16		
Log likelihood	-133.34		

Source: Survey data (2023)
*Notes: *, *** represents statistical significance at 10 and 1%*

4.2.3 Establishing region of support

There are several methods available to establish the region of support. In this study, statistical and graphical analysis approaches were employed.

4.2.3.1 Statistical region of support

The results in Table 4.14 below indicate that there is a high level of common support, none of the observations successfully matched were off support. In this study, 87 observations and 158

observations of the treated and untreated groups respectively were successfully matched and none of these observations fell off support.

Table 4.14: Region of support

Treatment assignment	Off support	On support
Untreated	0	158
Treated	0	87

Source: Survey data (2023)

4.2.3.2 Graphical region of support

The graphical output of the region of support in the figure below agrees with the statistical findings for both outcome variables that there was significant common support (Figure 4.6).

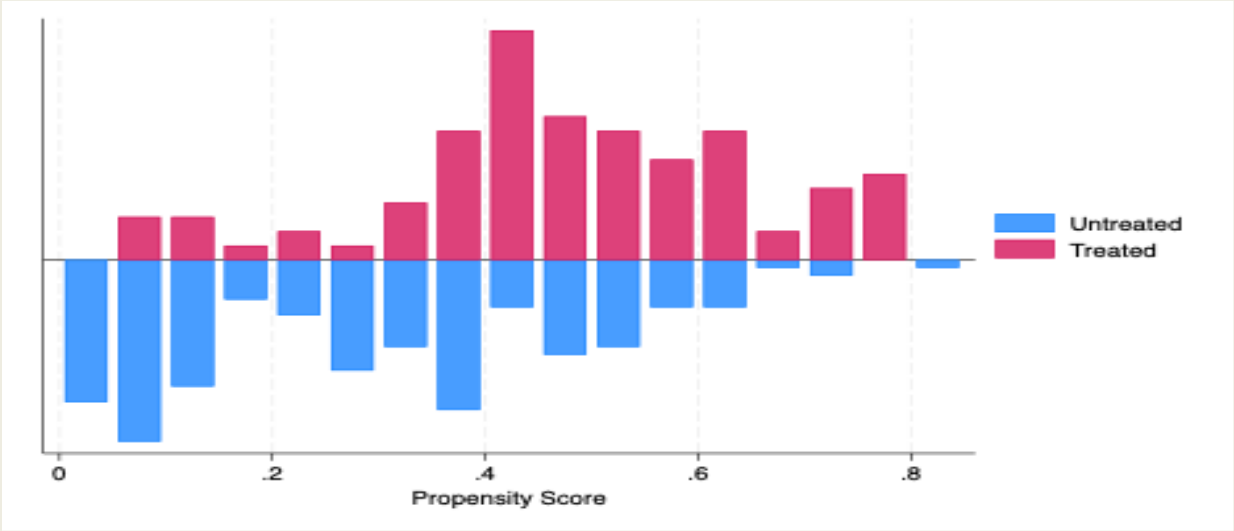

Figure 4.6: Graphical representation of the region of support

Source: Survey data (2023)

4.2.4 Estimating the average treatment effect on the treated

The estimation of the average treatment effect on the treated is provided in Table 4.15 detailing the mean differences between beneficiary and non-beneficiary observations for both outcome variables (HDDS and FES). Four matching methods were used to estimate the Average Treatment Effect on the Treated to ensure robustness and consistent results.

The results reveal that beneficiary households have higher dietary diversity than non-beneficiaries because they exhibit a higher likelihood of consuming more food groups than non-beneficiary

households. While this suggests that participating in the biodiversity economy improves the HDDS, it is noteworthy that the average number of food groups consumed by both groups falls within the moderate dietary diversity threshold. This implies that households may be consuming acceptable diets but lack diversity. This is evident Appendix 1: Household Dietary Diversity Frequency) consumption frequency shows that diets are highly caloric, and less protein and fruit-based. Furthermore, the difference in HDDS is not statistically significant between the two groups, acknowledging that both groups do not have very diversified diets, it is plausible to conclude that there is no statistical impact that the park has had on the household-level food security situation of both beneficiaries and non-beneficiaries.

Additionally, it is crucial to highlight that among the highly consumed food groups are condiments, which, while prevalent among households, contribute minimally to nutritional significance in diets. A more detailed breakdown of food group consumption frequency is available in Appendix 1.

Regarding the Food Expenditure Share (FES), the second outcome variable in this study, the results indicate a notably high proportion of household income allocated to food expenses. Beneficiary households allocate 66 percent of their income to food purchases, while non-beneficiary households allocate close to 70 percent. This high proportion points out the vulnerability of households to food shocks for both groups. However, it is noteworthy that participation in the biodiversity economy reduces this proportion of income spent on food, implying that enhanced investment in the biodiversity economy has the potential to alleviate communities from poverty or prevent food insecurity outcomes.

Lastly, the t-stat results suggest that the results are not statistically significant. This implies that there is a weak or no relationship between the biodiversity economy of the GNP and household food security of local communities. However, the results are robust in that there is similarity in the results across the four matching methods used. The study did not find treatment effects between the beneficiaries and non-beneficiaries. Therefore, participation in the biodiversity economy does not have significant impacts on food security indicators; household dietary diversity or food expenditure share. Policies that seek to improve household welfare should aim to increase access and utilization of environmental resources to enhance welfare

Table 4.15: ATT Estimation

	ATT Matching Methods				
Matching algorithm	Treated	Control	ATT	Standard Error	t-stat
Household Dietary Diversity Score					
Nearest Neighbour	87	48	0.126	0.233	0.543
Stratification matching	87	130	0.192	0.184	1.044
Kernel matching	87	130	0.187	0.145	1.285
Radius Caliper Matching	87	130	0.224	0.174	1.287
Food expenditure Score					
Nearest Neighbour	87	48	-6.313	3.67	-1.72
Stratification matching	87	130	-0.03	3.465	-0.009
Kernel matching	87	130	-0.881	2.912	-0.303
Radius Caliper Matching	87	130	-0.164	3.086	-0.053

Source: Survey data (2023)

4.2.5 Checking matching quality

This study focuses on two outcome variables: the Household Dietary Diversity Score (HDDS) and the Food Expenditure Share (FES) shown in Table 4.16. These variables were chosen as representatives of the food security situation due to their heightened severity when compared to other measured food security indicators and their statistical variability. To assess the impact, two distinct regressions were conducted for each outcome variable, with matching quality analysis performed for each variable. The ensuing results delve into the matching quality of the two regression methods.

Matching quality was performed using t tests and standardised percentage biases as well as other measures of covariate imbalance. The t tests give a good indication of reduced bias as can be seen by the few levels of statistical significance in the included variables. Further, the standardised percentage bias is in an acceptable range for the majority of the variables which further signifies acceptance balance was achieved.

Table 4.16: Checking for bias reduction post matching

Variable	Treated	Control	%bias	T test	p>t
Gender of the household head	0.70	0.79	-17.60	-1.10	0.27
Household farm plot size	23.12	33.63	-2.90	-0.24	0.81
Household size	7.78	7.38	14.40	1.05	0.29
Household head is married	0.28	0.23	10.30	0.63	0.53
Household income sources	1.39	1.37	3.60	0.23	0.82
Household went to bed hungry in the last 12 months	0.30	0.20	20.10	1.46	0.15
Household is involved in natural resource decision-making	0.37	0.36	0.80	0.05	0.96
Household is aware of the transfrontier conservation area	0.83	0.78	11.60	0.82	0.41
Community benefits in wildlife conservation	0.93	0.93	0.00	0.00	1.00
Distance to park policy office (km)	42.94	41.57	5.70	0.39	0.70
Household members are native	0.17	0.16	3.20	0.20	0.84
Household head number of years of schooling	5.83	6.50	-15.9	-1.05	0.29

Source: Survey data (2023)

CHAPTER 5: DISCUSSION

5.1 Characterisation of the communities

5.1.1 Social demographic and economic characteristics

The findings of this study shed light on several crucial aspects of the socio-economic dynamics within communities residing near protected areas, particularly focusing on the disparities between beneficiary and non-beneficiary households. These findings provide valuable insights into the complex interplay between socio-economic factors, natural resource dependency, and conservation efforts.

First and foremost, the demographic characteristics of the households underline the prevailing patriarchal structure within the communities, with a majority of household heads being male. This reflects a traditional societal setup where males typically hold positions of authority within the household (Onyima, 2021). Moreover, the prevalence of widowed and divorced female household heads further accentuates the vulnerability of women within these patriarchal structures, indicating potential socio-economic challenges they may face, such as limited access to resources and decision-making power.

The study also highlights the ageing population among household heads, with an average age of 51 years. This demographic trend raises concerns regarding the future productivity and economic capacity of these households, especially considering the declining productive capacity associated with advancing age. Consequently, the ability of these households to engage in productive activities and adequately provide for their families may be constrained, perpetuating cycles of poverty within these communities. These findings are consistent with the findings of (Ren et al., 2023), who conclude that older age hurts farm size and agricultural productivity. Similarly, the large household sizes yet small house sizes (less than 3 rooms) reveal a high dependency ratio in the sampled households. Snyman et al. (2015) argue that small houses are an indication of prevailing poverty in a community. This argument is further supported by the findings in this study, indicating that over 90 per cent of these households are built with locally sourced materials such as mud and thatch grass, timber poles, and mud floors (Snyman et al., 2015; Wells et al., 1998). While large household sizes may intensify poverty for households, they are also beneficial for providing labour in agricultural households (Gaddis et al., 2019).

Moreover, there is evidence of illiteracy prevalence among household heads, with beneficiary heads having an average of 5.83 years in school and non-beneficiary household heads having 5.9 years in school. According to the Zimbabwean school curriculum, 6 years in school get one up to primary level education. On this basis, households in the study area are primary-level scholars and these findings are consistent with Ntuli & Muchapondwa, (2017, 2018) who found that the majority of uneducated households stay back in the rural communities while most educated household heads find work elsewhere including in neighbouring countries.

Furthermore, the significant proportion of children from these households working abroad underscores the reliance on remittances as a crucial source of income for many households. This dependence on external sources of income reflects the limited economic opportunities available within the local communities, which may hinder sustainable livelihood development and contribute to socio-economic disparities (Bourgeois et al., 2023; Ntuli et al., 2021).

The disparity in employment rates and income levels between beneficiary and non-beneficiary households stresses the impact of conservation interventions on local livelihoods. Beneficiary households, despite facing more human-wildlife conflicts, exhibit relatively better economic outcomes, including higher employment rates, income levels, and access to natural resources. This suggests that conservation initiatives, such as community-based conservation programmes, may contribute to improving livelihoods and enhancing economic resilience among beneficiary households. These findings are in agreement with a study by Oduor (2020), which found that co-management of conservancies has the potential to uplift communities' livelihoods provided that functional institutions are in place.

On the other hand, non-beneficiary households, while facing fewer human-wildlife conflicts, did not perform well on a number of economic indicators considered in this study and are more reliant on cross-border work to sustain their livelihoods. The prevalence of illegal activities, such as hunting, among non-beneficiary households, which is consistent with the findings of Ntuli et al., (2021), further highlights the challenges associated with marginalisation from conservation benefits and limited economic opportunities.

The findings also emphasize the importance of natural resources, particularly those derived from protected areas, as essential sources of food and livelihood for local communities (Dawson et al.,

2021). However, the high dependency on these resources also raises concerns about sustainable resource management and the potential for conflicts over resource access.

Overall, the study findings emphasise the intricate relationship between conservation efforts, socio-economic dynamics, and human-wildlife interactions in communities residing near protected areas. Addressing socio-economic disparities and promoting inclusive conservation strategies that benefit all households while mitigating human-wildlife conflicts are essential for fostering sustainable development and biodiversity conservation in these regions.

5.1.2 Food security situation in the study community

The comprehensive analysis of five food security indicators in the study community provides valuable insights into the multifaceted nature of food insecurity and the adaptive strategies adopted by households to cope with food security challenges.

Firstly, the Household Dietary Diversity Score (HDDS) highlights moderate dietary diversity among both beneficiaries and non-beneficiaries, an average of 4.8 out of 12 food groups were consumed. Although there is no global consensus on standards used to consider what is adequate dietary diversity, studies indicate that to determine the adequate dietary diversity score for a population, the average dietary diversity of the top 33 percent of the population should be considered (Kennedy et al., 2011; Swindale & Bilinsky, 2006). In this study, the top 33 percent consumed between 6 to 8 food groups, suggesting that the majority of households currently have moderate dietary diversity scores. Additionally, there is a notable high consumption of cereals and fats, a considerable consumption of vegetables and a low consumption of proteins. This is not surprising considering the findings of studies that suggest that resource extraction is a main food source for park-adjacent communities (Dawson et al., 2021). This underscores the need for interventions to enhance access to a wider range of nutritious foods. While dietary diversity alone may not fully capture food security status, its association with overall nutritional adequacy suggests opportunities for promoting healthier diets and reducing vulnerability to malnutrition.

Secondly, the Coping Strategy Index sheds light on households' resilience in the face of food shortages. The results suggest low use of coping strategies is prevalent which signifies a proactive approach by households to mitigate food shortages without resorting to drastic measures. The most commonly used coping strategies were relying on borrowed food or aid from relatives, reducing

portion sizes, limiting daily meals and turning to less preferred food options. Three out of the four coping strategies have a weight of 1, and one has a weight of 2. This implies that the employed strategies are the least severe coping mechanisms. Conversely, less used strategies included sending household members elsewhere for meals and prioritising food for working members over non-working ones.

These adaptive behaviours among households, while indicative of resilience in the face of adversity, also accentuate the urgent need for comprehensive interventions addressing the root causes of poverty and food insecurity. Efforts aimed at bolstering household income, improving access to education and employment opportunities, and enhancing social protection mechanisms could play a pivotal role in alleviating the burden of food insecurity and fostering long-term resilience.

Thirdly, the Asset Index offered insights into households' resilience to shocks, highlighting the prevalence of basic household items but a lack of productive assets essential for livelihood enhancement. This stresses the importance of asset accumulation and livelihood diversification strategies to build long-term resilience and mitigate vulnerability to food insecurity. Studies have shown that households with an asset base are more resilient to shocks than those without (Booysen et al., 2008; Prakongsai, 2006)

Fourthly, the Food Expenditure Share (FES) indicates high levels of food insecurity, with most households spending over 65 percent of their income on food. Households that spend over 65 percent of their income are considered food insecure as there exists an inverse relationship between household income and proportion of income spent on food (Mulamba, 2022). This underlines the importance of income generation and social protection programmes to improve household purchasing power and reduce reliance on food aid.

Finally, the Months of Adequate Household Food Provisioning (MAHFP) indicator reveals significant proportions of households experiencing moderate food provisioning, averaging 10 months of sufficiency, consistent with the findings of other studies (Bilinsky & Swindale, 2010; Walsh et al., 2020). Although no households were experiencing low levels of food security, the results also show the persistent nature of food insecurity especially during the lean season between October and March. These findings align with the seasonal pattern of the Zimbabwe cropping

season, where food availability typically peaks during and after the harvest period in April and declines towards the lean period between November and March (FEWSNET, 2014). This pattern is logical considering that Zimbabwe's agricultural sector relies heavily on rainfed agriculture (Bhalla et al., 2018). Moreover, the rainy season enhances the growth of wild foods such as fruits, vegetables, insects, mushrooms, and roots. Consequently, there is a surge in wild food availability during and towards the end of the rainy season and thereafter that grows during the rain season. In conclusion, there is need for targeted interventions to address underlying food related structural barriers and inequalities.

Drawing lessons from other studies in the literature, interventions aimed at enhancing food security should adopt a holistic approach that integrates social protection, livelihood support, and nutrition-sensitive programmes. For example, sustainable access to natural resources can play a critical role in improving food security outcomes by enhancing households' resilience to environmental shocks and supporting livelihood diversification strategies. Additionally, efforts to strengthen social safety nets and promote asset accumulation among vulnerable households can help mitigate the impacts of food insecurity and build long-term resilience. Moreover, investments in education, skills development, and income-generating activities are essential for improving livelihoods and reducing reliance on coping strategies that undermine household well-being.

In conclusion, addressing the complex challenges of food insecurity requires coordinated efforts across multiple sectors, including agriculture, health, education, and social welfare. By adopting a comprehensive approach that addresses the underlying drivers of food insecurity while promoting sustainable livelihoods and equitable access to resources, policymakers and stakeholders can work towards achieving food security for all households, thereby improving overall well-being and fostering resilience in the face of future challenges.

5.2 Econometric results

Using a t-test, the study determined that two of the five food security indicators were showing statistically significant variability; the HDDS and the FES. The two indicators were selected as outcome variables on this basis in the propensity score matching econometric method.

In the probit method, variables such as the marital status of household heads, communities benefiting from the park, and proximity to the park office exhibited statistical significance. It is well known in the literature that households living close to parks indeed engage in tourism income-generating activities that become a source of livelihood (Dawson et al., 2021; Goodwin & Santilli, 2009; Ntuli et al., 2021).

The Average Treatment Effect on the Treated of the biodiversity economy of the GNP on the two outcome variables; HDDS and FES was statistically insignificant. Therefore, although there is a statistically significant difference in households' consumption of diverse diets and expenditure share on food between beneficiaries and non-beneficiaries, the impact that the GNP has had on this outcome is insignificant and, therefore cannot be attributed to the existence of the park and its economic activities. However, according to the literature, one of the desired outcomes of promoting transfrontier conservation areas like the GLTFCA was to enhance community development and livelihood (Hanks, 2003; Munthali, 2007b; Ntuli et al., 2019), but this study finds that this has not been achieved.

The study communities are food insecure, although a review of the data suggests that beneficiaries have a slightly better outlook on food security than non-beneficiaries. They are engaging coping strategies to cope with food shortages and there is a lack of government social protection programmes to uplift these communities out of poverty. Furthermore, the findings indicate that the park has the potential to support livelihoods, but its poor performance in attracting tourists renders it incapable of providing sufficient economic opportunities (Gandiwa, 2011). This is despite the fact that HWC persists and it remains a difficult challenge for local communities to access natural resources without facing legal consequences.

Our findings do not dismiss the potential of the PAs to uplift the adjacent communities out of poverty, as it is inexact. Literature discussed in this chapter indicates that communities near other parks experience considerable benefits, such as basket and mat weaving, crafts, farm employment, fishing, palm wine production, remittances, and cross-border trade. Properly managed, transfrontier conservation areas offer a range of economic opportunities, as demonstrated by studies in various regions. For instance, basket weaving and broom crafts, palm wine production in the greater Mapungubwe Transfrontier (Sinthumule, 2020), artisanal mining in Chimanimani

Transfrontier Conservation Area (Kachena & Spiegel, 2019) community-owned and managed Lodging-Bulungula lodge and service providers in Nqileni Village (Setoke, 2021). These research studies give an array of economic opportunities that transfrontier conservation areas present if properly managed.

The challenges faced by the study communities have exacerbated their situation, with the COVID-19 pandemic severely impacting tourism. Households were not spared of its impacts as many were unable to sell agricultural produce or access inputs, and a significant proportion reported falling sick in the past 12 months. PAs, typically located in remote areas with limited access to basic health services, contribute to the prevalence of diseases like malaria, further straining community health. Moreover, households expressed concerns about wildlife damaging their crops and livestock without receiving compensation, potentially contributing to retaliatory behaviours like poaching.

Examining livelihood sources in GNP reveals that the community member's main source of livelihood was casual labour (over 50 percent of households), followed by remittances and self-employment. Formal employment ranks second to last, and pensions are the least common source of income. This pattern underpins the limited economic opportunities in the park's vicinity. Population growth has strained the park's capacity to absorb labour, emphasising the need for improved social protection policies. Despite prevailing poverty, none of the study households reported social protection grants as a source of income.

In summary, Gonarezhou National Park has not succeeded in positively impacting household-level food security, necessitating further interventions. As GNP is part of a transfrontier conservation area shared between Mozambique and South Africa, cross-border migration is frequent. If poverty persists, the natural resources across the entire GLTFCA are at risk of exploitation. Addressing these challenges requires a comprehensive approach that considers economic opportunities, health services, compensation for wildlife damage, and improved social protection policies.

CHAPTER 6: CONCLUSIONS AND POLICY RECOMMENDATIONS

This study aimed to investigate two specific objectives:

i) To characterise the social, demographic, economic and cultural characteristics of households living adjacent to the GNP.

The main findings of the first objective reveal that households are patriarchal in nature, headed by married male heads. The majority of female-headed households were unmarried, divorced or single. Furthermore, the household heads have primary-level education, are unemployed or highly depend on the park for food and livelihood. Moreover, communities under study were living within a 45km radius to the park and therefore persistently faced human-wildlife conflict, livestock disease from wildlife and arid climatic conditions that do not support highly productive agricultural activities.

ii) Evaluate the impact of participating in the biodiversity economy of the GNP on the food security of pack adjacent households.

The second objective covered two main areas, an analysis of the food security situation by assessing the five food security indicators and an impact evaluation based on two food security indicators. Important conclusions from this objective showed that households' food security conditions were generally poor. There was clear evidence of strategies to mitigate food shortages: households were consuming an average of five out of the twelve food groups on a daily basis, and they were going without enough food for two months out of every twelve. Households showed resilience in asset ownership in spite of the poor food security outcome, with at least ten assets owned by each. However, the possibility of generating income was limited because not all assets were productive. Interestingly, a significant proportion of household income was earmarked for food expenses.

Furthermore, the econometric analysis of the two outcome food security indicators, the HDDS and FES showed that the park has had no significant impact on household food security. Seemingly because of the low economic opportunities it presents, households' livelihoods have remained unchanged and, therefore, resulting in an insignificant impact on their food security.

6.1 Conclusions

This research aimed to investigate the impact of the GNP's biodiversity economy on household food security. The study focused on communities situated within a 45 km radius of Gonarezhou National Park (GNP) in Zimbabwe. A thorough literature review highlighted a scarcity of studies examining the impact of Protected Areas (PAs) on food security, especially at the household level. Furthermore, existing studies on the livelihood outcomes of adjacent communities near PAs lacked consensus on whether the impact was positive or negative.

Our findings were insignificant and therefore, the food security situation among communities around the park cannot be confidently attributed to the existence of the park. The conclusive finding suggests inadequate food security outcomes observed among both participants and non-participants. For example, households exhibited poor dietary diversity, consuming fewer than five food groups, including condiments with limited nutritional value. The situation is exacerbated by households employing more than four coping strategies to address food shortages, spending a significant portion (65-70%) of their income on food. Despite these efforts, dietary diversity remains inadequate, and food shortages persist for at least 10 out of 12 months in the year.

6.2 Policy recommendations

Food aid assistance: According to our results, households do not only struggle with weekly food shortages but often face at least two months of food insufficiency which is mainly caused by seasonal changes. Food aid has proven to be an immediate and effective solution to food insecurity in situations of both acute and chronic food insecurity. Given the findings of this study, social protection programmes providing food aid, especially in the months identified as hunger-prone (October-March), should be implemented to improve nutrition and reduce hunger experiences. Hunger experiences may be the main driver of illegal natural resource extraction.

Increased social protection programmes: given the overarching findings that point to limited economic opportunities in the park and the prevalence of aged household heads, social protection programmes may provide sustainable long-term solutions. Social protection programmes can avert the need for a humanitarian response during shocks like the COVID-19 pandemic or cyclone Idah. Therefore, the government should introduce or expand social protection programmes targeting the vulnerable in the study communities. However, social protection policies should be implemented

with caution as there is a downside to increased social protection grants. The grants may lead communities to shift away from large-scale farming to relying instead on small-scale vegetable production in their backyards and use of grants to purchase household food supplies.

Investment in education services and upskilling trades: An emerging issue from this study is the high illiteracy levels among rural community members, resulting in their inability to gain non-agricultural employment in other sectors of society. Therefore, long-term investments in the education of these communities and building trade skills would reduce their low employability rate.

Agricultural subsidies: Livelihood disruption is a common feature of conservation area formation. The Greater Mapungubwe TFCA case demonstrates how the switch from farming to conservation land use pushed many black farm dwellers into destitution (Sinthumule, 2018). A similar incident occurred in the GNP when the park was formed. Although it was believed that more lucrative livelihoods could be realised from the tourism industry, certain factors were not considered, such as tourism livelihoods being more lucrative but employing fewer people and requiring specific skills and training. Agricultural livelihoods, on the other hand, employ more people and require easier-to-learn skills. Therefore, agricultural livelihoods should continue to be encouraged concurrently with other livelihoods. Agricultural subsidies can support and promote agricultural livelihoods, increasing household-level income and access to food from own production in the GNP.

6.3 Recommendation for further research

While this study provides valuable insights into policy formulation considering the food security needs of local communities that bear the highest cost of creating conservation areas, it was conducted within a limited number of communities and may not comprehensively represent the food security situation of all local communities living adjacent to conservation areas. Future studies could include cross-country analysis to offer a broader context and a wider array of information for policymakers. For example, conducting a comparative study across the three countries comprising the GLTFCA would enhance understanding of common or joint management policies that could reduce consumptive natural resource use among the surrounding communities.

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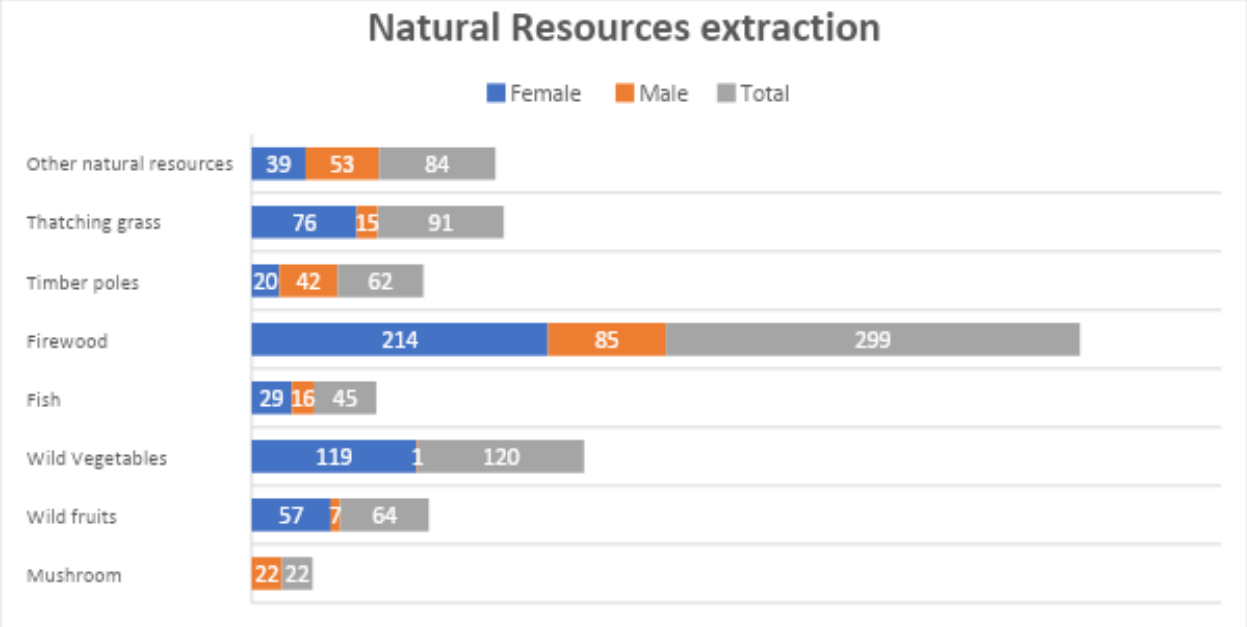
APPENDICES

Appendix 1: Household Dietary Diversity Frequency

HDDS Frequency	Non beneficiary (%)	Beneficiary (%)	Average (%)
Cereals	99	100	99
White roots and tubers	7	4	6
Orange fleshed vegetables	21	11	18
Dark green vegetables	39	24	34
Other vegetables	60	76	65
Orange coloured fruits	1	4	2
Fruits	0	2	1
Organ meat	0	0	0
Other meat	16	22	18
Eggs	1	1	1
Fish	1	0	1
Legumes	10	13	11
Milk	15	24	18
Fats and oils	85	88	86
Sweets	57	62	58
Condiments	83	87	84

Source: Survey data (2023)

Appendix 2: Gendered frequency of natural resource extraction



Source: Survey data (2023)

Appendix 3: Income sources

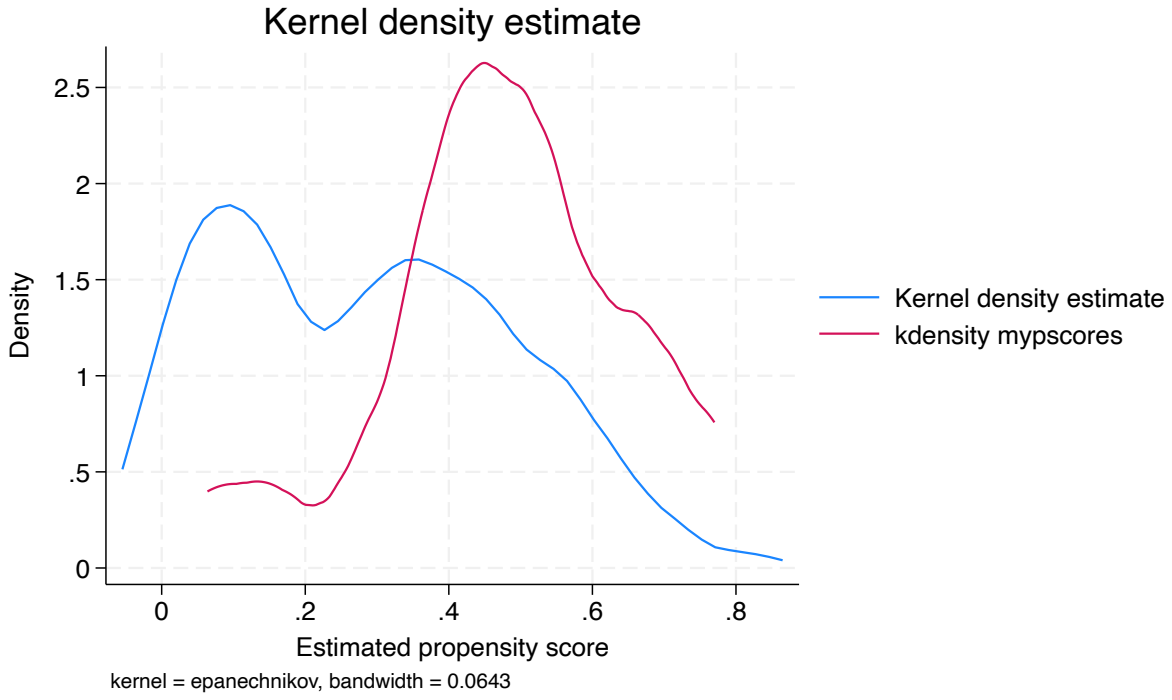
Income source	Non beneficiary (%) n=220	Beneficiary (%) n=100	Total (%) n=320
Casual labour	59.55	53	57.5
Formal employment	12.27	17	13.75
Self employment (business)	26.82	27	26.88
Pension	3.18	12	5.94
Remittances	24.55	25	24.69

Appendix 4: Livestock ownership

Beneficiary					Non-beneficiary			
Livestock	Observations	Mean	Min	Max	Observations	Mean	Min	Max
Cattle	52	8.11	0	45	134	7.7	0	79
Goat	75	10.6	1	60	166	9.9	1	50
Sheep	4	6	2	15	12	6.3	2	20
Pig	4	4	1	7	9	4.4	0	8
Donkey	24	4.8	1	15	44	4.4	0	17
Chicken	84	15	1	63	178	14.2	1	60

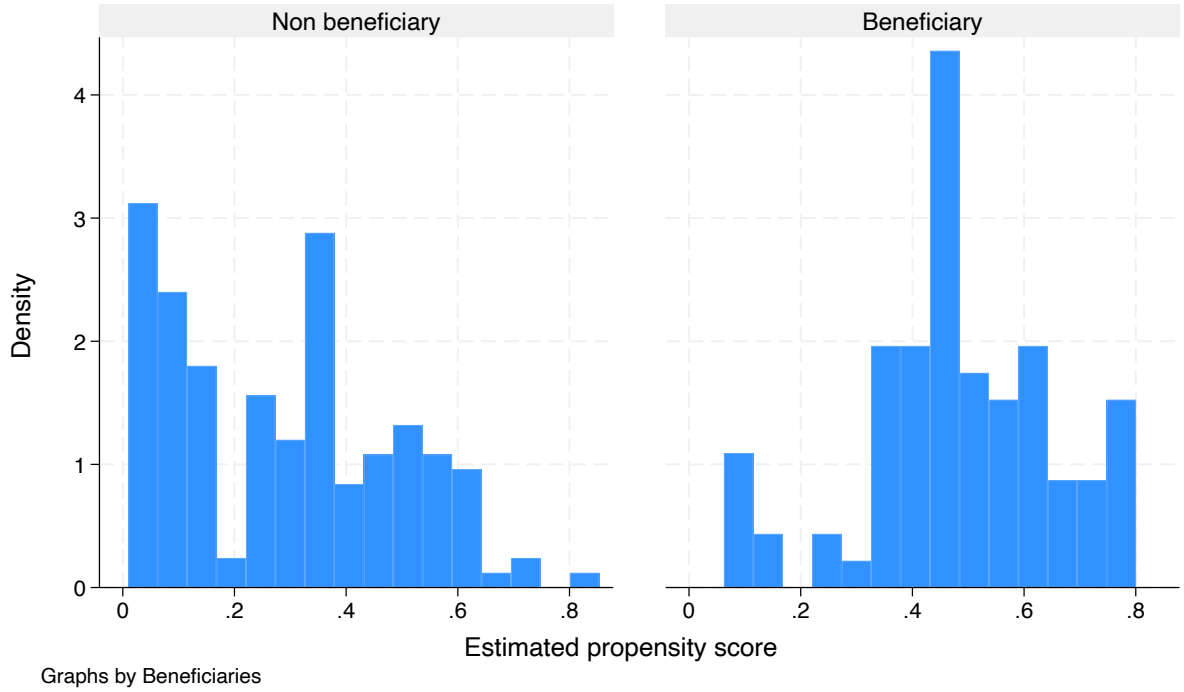
Source: Survey data (2023)

Appendix 5: Kernel density distribution showing the overlap between beneficiaries and non-beneficiaries



Source: Survey data (2023)

Appendix 6: Distribution of estimated propensity scores by treatment



Source: Survey data (2023)

Appendix 7: Ethics approval letter

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Natural and Agricultural Sciences
Ethics Committee
E-mail: ethics.nas@up.ac.za

7 September 2023

ETHICS SUBMISSION: LETTER OF APPROVAL

Mwansa Mwansa
Department of Agricultural Economics Extension and Rural Development
Faculty of Natural and Agricultural Science
University of Pretoria

Reference number: NAS177/2023
Project title: The Impact of participating in the biodiversity economy on household food and livelihood security: a Kruger National Park communities case study

Dear Mwansa Mwansa,

We are pleased to inform you that your submission conforms to the requirements of the Faculty of Natural and Agricultural Sciences Research Ethics Committee.

Please note the following about your ethics approval:

- Please use your reference number (NAS177/2023) on any documents or correspondence with the Research Ethics Committee regarding your research.
- Please note that the Research Ethics Committee may ask further questions, seek additional information, require further modification, monitor the conduct of your research, or suspend or withdraw ethics approval.
- Please note that ethical approval is granted for the duration of the research (e.g. Honours studies: 1 year, Masters studies: two years, and PhD studies: three years) and should be extended when the approval period lapses.
- The digital archiving of data is a requirement of the University of Pretoria. The data should be accessible in the event of an enquiry or further analysis of the data.

Ethics approval is subject to the following:

- The ethics approval is conditional on the research being conducted as stipulated by the details of all documents submitted to the Committee. In the event that a further need arises to change who the investigators are, the methods or any other aspect, such changes must be submitted as an Amendment for approval by the Committee.
- **If Applications using GM permits:** If the GM permit expires before the end of the study, please make an amendment to the application with the new GM permit before the old one expires
- **If Applications using Animals:** NAS ethics recommendation does not imply that Animal Ethics Committee (AEC) approval is granted. The application has been pre-screened and recommended for review by the AEC. Research may not proceed until AEC approval is granted.

Post approval submissions including application for ethics extension and amendments to the approved application should be submitted online via the Ethics work centre.

We wish you the best with your research.

Yours sincerely,

Prof VJ Maharaj
Chairperson: NAS Ethics Committee

Appendix 8: Permission letter to use data from the UGOT/UP project

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Dr Herbert Ntuli
Senior Lecturer
Department of Agricultural Economics, Extension and Rural Development
University of Pretoria
Agriculture Annex, Office 3-7
Private Bag X20
Hatfield 0028
Cell: +27 318 7754
Landline: +27 420 3253
Email: herbert.ntuli@up.ac.za

16th August 2023

To Whom It May Concern
The Ethics Committee
Faculty of Natural & Agricultural Sciences
University of Pretoria

RE: PERMISSION FOR MWANSA TO USE UNIVERSITY OF GOTHENBURG (UGOT) & UP PROJECT DATA FOR MASTER'S THESIS

Dear Sir/Madam

I Dr Herbert Ntuli (u27629697) am writing to clarify the circumstances under which Mwansa Mwansa (u20657791), a student in the MSc Agricultural Economics Master's Programme in the Department of Agricultural Economics, Extension and Rural Development at the University of Pretoria is granted permission to use the data collected and generated from the Welfare Effects and Gender Dimensions of Licit and Illicit Biodiversity Economy: The Case of the GLTFCA, KAZA and SOKNOT Project, for the purpose of her master's thesis research.

The UGOT/UP Project is funded by the University of Gothenburg in Sweden as part of a collaborative research project UNIQUE NR NAS 2022, 0134 or Agreement VR ref 2015-03421 that was signed between Gothenburg University and the University of Pretoria. Researchers at the University of Pretoria are leading the data collection exercise in the GLTFCA and Mwansa is part of the team of postgraduate students recruited to supervise the fieldwork and to benefit from the data collection exercise as part of this agreement. The UGOT/UP project is an ongoing collaborative research project which was initiated in 2015 by researchers in the Environment for Development (EfD) Initiative or network in South Africa and Sweden.

As the principal investigator of the Welfare Effects and Gender Dimensions of Licit and Illicit Biodiversity Economy: The Case of the GLTFCA, KAZA and SOKNOT Project, an

Environment for Development (EfD) funded project I am pleased to support Mwansa in her academic pursuit and utilisation of the project data. I believe that her research aims to align with the goals of the project, and her work can contribute valuably to the field of Agricultural Economics. It is my understanding that Mwansa intends to analyse, interpret, and draw conclusions from the data to enhance our understanding of the impact of natural resource conservation on local community welfare including their livelihoods and food security.

I assure you that Mwansa will adhere to all ethical guidelines and data usage policies set forth by the University of Pretoria and the Welfare Effects and Gender Dimensions of Licit and Illicit Biodiversity Economy: The Case of the GLTFCA, KAZA and SOKNOT Project. She will treat the data with the utmost respect for confidentiality and will ensure that the results of her research are appropriately shared within the academic community.

Mwansa will not have the authority to share the data with any third parties or use it for purposes beyond the scope of her master's thesis research without obtaining explicit consent from me, as the principal investigator.

If there are any specific procedures, protocols, or requirements to follow when working with the project data, kindly communicate those to Mwansa to ensure smooth collaboration.

Thank you for considering this request. I am confident that Mwansa's work will reflect positively on both her academic journey and the ongoing efforts of the Welfare Effects and Gender Dimensions of Licit and Illicit Biodiversity Economy: The Case of the GLTFCA, KAZA and SOKNOT Project. Please feel free to reach out to me by any means provided herein if you have any questions or require further information.

Yours faithfully,

Herbert Ntuli, PhD
Supervisor